Lecture Notes in Electrical Engineering 698

Amit Kumar
Stefan Mozar *Editors*

ICCCE 2020

Proceedings of the 3rd International Conference on Communications and Cyber Physical Engineering

Springer

Lecture Notes in Electrical Engineering

Volume 698

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ISSN 1876-1100 ISSN 1876-1119 (electronic)
Lecture Notes in Electrical Engineering
ISBN 978-981-15-7960-8 ISBN 978-981-15-7961-5 (eBook)
https://doi.org/10.1007/978-981-15-7961-5

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The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Contents

A Multi-tier Architecture for Soft and Hard Real-Time Systems Involving Multiple Data Sources for Efficient Data Processing

Suman De and Vinod Vijayakumaran

Abstract The advancement of technology has seen the growth of IoT based devices all around the globe. With the introduction of wearable devices, smart appliances, the amount of accumulated data has increased exponentially. For soft real time systems, it is a major issue when it comes to analytics and providing the accurate results for future strategies leading to profitability aspects of an organization to the estimation of life expectancy of an individual. Soft real-time systems, where huge amount of data processing is equally important to context awareness, pervasive computing systems can use another layer for its data flow and this paper looks at an idea which benefits such systems. The proposed paper introduces an intermediate layer between User interfaces and the databases along with the traditional application layer and context or networking layer that already exists. The proposed paper also explains at how this architecture will be implemented and can be used as a generic architecture model.

Keywords Pervasive computing · Architecture · Data processing · Soft real-time system · Hard real-time system

1 Introduction

Pervasive Computing is expanding as one of the latest computing technologies that covers communication scenarios where any device can be accessed from anywhere by the user. The user interacts with various sources using laptops, tablets, terminals, mobile phones and smart phones. Pervasive Computing uses internet, advanced middleware, operating systems, actuators/sensors [4], microprocessors, and mobile protocols to facilitate such interactions.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_1

Context-aware systems adapts to changes as a reaction to updates to their context, i.e. their physical, the social and the technical environment. Reactive adaptation reacts only during changes. For frequent context changes, adaptation occurs frequently as well. The adaptation logic is singular as it takes into consideration only the current information. Context prediction is used to plan adaptation even before it happens.

With respect to this, applications choose if they adapt the behavior or adapt to the context and optimize the next series of adaptations for a certain strategy.

Soft real-time systems need decision making capabilities along with context aware readily available data. This process of data analysis can be cumbersome and even involves various data sources including on-premise data sources or even raw file systems which are not fully processed. The current application layer is uses RESTful services, OData, SOAP, etc. but decoupling the entire data source into two layers makes it systematic. The existing 3-Tier architecture is best suited for a Hard-Realtime system where there is no possibility of a delay but for soft real-time systems, delay resulting in a deeper analysis and a more efficient information base is acceptable. In this paper, we propose a hypothesis of having such a layer in the architecture of relevant systems that has requirements of both Context awareness and in-depth analytics from multiple other sources.

The primary objective of the framework is to construct the user's virtual computing environment dynamically in any network terminal by reassembling application services distributed over networks and resources around users. Being mobile, the user still has access to their personalized computing environments from any geography.

2 Literature Survey

There have been multiple works on Pervasive Computing in terms of frameworks, user interface designs, security, search techniques, etc. In the work [1] by Zhenmin Zhu, Xiaoli SuI, Jintao Li, Junbo Guol, Jian Ye, the framework targets devices ranging from public terminals to PDAs to laptops. Figure 1 depicts the architecture of their work. The architecture is classified into three layers: a user layer, a service management layer and a resource management layer. The user layer provides users with a virtual desktop to interact with remote services, virtual devices to make remote applications seamlessly access local devices. The service management layer creates user virtual session according to current context and supports a service-oriented architecture. The resource management layer control and monitor applications which are distributed over network and resources around users. This layer can load and unload components at runtime without disrupting the applications.

The works of Janne Riihijarvi and Petri Mahonen, presents a prototype implementation of a data storage and processing framework specifically tailored for pervasive computing applications, with scalability properties needed for dealing with massive data sets. The prototype works on radio coverage estimation, which

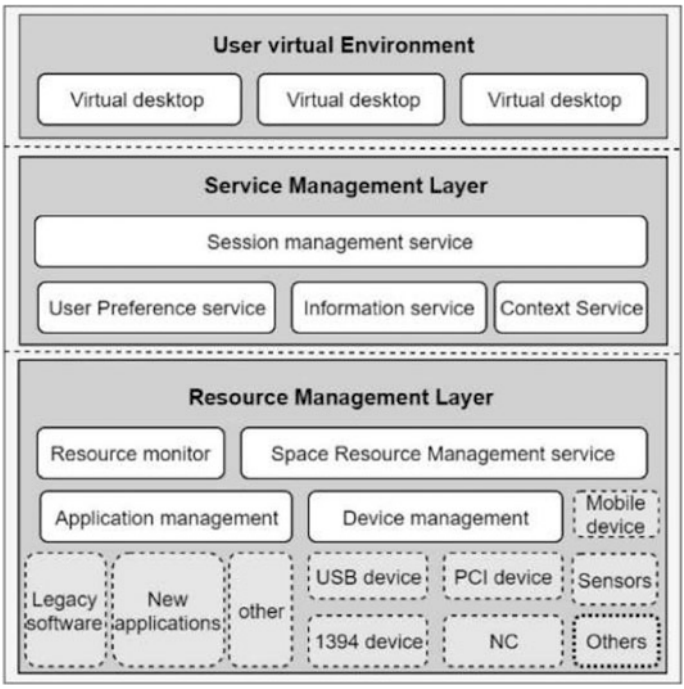

Fig. 1 System architecture for the given model

has been substantially extended to support additional sensor modalities and data processing algorithms. They focus specifically on spatio-temporal estimation problems in the demonstration, basing the work on recently developed fixed rank spatial and spatiotemporal estimation methods as well as sublinear machine learning techniques [2].

3 Generic Architecture for Pervasive Computing

The Pervasive computing architecture has the following four vital areas, they are:

3.1 Devices

Ubiquitous environment consists of multiple input and output devices. Keyboard, mouse, touchpad, wireless devices, sensors, pagers, mobile phones and smart phones are devices for a pervasive environment. The sensors automatically collect data about the environment and feeds the input directly to the pervasive network [13].

3.2 Networking

Pervasive devices connect to other communication devices through a distributed network. They are connected via the Local Area Network (LAN) or Metropolitan Area Network (MAN) or Wide Area Network (WAN) for global availability.

3.3 Middleware

Pervasive computing requires a middleware "kernel" for making communication between an end-user and a system. It may be a web application or a set of software bundle. The software-bundle executes in client-server mode or peer-to-peer mode [6].

3.4 Applications

Pervasive computing is environment-centric rather than web-based or mobile-based. The data collected through a pervasive environment is processed by the middleware software and the output is generated by the present environmental inputs.

4 Challenges Observed from Literature Surveys

A Real Time Operating System is of two types- Soft Real-Time Systems and Hard Real-Time Systems. With the introduction of wearable devices, smart appliances, the amount of accumulated data has only increased exponentially. For soft real-time systems, the issue starts with analytics and providing accurate results related to profitability aspects of an organization to the estimation of life expectancy of an individual. The clarity of handling such massive data sources is currently missing and affects the Quality of Service (QoS) provided by such systems [3].

The other challenge is to decouple data sources in terms of the application's architecture as it is highly coupled and do not differentiate a data source in terms of its mission criticality. It becomes extremely confusing for an application developer or a solution architect to prepare a generic solution with respect to the possible application offerings and the respective data sources. The result is the development of a Hard-Real Time System or a Soft Real Time System but not a single system that can behave as per the need of the end user.

The challenges observed following the Literature Survey of related papers were [1–3, 6, 7, 9–12]:

- How do we handle massive data sources in Real Time Scenarios?
- Quality of Service for the users is low
- Differentiating of Mission critical information
- Lack of focus on the application developer
- High coupling of layers and how data is handled
- Differentiation of mission critical IoT devices
- Categorization of data in terms of context, perception, etc. missing
- Platform independent view of handling massive data sources

5 Proposed Architecture

This paper proposes a design for real-time systems with decision making capabilities along with context aware readily available data. The current application layer uses RESTful services, OData, SOAP, etc. but decoupling the entire data source into two layers makes it systematic. The existing 3-Tier architecture suits a Hard-Real-time system where there is no scope for delay, but soft real-time systems can afford a deeper analysis and a more efficient information base. Here, we give the hypothesis of having such a layer in the architecture of relevant systems that has a requirement of both Context awareness and in-depth analytics from multiple other sources.

This is an extension of the current architecture used for Pervasive Computing systems. The context awareness is the mainframe for the proposed system with an inclusion of a middle layer that accounts for larger chunks of data processing (see Fig. 2). The interactive layer relates to a device or interface that the end system is in

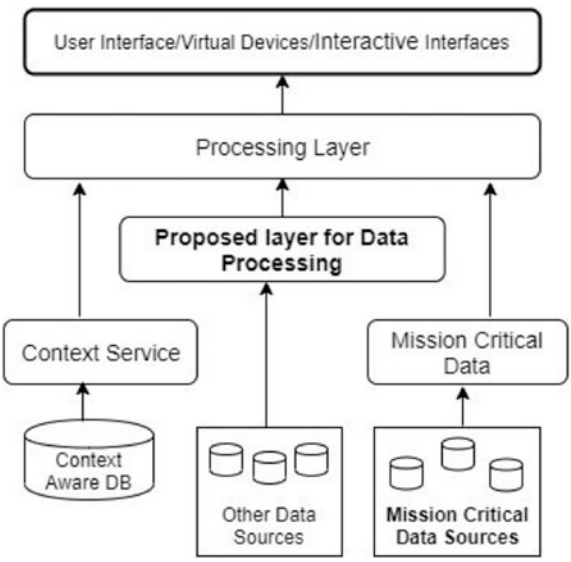

Fig. 2 Proposed architecture

contact and does the primary functionality for which the system is built. The layer comes with a criticality value that decides the services to be called from the Processing layer. The processing layer looks at an integration of service calls from Context services, Mission Critical data generators or APIs and the proposed layer extracts data from much larger boundaries of data sources. The removal of the proposed layer makes the system a Hard Real-time system that works on the go. Similarly, the inclusion of the proposed layer to process further data from larger data sources makes the system slow but accounts for a better functionality and much accurate results. This helps systems with higher response time which contrasts with a Hard-real-time system.

6 Implementation and Applications

The proposed paper looks at a separate application layer which serves data but from a larger number of data sources. This API is extensive as it helps in data processing from various types of data sets and is heavy. The Processing Layer receives a larger chunk of data than during the real-time implementation of the system. The decoupling of both data sets is the key for such systems with respect to data processing capabilities. The current day programming languages makes it easier to implement such systems as seen in development of microservice-based applications. We further dive deep into the system architecture and how it is used for hard and soft real-time systems. The decoupling of the same is shown in Fig. 3(a) and (b).

The governing algorithm is in the processing layer that considers context. Based on the criticality, it selects the service to be called. For criticality = 0, the service

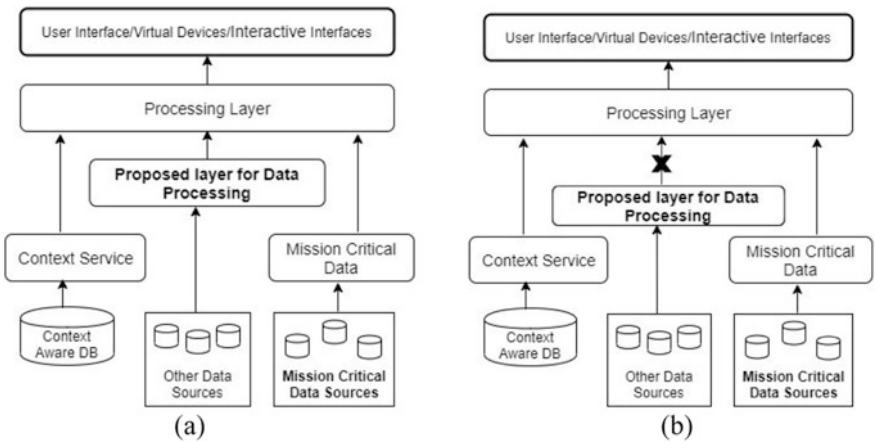

Fig. 3 Soft real-time (a) vs hard real-time (b) scenario

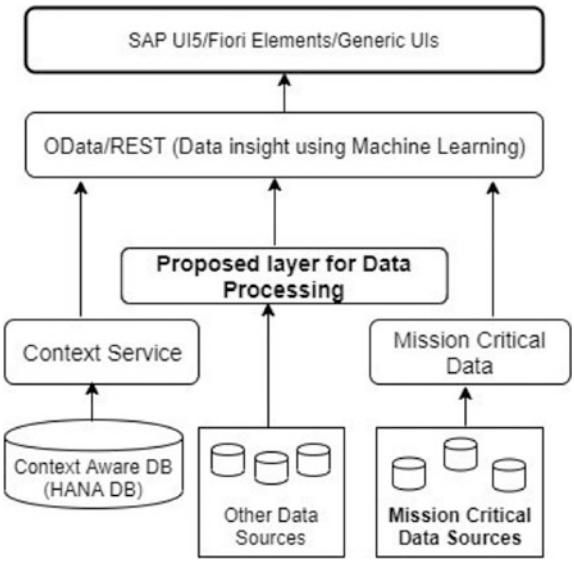

Fig. 4 Architecture adopted for SAP technology stack

contains data from mission critical data sources (Fig. 3(b)), while in case of criticality = 1, the service with both mission critical information and other listed data sources are called.

An application of the same could be a wearable device which checks a person's heart rate, blood pressure levels and comparing them with other behavior shown in nearby devices in a location. It helps predict the possibility of sleeping disorders and then further look at the causes. The cause for the disorder can be propagated to the person when the sleeping cycle is over. The same device daily tracks heart rate and other conditions and sends relevant data to the registered health organization or doctor.

Now, we look at the architecture with respect to a leading Enterprise Resource Planning organization, SAP (Fig. 4), and how the architecture adapts to SAP's technology stack creating a clear distribution between the available components of APIs, Machine Learning layer, HANA database and other data sources. It signifies the adoption of the architecture for real-time system scenarios where any implementation of Use cases relevant to ubiquitous computing is made easy and simple.

7 Comparison

Consider the following table with a set of tasks that a system executes as per the given priority and the time taken to execute each task. The priority acts as a base for the type of system that is being designed. Although low priority tasks are addressed

Table 1 Sample data Set using the proposed architecture

Task	Priority	Time	Data Source
A	2	45	2
B	4	12	3
C	3	56	1
D	1	23	3
E	5	6	1

later, they hold a significant importance with respect to features made available as part of the system (Table 1).

For the above data set, the proposed model considers priority, time taken, and the data sources associated with a task to take a logical decision with respect to required calls to be made for the system to work as a real-time system. The criticality factor is vital to process higher number of requests and providing better processing capability with respect to existing singular hard or soft real-time systems. The proposed architecture is advantageous over existing models where only a task can be executed or only a set of data source can be called while serving data. Instead, this model uses a decision system that lets the application developer design a system that caters to a larger number of tasks and covers wider set of data sources. Here, the existing models may ignore Task B or Task E, but with the proposed architecture, the system makes a conscious decision of involving Task E considering the task and data source allotted. For Hard-Real Time systems, it facilitates better decision making than before which is an advantage.

8 Conclusion

This paper looks at a middle layer that decouples the data processing capability of an IoT based system in terms of being hard or soft real-time systems based on criticality. A major work must be done to get this validated in different Usecases and identify the risks of the proposed architecture. An additional layer is introduced that processes larger chunks of data which can be delayed but accounts for in depth results. This also helps an application developer to segregate the technical pieces required to build a real time system based on the priority of the output required. This leads to development of microservices which are responsible to fetch data from different data sources.

References

1. Zhu Z, Su X, Li J, Guo J, Ye J (2006) A user-centric service framework for pervasive computing. In: 2006 first international symposium on pervasive computing and applications, Urumqi, pp 1–4. https://doi.org/10.1109/SPCA.2006.297473
2. Riihijärvi J, Mähönen P (2013) Highly scalable data processing framework for pervasive computing applications. 2013 IEEE international conference on pervasive computing and communications workshops (PERCOM workshops), San Diego, CA, pp 306–308. https://doi.org/10.1109/percomw.2013.6529501
3. Lathies Bhasker T (2013) Pervasive computing issues, challenges and applications. Int J Eng Comput Sci 2(12):3337–3339 ISSN 2319-7242
4. Chopra A, Tokas S, Sinha S, Panchal VK (2014) Integration of semantic search technique and pervasive computing. In: 2014 international conference on computing for sustainable global development (INDIACom), New Delhi, pp 283–285. https://doi.org/10.1109/indiacom.2014.6828144
5. Liu B, Jiang T, Wang Z, Cao Y (2017) Object-oriented network: a named-data architecture toward the future internet. IEEE Internet Things J 4(4):957–967. https://doi.org/10.1109/jiot.2017.2714658
6. VanSyckel S (2013) Middleware-based system support for proactive adaptation in pervasive environments. In: 2013 IEEE international conference on pervasive computing and communications workshops (PERCOM workshops), San Diego, CA, pp 425–426. https://doi.org/10.1109/percomw.2013.6529534
7. Han J (2016) Chaining the secret: lightweight authentication for security in pervasive computing. 2016 IEEE international conference on pervasive computing and communication workshops (PerCom Workshops), Sydney, NSW, pp 1–3. https://doi.org/10.1109/percomw.2016.7457084
8. Taib SM, De Coster R, Nyamu J (2016) Innovation diffusion of wearable mobile computing: pervasive computing perspective. In: 2016 international conference on information society (i-Society), Dublin, pp 97–101. https://doi.org/10.1109/i-society.2016.7854185
9. Gökalp MO, Koçyigit A, Eren PE (2015) A cloud based architecture for distributed real time processing of continuous queries. In: 2015 41st Euromicro conference on software engineering and advanced applications, Funchal, pp 459–462. https://doi.org/10.1109/seaa.2015.61
10. Abdelsamea MHA, Zorkany M, Abdelkader N (2016) Real time operating systems for the Internet of Things, vision, architecture and research directions. In: 2016 World Symposium on Computer Applications & Research (WSCAR), Cairo, pp 72–77. https://doi.org/10.1109/WSCAR.2016.21
11. Kiljander J et al (2014) Semantic interoperability architecture for pervasive computing and Internet of Things. IEEE Access 2:856–873. https://doi.org/10.1109/ACCESS.2014.2347992
12. Srinivasulu P, Babu MS, Venkat R, Rajesh K (2017) Cloud service-oriented architecture (CSoA) for agriculture through Internet of Things (IoT) and big data. In: 2017 IEEE international conference on electrical, instrumentation and communication engineering (ICEICE), Karur, pp 1–6. https://doi.org/10.1109/iceice.2017.8191906
13. Srinivasulu P, Sarath Babu M, Venkat R (2016) Automated services for agrofarms using Internet of Things (IoT). Int J Comput Appl (IJCA) 154(11):17–21

Types of Keyloggers Technologies – Survey

Ashley Tuscano and Thomas Shane Koshy

Abstract Keyloggers are rootkit malware that record the keystrokes of the victim's system and log it into the attacker's system. It can be used to capture sensitive data like passwords, PINs, usernames, some kind of confidential messages shared between two entities etc. We would be explaining different types of keyloggers and their working. We have also explained the different applications and measures needed to avoid keylogging activities on your system.

Keywords Keylogger · Anti-loggers · Malware · Malicious · Interception · Keystrokes

1 Introduction

Hacking is unauthorized intrusion in a system through different mediums. It includes different aspects like interception, interruption, manipulation of the data etc. Data interception can be achieved by key logging which is a spying software used to record the keystrokes on a computer. It forms a way to collect the sequence of keys entered by the victim through keyboard while performing a particular action [1]. Keyboard can distinguish between various physical keys existing on keyboard and reports the controlling software about them. After receiving the report, the interpretation of the keys done by the software [2].

The two major types of the keyloggers are the hardware and the software keylogger. As the name suggests the hardware keyloggers are devices attached to the keyboard and the software. It can be a small USB like device attached to the keyboard which collects the keystrokes. It can also happen that the keylogger may be attached within the keyboard, that means it may be inbuilt. In some cases, the keyboard is designed to record the keystrokes and report it to the software.

Software keyloggers can be a program or a software which needs to be installed in the target system. It is invisible to the human eye and sometimes it might disguise

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_2

itself as a Virtual Machine manager or as a keyboard driver to monitor the keystrokes. Software keylogger can be a user level or a kernel level program. User level is the easiest to create and is easy to detect as well.

Software keylogger may enter a system as a malicious package which is downloaded on a computer. It is able to send the data through network to a remote system. Let us further learn more about the different types of keyloggers [3].

2 Types of Keyloggers

In this paper we would be talking mainly about four main types of keyloggers based on method of acquiring data. They are Hardware, Software, Acoustic and wireless intercepts [4].

2.1 Hardware Keyloggers

Hardware keyloggers are further divided into the following types [5].

2.1.1 Regular Hardware Keylogger

It is a circuit which is attached to the keyboard and a computer. It records keystrokes in its internal memory which is accessed during typing of certain characters previously defined for the circuit. It has an appearance which may camouflage itself with the rest of the cables. Some hardware keyloggers communicate wirelessly (Fig. 1).

2.1.2 Wireless Keyloggers Sniffers

It collects the transferring packet of data. Then it tries to crack the encryption key being used [6]. As the name suggests, it tries to gather data wirelessly and segregate the required information from the rest.

2.1.3 Firmware

The Computer BIOS is reprogrammed to record the keystrokes of the victim as the BIOS is responsible for handling keyboard events and processes it [6]. Since firmware is extremely complex it requires a wide variety of knowledge to be designed. It is harder to detect and remove due to the nature of the firmware.

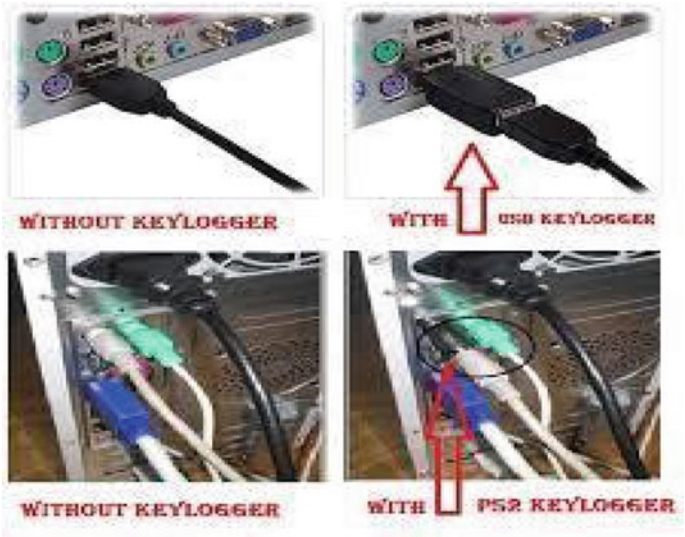

Fig. 1 Shows device with and without keyloggers. [17]

Fig. 2 Shows Keyboard overlays on ATM [24]

2.1.4 Keyboard Overlays

There is a fake keypad overlaying the real keypad and as a result, when the key is pressed it is recorded by both attacker's device and the legitimate device that the victims is using. This technique is used on an ATM to capture the PINs. Since it is a physical overlay an observant person can detect it but mostly undetectable as no one is explicitly looking for it (Fig. 2).

2.2 *Software Keyloggers*

Software based keyloggers are computer programs or applications (software) which store the key strokes from the keyboard or any other typing device [7]. Software based keyloggers are similar to Hardware based keyloggers, as here the hardware is replaced with a software which stores the key strokes directly. Different companies use keyloggers legally to monitor their network usage without the knowledge of their users. Microsoft admitted in their policy that Windows 10 operating system has inbuild keyloggers to improve typing and writing services [8]. All this is done under the pretext of providing better services to the users. But, any malicious software or a software deployed by an attacker can be used to steal passwords and credit card information. Keylogger application might get installed when the user visits an untrusted website or server. Keylogger can be made in such a way that they will be hidden in the Task Manager, making it is difficult to stop them from storing keystrokes and sending them to the attacker [9] (Fig. 3).

Software Keyloggers are divided into following types.

2.2.1 Hypervisor Based Software Keyloggers

The term Hypervisor refers to a computer software that creates and runs virtual machines. It is also known as virtual machine monitor (VMM) [10]. Hypervisor based Software Keylogger is theoretical.

Hypervisor, theoretically captures an operating system's instance in a mobile device or a computer and virtualize all the devices and files that it contains. The virtualization can allow the keystrokes to be logged or intervened as they are entered. A rootkit would be required for installing the malware [10]. Blue Pill is an example of the Hypervisor Based Software Keylogger. Blue Pill is a reference from a 1999 film, Matrix. Blue Pill is also called as rootkit which is based on x86 virtualization. Originally AMD-V virtualization support was required by Blue Pill, but later it could support Intel VT-x also. Joanna Rutkowaka designed it and Black Hat Briefings demonstrated it on August 3, 2006. It was done for Microsoft Windows Vista kernel [11].

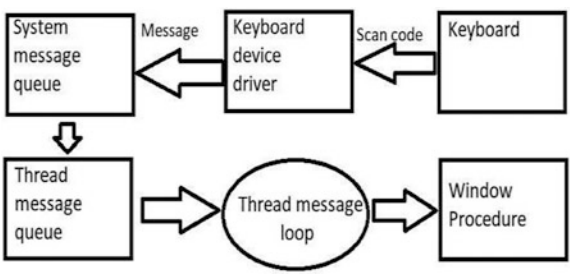

Fig. 3 Keyboard input model and where the keyloggers can work [9]

2.2.2 Kernel Based Software Keyloggers

Kernel Based Software Keyloggers are the programs that gain root access in the operating system and intercepts the keystrokes that pass through the kernel. This keyloggers, as they have the root access, are very well hidden, so noticing them is nearly impossible. The application that do not have root access cannot detect this keyloggers at all. Kernel level software keylogger can act as device driver for keyboard, and gives the same services as the original device driver, but it will also store the key strokes and give it to the attacker [12].

2.2.3 API Based Software Keyloggers

API Based Software Keyloggers intercept keyboard or keypad APIs inside an application that is running. Keylogger registers every keystroke as it a normal application and no traces of malware are found. It can stores the key presses or releases or both in some cases [13].

2.2.4 Memory Injection Based Software Keyloggers

Memory Injection Based Software Keylogger make use of browsers memory tables. This type of malware is very expensive to implement but it has become a very serious problem as it can bypass the 2-step authentication [10]. It can even bypass Windows UAC (User Account Control) [7]. The method is used by Trojans SpyEye and Zues [14].

2.3 Acoustic Key Loggers

Acoustic Key Loggers falls under the category of Hardware Key Loggers. This type of Key Loggers include keyboard overlays. Acoustic Key Logger is a logger that record the sound of a person tapping on a keyboard. It works out the tiny differences in the sound that each key makes, and their "electromagnetic emissions". These keyloggers capture the electric pulses leaking into the air from a keyboard cable. The idea about hacking/attacking a system using this method seems to come straight out of movies (Fig. 4).

Fig. 4 Acoustic keylogger

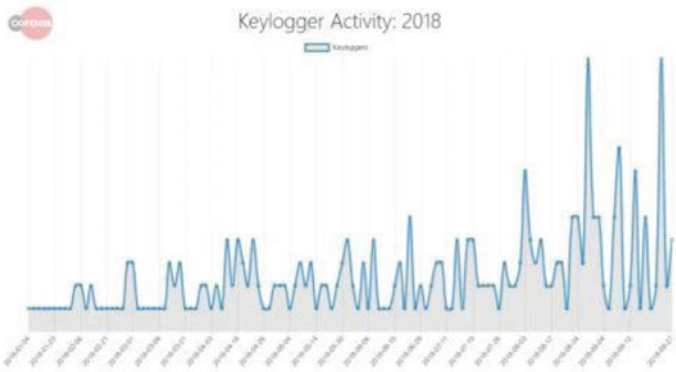

Fig. 5 Increased use of keyloggers by cyber criminals [14]

Acoustic Key Loggers can be also named as Acoustic Cryptanalysis because it takes the help of the sound created by someone typing on a computer to monitor it. When struck, each key on the keyboard makes a subtly different acoustic signature. Each keystroke signature and its corresponding keyboard character can be identified by using statistical methods such as frequency analysis. The parameters that can be considered here for analysis are as follows: The frequency of repetition of similar acoustic keystroke signatures, the timings between different keyboard strokes and the probable language in which the user is writing are used to map sounds to the letters. To use this method a large sample of keystroke sounds is required. Since keyloggers store the keystrokes of each of its victim, they can be used to study the victim's behaviour. Hence, it can be used in the following ways (Fig. 5).

3 Applications

3.1 Business Administration

Keyloggers can be used for monitoring the employees. It ensures that the employees do their tasks and do not abuse office network. Reports of their keystrokes can be delivered via mail to the network administrator anytime [24].

3.2 School/Institutions

Keyloggers help to monitor students' network usage and stop them from misusing it. If any user misuses the system, then the action can be traced back to them [25].

3.3 Personal Control and File Backup

If privacy is a concern for a device, then a keylogger can be used to monitor unauthorised access. All the events and key strokes will be saved as a log. Hence all kinds of access is monitored. Keyloggers can also be used to save documents that has been lost due to system crashes [26].

4 Measures

4.1 Anti-key Loggers

A piece of software called as Anti-key logger is designed to detect Key Loggers on a computer. It is used for comparing all files in the device against a database of Key Loggers looking for similarities, which may signal the presence of a hidden Key Loggers. As these softwares have been designed specifically to detect Key Loggers, they have the potential to be more effective than conventional antivirus software; some antivirus software do not consider a Keylogger to be a virus, as under some circumstances a Key Logger can be considered a legitimate piece of software [18].

4.2 One-Time Passwords (OTP)

OTP (one time password) as the name suggests is a password that can be used only one time. The single use feature may protect us against Key Loggers, as each password becomes invalid as soon as it is used. This may provide security to someone using a public device. If an attacker has remote control over such a computer, he/she can simply wait for the victim to enter his/her important credentials. Later the attacker can perform the unauthorised transactions while the victim is inactive.

4.3 Network Monitors

Reverse-firewalls also known as Network Monitors can be used to alert the user/victim whenever an application/attacker attempts to make a network connection. This gives user the chance to prevent the Key Loggers from Phoning home with his or her typed information (Fig. 6).

Fig. 6 Virtual keyboard design [14]

4.4 Virtual Keyboard

Another type of software called as virtual **keyboard** is a component that allows the input of characters without the need for physical keys. In virtual keyboard, interaction happens mostly with a touch screen interface. It can also take place in a different form in virtual or augmented reality.

As referred from a paper "a survey on keylogger" there are different ways for detecting and preventing logging, the solutions are given by various industries and also researchers. Various industries has launched different software like antivirus with malware prevention and anti-keyloggers for the same. Many antivirus have added keylogger to their databases to provide protection against malicious attack by keylogger. Users need to keep their antivirus databases update to ensure protection. On other hand anti-keylogger and anti–keystroke logger is special software designed to detect keylogger program. But when compared to anti-virus and antispyware software, anti-keylogger cannot find the difference between a legitimate keystroke-logging program and an illegitimate keystroke-logging program like malware. All keylogger are marked and removed where they appear to be legitimate or not. In past days, keylogger were very simple. The keystrokes of keyboard got recorded by keylogger and are then sent to intruder/attackers through email or FTP (File Transfer Protocol) [29]. In order to deal with these, virtual keyboards were introduced for electronic payment pages [30]. For every time user logs into financial websites or any other portal keyboard buttons prone to changes to virtual keyboard making the key being pressed unrecognizable to the attacker. Hence, attacker fails to interpret passwords due to use of virtual keyboards. In addition to it, security softwares that are installed on OS carefully analyses start-ups to prevent systems from running keylogger. Thus by analysing keylogger files these applications are capable of recognizing the new keyloggers.

As technology progressed, more advanced keyloggers are developed, requiring special techniques for countering them. Many researchers have given solutions to

detect and prevent misuse of these techniques. For instance, consider paper [20]. It has provided a novel framework to detect and prevent a keylogger attacks. Detection and prevention systems are used for detection of keylogger and their removal. This techniques can be rendered useless if the intruder uses a database of email addresses to send email of system keylog to themself. Authentication which uses images is a challenge for keyloggers as given in [20]. In order to keep passwords safe, it makes use of cryptographic hash functions, which is resistant to brute force attacks while vulnerable to different Dictionary attacks, which allows users to obtain passwords from a variety of available resources.

5 Detection of Keyloggers

It is difficult to detect software keyloggers with our naked eyes. It may be possible to detect hardware keyloggers by searching if there is any device attached between the CPU connection and the connection of keyboard.

For identifying if there are any software keyloggers program working in the background just open your "Task Manager" in the Windows OS and look for suspicious processes. Search the unknown processes over internet and if they are keyloggers then end the processes. Other alternative is to go to msconfig and go to start up and see if any malicious process gets attached when the computer boots.

Hardware keyloggers can be PS/2 and USB keyloggers. Refer Fig. 7 to know about the communications of PS/2. Table 1

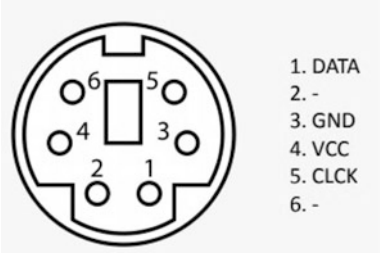

Fig. 7 Communication ports of PS/2 [15]

Table 1 Summary of Detection of keyloggers

Paper	Author	Solution Proposed	Change
Learning to Detect and Classify Executables in the wild	J. Zico Kolter, Marcus A. Malicious Maloof	Identifying malicious executables using Machine Learning and Data mining	Performance was not satisfactory and suspected obfuscation to be the cause
Malware Detection and classification using Machine learning techniques	Abhishek Dhiman	Detection of malware using KNN, Naïve Bayes, SVM, Decision Tree Algorithm	The Accuracy achieved by all the algorithms is not more than 93.6% (Decision Tree) and Naïve Bayes approach had a low accuracy of 65.4%. Methods used were relatively old and hence accuracy would have been better
Enhancing Keylogger Detection Performance of the Dendritic Cell Algorithm by an Enticement Strategy	Jun Fu, Yiwen Liang, Chengyu Tan, Xiao	A Dendritic Cell Algorithm is used to detect keyloggers on host machine	Detection rate is 50%. Not much improvement expected in the case of short sentences
An Online Approach for Kernel-level Keylogger Detection and Defense	Donghai Tian, Xiaoqui Jia, Junhun Chen, Changzhen Hu	Separate kernel extensions from the keyboard drivers (LAKEED)	Fails in defending from keyloggers reading keyboard buffer to gain the keystrokes using DMA

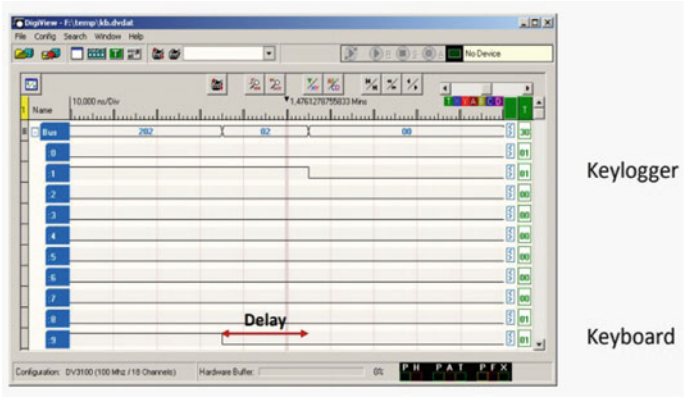

Fig. 8 Dislocation of the signal

As Hardware keyloggers have its own clock hence there can be a dislocation of the signals. When the clock is set to low then there would be a delay in the signal due to a Hardware keylogger as shown in the Fig. 8.

6 Conclusion

Keyloggers is a malware which creates a log of keystrokes and sends the collected log to the attackers. As the keyboard is capable of differentiating keystrokes it is easy to get information from the log recorded. Keyloggers are broadly classified into Hardware, Software and Acoustic Keyloggers. It is difficult to detect hardware keyloggers using software as it does not need to be installed. It can be easily connected between the Connection of keyboard and the Computer system. Software keyloggers are hard to detect with naked eyes and needs to be installed into the system through malicious packages or unprotected network connections. Software Keylogger can send data by using the network. We have seen various measures to prevent keylogging in the system along with the detection techniques like; using clock signals or just inspecting the Task Manager in your windows machine.

References

1. Rajendra RK, CA Wood (2010) Keylogger in Cybersecurtiy Education. Rechester Institute of Technology, Rechester, New York, USA
2. Olzak T (2008) Keystroke Logging Keylogging Erudio Security, LLC
3. Ysterud SA (2014) Keylogging of user interaction in physical and virtual environments and its implications for honeypot analysis
4. Ahmed YA, Maarof MA, Hassan FM, Abshir MM (2014) Computer Science, Faculty of Computer Science & Information Systems, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia
5. Davis A (2007) Hardware keylogger Detection. Smith Square London
6. https://en.wikipedia.org/wiki/Hardware_keylogger
7. https://en.wikipedia.org/wiki/Keystroke_logging#cite_note-1
8. By Caleb Chen, 20 March 2017. https://www.privateinternetaccess.com/blog/2017/03/microsoft-windows-10-keylogger-enableddefault-heres-disable/
9. Prabanand SC, Prathap C, Vignesh LS, Solairaj A, Mathalairaj J (2016) Keyloggers Software Detection Techniques
10. "Hypervisor" Wikipedia
11. "Kadix" keylogging Ontology
12. https://en.wikipedia.org/wiki/Blue_Pill_(softwaRe)
13. https://pdfs.semanticscholar.org/37ea/54247bb3bedd356f5171ee5f8e1a83662dfc.pdf
14. http://www.symantec.com/avcenter/reference/the.evolution.of.malicious.irc.bots.pdf
15. https://arxiv.org/abs/1405.3760
16. https://www.google.com/url?sa=t&source=web&rct=j. http://www.keyloggerpro.com/uses.php
17. Zico Kolter J, Maloof MA (2006) Learning to Detect and Classify Malicious Executables in the wild
18. http://techsohail.blogspot.com/2012/05/beware-ofhardware-keylogger-hardware_04.html
19. Obiniyi AA, Umar MA (2013) Random number based dynamic antiscreenshot virtual keyboard for securer web login. Int J Eng Sci 2
20. Wazid M, Katal A, Goudar RH, Singh DP, Tyagi A, Sharma R, Bhakuni P (2013) A framework for detection and prevention of novel keylogger spyware attacks. In: 7th international conference on intelligent systems and control (ISCO 2013)

21. ATM Skimming Devices are Still a Big Problem. https://coastalheritagebank.com/2016/05/13/atmskimming-devices-are-still-a-big-problem/
22. https://krebsonsecurity.com/2011/04/spyeyetargets-opera-google-chrome-users/
23. https://securelist.com/keyloggers-how-theywork-and-how-to-detect-them-part-1/36138/
24. Keyboard overlay image. https://coastalheritagebank.com/2016/05/13/atmskimming-devices-are-still-a-big-problem/
25. Doja MN, Naveen Kumar (2008) Image authentication schemes against key-logger spyware. In: 9th ACM ACIS international conference on software engineering, artificial intelligence, networking, and parallel/distributed computing 2008 (SNPD 2008)
26. Acoustic Keylogger. https://www.google.co.in/url?sa=t&source=web&rct=jhttps://www.comparitech.com/blog/vpnprivacy/what-is-keylogger
27. Anti Keylogger. https://en.m.wikipedia.org/wiki/Anti-keylogger
28. http://www.cryptomuseum.com/covert/bugs/selectric/index.htm
29. Fu J, Yang H, Liang Y, Tan C (2014) Enhancing keylogger detection performance of the dendritic cell algorithm by an enticement strategy
30. Wood CA, Raj RK (2010) Keyloggers in Cybersecurity Education, New York, USA

Edge Computing Approach to DEVOPS

Shivankit Bisht and Pratyush Shukla

Abstract Lagging or slow responsiveness is very common among Jenkins users, and you can find many reported issues on it. Slow Continuous Integration systems are frustrating, they increase the end to end Software development time. The combination of Edge Computing and Docker, a container-based technology could bypass these performance problems and increase the user experience. Our paper presents a way to use edge computing and docker approach for Continuous Integration and Continuous Delivery to run the Jenkins server on the local system/ developer system and once the checks and builds are run successfully on it, the deployment will be done to target environment.

Keywords Docker · Jenkins · Continuous integration · Continuous delivery

1 Introduction

Almost every major software organization has its central Jenkins servers and all the build are dependent on it. Any downtime or performance issue of the system affects deployment and thus developers loose valuable productive time. Hence, in enterprise software companies, there is a growing realization that the practice of software delivery face hurdles of delivery due to above.

Edge computing shifts the paradigm from centralized to decentralized; by utilizing compute, network and storage resources that is closer to the software developer [1]. Edge computing can greatly improve user experience by eliminating the dependency on central infrastructure failure or snap of network connectivity to it by bringing more control to the end-user.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_3

Containers are a form of OS Virtualization wherein the operating system resources, memory and services required to run an application or service are packaged inside a box. The isolation, reduced size, quick setup and tearing down provided by the containers can be used to run applications on edge where there is dependency on the central infrastructure.

In continuous integration (CI), development teams implement small changes and check in code to version control repositories frequently. Continuous delivery (CD) automates deployment to selected infrastructure environments. Most developers work on multiple deployment environment like production, development and testing. The deployment in these spaces happens via centralized Jenkins servers. Any performance impact on these servers impacts all the development and later to deployments.

This paper describes a new approach to end dependency on central servers for deployment of applications to different infrastructure environments. Additionally, any extra code checks like java unit test coverage, code errors etc. are run on the developer machine and not on the cloud.

2 Background

2.1 Edge Computing

Edge computing implies that the processing of data occurs at the source of data. When data is physically located closer to the users who connect to it, information can be shared quickly, securely, and without latency. Edge computing differs from cloud computing in the ways that Edge computing has the potential to address the concerns of response time requirement, battery life constraint, bandwidth cost saving, as well as data safety and privacy [4].

2.2 Docker

Docker is an open platform for developing, shipping, and running applications. Docker enables you to separate your applications from your infrastructure so you can deliver software quickly [2]. It's designed to help delivering applications faster by using a lightweight container virtualization platform surrounded by a set of tools and workflows that help developers in deploying and managing application easier. Docker container is basically where you can create applications, place them together with all required dependency components for the apps to be able to run inside a hardened box and then put it through any verification or rigorous testing as needed for quality purpose. The creation of the box can be done on almost any operating system and infrastructure, including cloud environment and it's very fast thanks to

the leveraging of unified systems and other techniques. Docker can build images automatically by reading the instructions from a Dockerfile. A Dockerfile is a text document that contains all the commands a user could call on the command line to assemble an image. Using docker build users can create an automated build that executes several command-line instructions in succession [6].

2.3 Jenkins

Jenkins is an open-source automation platform [3] that is widely used for building and deploying software. Developed in Java, Jenkins provides nearly infinite possibilities for what it can do through its 1000 plus plugins.

2.4 Cloud Computing vs Edge Computing

Cloud computing has reached its maturity. It serves as a good business and user model. Low startup cost pay-per-use, on-demand and elasticity of resources put Cloud computing on an attractive proposition for businesses. From user perspective, the application and data can be reached from anywhere, everywhere and anytime [1]. All this data is hosted on the infrastructure provided by select cloud providers: Amazon, Microsoft, Google and IBM. However, the transfer of data to these cloud providers is restricted variable such as the speed of the internet connection and the application response time. Under Edge Computing the real time processing occurs on the device and not on the cloud. Table 1 shows the advantage of Edge Computing over Cloud Computing.

Table 1 Advantages of cloud computing vs. Edge computing. Taken from CISCO Blog [5]

Requirements	Cloud computing	Edge computing
Latency	High	Low
Delay jitter	High	Ver low
Location of service	Within the internet	At the edge
Distance client and server	Multiple hops	One hop
Location awareness	No	Yes
Geo-distribution	Centralized	Distributed
Support mobility	Limited	Supported
Real time interaction	Supported	Supported

3 Proposed Idea

Cloud computing provides remote servers hosted in the Data Centers and a set of services constantly transmitting data to the servers for processing data instead of providing the data processing capabilities at the edge (local servers or personal computers). This not only introduces latency but also a tightly coupled dependency is there on the remote servers. Traditionally in such a setup, most the systems transmitting data to the Central Server were not capable enough to process data at the edges. Cloud computing still plays an important role in current infrastructures of most of the tech giants. However, the bottlenecks present in cloud native architectures opens new doors of exploration for the companies in the form of Edge Computing and evaluate data processing capabilities nearer to the source: edge in our case. Also, with recent developments in terms of miniaturization of processing has helped the tech giants to gather data at the edges and minimize the call to the remote servers.

Our solution is about implementing and rendering the advantages of Edge Computing in real life scenarios.

Figure 1 shows the flow of application deployment in a traditional approach wherein the central Jenkins pulls source code from any Git repository that the Jenkins build node can access. After this, the Jenkins server, runs code checks and then deploys the application in the Production server. This approach comes with certain disadvantages. The costs of hosting server that Jenkins runs on cannot be

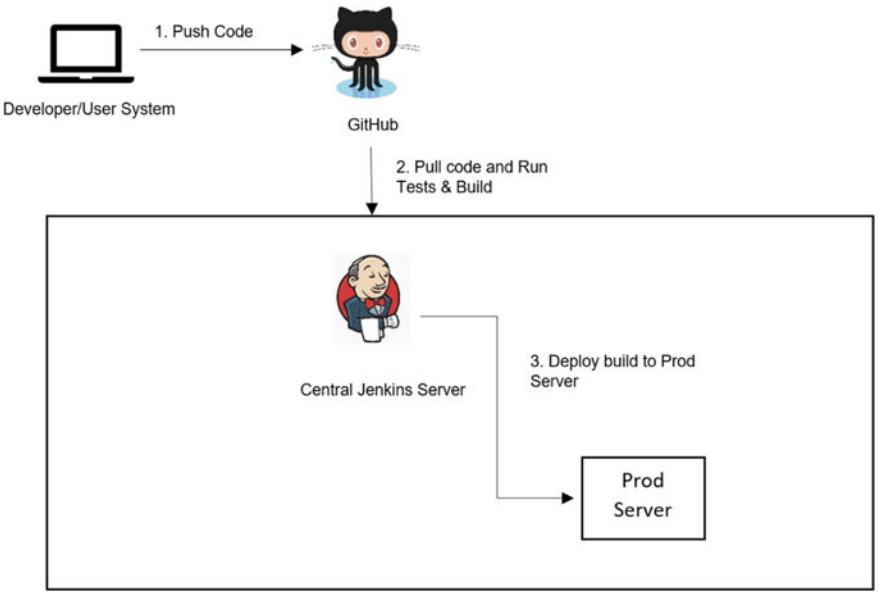

Fig. 1 Cloud application deployment using remote central Jenkins server

predicted easily. The hosting server costs depends on volume of code that is pulled and the number of builds that are running on it simultaneously. Due to this the central server is prone to slow builds and high deployment times.

These cost overheads can be avoided by bringing in Edge computing approach to cloud application deployment architecture. By eliminating centralized environment, edge computing removes bottlenecks and potential point of failure, thus making the entire application deployment faster and more preferably resilient to failure.

To validate our approach, we propose bringing the entire central Jenkins server on the Developer/user system. The setup has been shown in Fig. 2. The Jenkins server will run on the locally hosted docker container. Inside the docker container the code will be pulled from GitHub repository and then deployed to the Production space. In addition, code checks can be performed before deployment to production server on the developer/user system. It should be noted here that the pull of code from target git repository.

By adopting this approach, we can bypass the dependency on outside servers and in turn improve the build and deployment times by almost 80%. Additionally, by bringing the Jenkins server to the edge, ownership will be transferred to individual users/developers building the application.

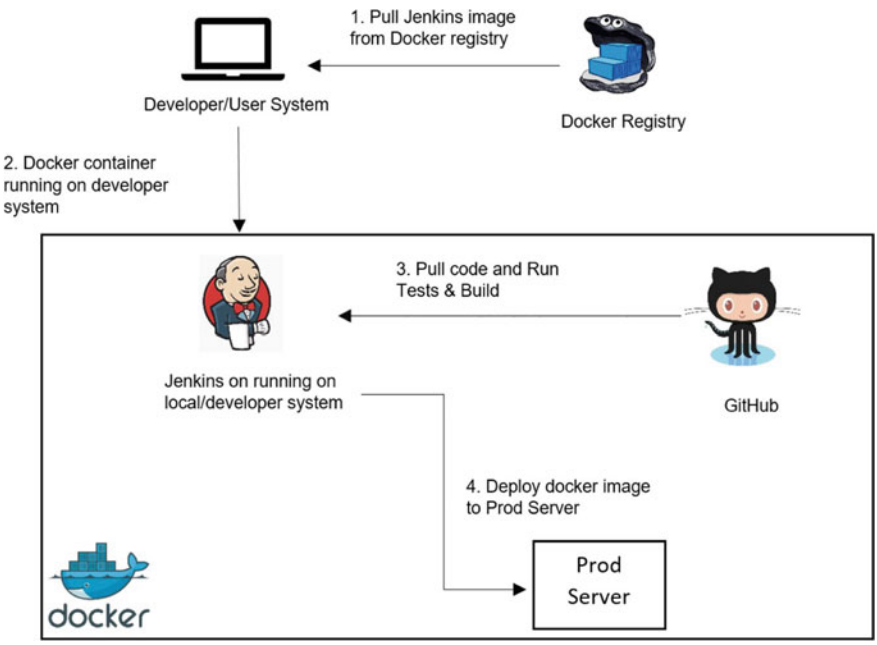

Fig. 2 Cloud application deployment using Jenkins server running on a docker container in developer/user system

4 Implementation

Our team had been using the Cloud native architecture for building applications where the Jenkins server was centrally hosted on a remote server and all the build and checks were running on the server thus causing latency and slower performance. This led to introduction of many overheads and a lot of co-ordination was required between the development and the operations team.

Owing to the negative impacts been faced on a day to day basis, we decided to carry out an experiment to evaluate Docker and Jenkins running on edge (developer's machine) for implementing an Edge Computing approach to DEVOPS and implemented a solution as illustrated in Fig. 3. Our solution runs on an edge site which will be the developer's machine near to the source of data generation.

For our implementation we created a Dockerfile which is text file and contains the list of instructions to be executed for creating a Docker image. DockerHub usually has the list of commonly used Docker images like Jenkins. However, via the Docker file, we can automate Docker Image creation process. On execution, our Dockerfile pulls all the required dependencies mentioned in the file from the Docker Registry which is the storage and distribution system for named Docker images. Docker machine starts running on port 8000 of the Edge system. Once, all the dependencies are successfully pulled from the Docker Registry, Jenkins server is started locally on port 9000 which serves as the primary interface between version control systems and deployment. It also manages the container build process for each image repository. In addition, the local Jenkins run also equips the machines running at edges to perform all the code checks before the code base is pushed to production.

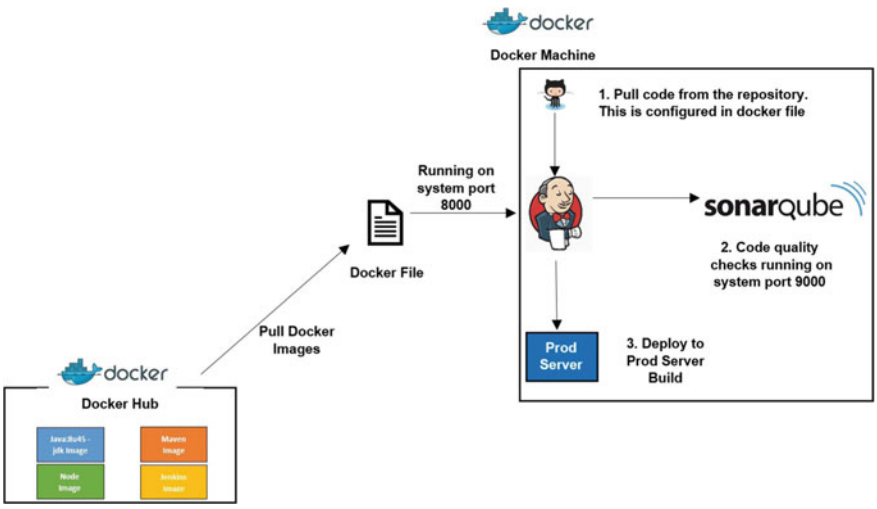

Fig. 3 Implementation overview

Thereafter, a Jenkins job will be triggered which will pull code from the GitHub repository based on the parameters defined in the Dockerfile, perform code quality checks and deploy to production space.

To take advantage of the edge computing capabilities we cached the application data in the docker container. This means that every time a new build is triggered, the dependencies that were downloaded in the first execution, will be reused.

5 Results

Through this paper, our aim was to evaluate performance of software deployments without the use data center clouds. We can observe that the Edge computing provides clear benefits over the current cloud-based approach. However, we also identified certain limitations. Firstly, graphical applications don't work well inside a docker container. Secondly, any change in the docker file will lead download of all the dependencies again. However, these dependencies are cached for successive deployments.

Figure 4 shows the performance results of the experiment done. The graph is representations of the deployment number done vs the time taken for the deployment. Initially we can see that none of the dependencies were cached and the deployment of application of size 105 MB took around 13.26 min. In a normal scenario where the applications communicate with a remote server it usually takes the same time. However, in our Edge Computing approach to DEVOPS we can see that the later builds are faster as compared to initial build. This is because the dependencies are cached in the docker container for future deployments.

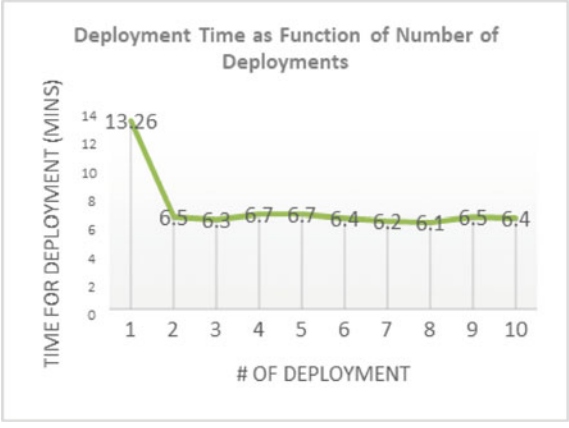

Fig. 4 Performance as function of Number of Deployments

The results were achieved on a Windows 64-bit laptop with Intel i5 processor and 16 GB RAM. The test file used for deployment was of size 105 MB.

References

1. Ismail B, Mostajeran E, Karim M, Tat W, Setapa S, Luke J-Y, Ong H (2015) Evaluation of docker as edge computing platform. https://doi.org/10.1109/ICOS.2015.7377291
2. "Docker overview" Docker documentation. https://docs.docker.com/get-started/overview/
3. Jenkins. https://jenkins.io
4. Shi W et al (2016) Edge computing: vision and challenges. IEEE Internet Things J 3:637–646
5. Abdelshkour M (2015) IoT, from cloud to fog computing. https://blogs.cisco.com/perspectives/iot-from-cloud-to-fogcomputing
6. "Dockerfile reference" Docker documentation. https://docs.docker.com/engine/reference/builder/

A Game-Theoretic Approach for Cognitive Radio Networks Using Machine Learning Techniques

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Abstract Cognitive Radio has been viewed as a promising technology to enhance spectrum utilization significantly. In this work, we propose a model for Dynamic Spectrum Allocationin Cognitive Radio Networks using Game Theory. Furthermore, in order to accommodate for all cases, we have put to good use of Preemptive Resume Priority M|M|1 Queuing Model. To supplement it we introduce a priority-based scheduling algorithm called Incremental Weights-Decremental Ratios (IW-DR). As a means to ameliorate the efficiency, we have made use of Regression Models.

Keywords Cognitive networks · Spectrum allocation · Queuing theory · Game theory · Regression

1 Introduction

With the advent of the digital age, there has been a critical deficit of unlicensed spectrum, as a consequence of rising demands for wireless spectrum. There are an exponentially increasing number of applications and devices that singularly depend on the availability of the unlicensed bands. Such applications and devices make the unlicensed bands congested, contrarily; preliminary studies have shown that a significant portion of the licensed bands is being underutilized. To ensure the prospective growth of wireless services, it is vital to increase the efficient usage of these channels.

Cognitive Radio (CR) [1] & [2] Networks have been proposed as the novel solution to alleviate the deficiency problem of the limited radio spectrum. The CR Network is composed of intelligent spectrum-agile devices that are competent of

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_4

adjusting their configurations based on the spectrum environment [3] & [4]. A CR Network typically has two types of users: Primary Users (PUs) who are obligatory licensed users of the spectrum and Secondary Users (SUs) who try to opportunistically access the unused licensed spectrum, this feature is called Dynamic Spectrum Access [5]. The system has to attain a way to ensure that these networks are able to peacefully and harmoniously coexist without any loss in Quality of Service. In [6–8] & [9], game theory, auctions, leasing etc. have been proposed to aid dynamic spectrum allocation.

However, game theory has been used as a robust tool developed to model the interactions of players with contradicting interests. However, while implementing game theory, there is a premise that each player in the game is rational. Being rational players in the game, SUs intent to individually maximize their own payoffs. In our case, the payoff being the allotment of a channel.

This work proposes the use of a non-cooperative dynamic game wherein the SUs (players) compete for the available channels, relinquished by the PUs. Their strategy is to switch or stay between the available networks in such a fashion that they dodge collisions with other SUs. The game reaches an equilibrium point once all the SUs have acquired an accessible channel.

In [10, 11] & [12] a similar, game-theoretic environment was set up for dynamic spectrum access. In [11] & [12], the Nash Equilibrium for the game is formulated. In [10] regression techniques are implemented to simulate the game. However, in [10] there was a setback, the system fails when the traffic surpasses the number of available channels.

In this work, we have amended this setback. In order to relieve the congestion among the arriving SUs [10] we make use of Preemptive Resume Priority (PRP) M|M|1 queuing network model [13] & [14].

Another premise to consider while implementing Game Theory in Spectrum Allocation is that all SUs might not be guaranteed the same levels of performance [15]. Thus, in this work we introduce a customized scheduling algorithm named Incremental Weights-Decremental Ratios (IW-DR). Where, in order to bolster the delaysensitive secondary user applications and achieve the quality of service between different classes of users, we prioritize them based on their application type and order of sensitivity.

To realize learning in the game, we have analysed various regression algorithms as the datasets would be in a continuous fashion. In this paper, we have employed Linear Regression, Polynomial Regression, Support Vector Regression, Decision Tree Regression and Random Forest Regression in order to predict the optimal probability for a given (N_N, N_C) tuple, where N_N is the number of available networks and N_C is the number of active channels competing for the networks.

2 System Model

Assume a game environment with dynamically changing components, let X_T be the number of available channels at a given point of time and Y_T be the number of networks or SUs competing for X_T channels. Assume the time period of arrival into the system $(1/\lambda_T)$ is greater than the time taken to accommodate the channels (T_{EQ}). Based on X_T and Y_T the system can be divided into two sub-cases.

Case 1: $X_T \geq Y_T$

In this case, at equilibrium $^{(T}EQ)$all the Y_T networks would be accommodated in either of the X_T channels. All the Y_T networks are given an equal opportunity to all the X_T channels. But, if a conflict of interest occurs (i.e.) two or more networks competing for the same channel, then their strategy is to switch or stay between the channels to avoid collisions depending on the most favourable option as depicted in Table 1, where C is the cost of switching.

We illustrate this system with Fig. 1 where the squares represent the channels. In our case, we have 8 networks competing for 10 channels. (SU_3, SU_1, SU_7), (SU_2, SU_4) & (SU_5, SU_6) in Step 1 (SU_2, SU_1) & (SU_4, SU_6) in Step 2 and (SU_1, SU_4) tuples in Step 3 have a collision. However, in each case the problem is dealt in a different manner, depending upon the optimal probability.

From the above example, we can comprehensively establish the fact that the optimal probability of switching can neither be 0 nor be 1. As neither would lead to a state of equilibrium. If p is the probability of switching, the probability of staying would be $1-p$. Hence, the probability tuple would be $(p,1-p)$.

Case 2: $X_T < Y_T$

In a practical scenario, we would be dealing with different application types in CR networks, one being the real-time applications and the other being non-real time applications. The real-time application types are more sensitive to transmission delay than the non-real-time applications. According to their sensitivity, they are pushed into either of the Y queues with descending order of priority.

Additionally, to enhance the user experience and Quality of Service, an interrupted SU must be given higher priority than the newly arrived SU. This typical case of traffic congestion provides a good application for the use of a Preemptive Resume Priority (PRP) M|M|1 queuing network model. As depicted in Fig. 2, the interrupted SUs are given a higher priority.

To provide an opportunity for Lower Priority Queue members to access the networks and to reduce the waiting time for the Lower Priority Queue members we devised a scheduling algorithm called Incremental Weights - Decremental Ratios (IW - DR).

Table 1 Payoff matrix/game strategy

A/B	Switch		Stay
Switch	(C, C)		(C,0)
Stay	(0, C)		(0,0)

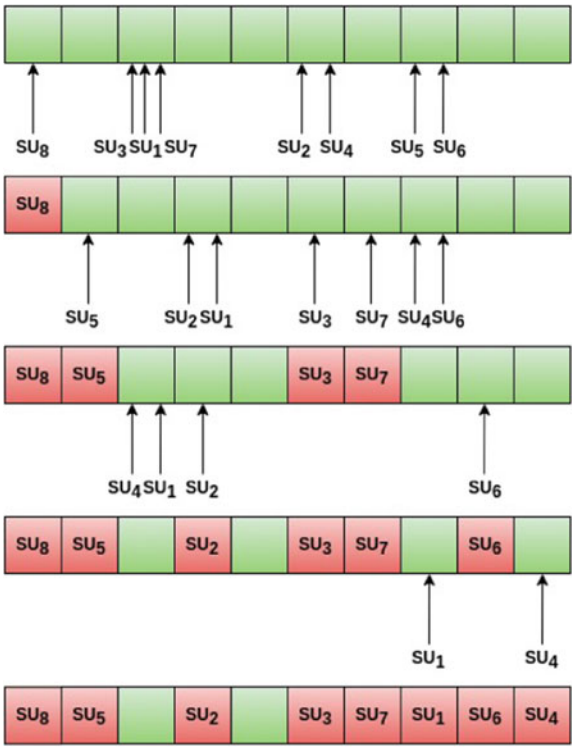

Fig. 1 Ilustration of the non-cooperative dynamic game with 8 networks and 10 channels

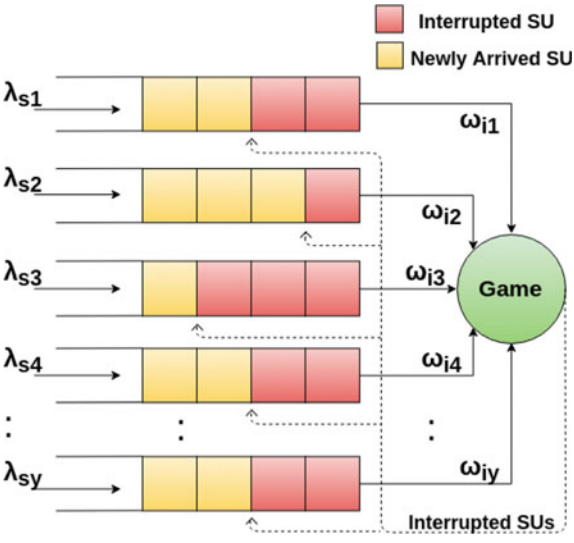

Fig. 2 Illustration of PRP M|M|1 queuing network model with y levels of priority

IW - DR Scheduling Algorithm:

```
N - > Number of Active Queues
if(Q1)
  Allow Users (Q1, N)
  Continue
if(Q2)
  Allow Users (Q2, N-1)
  Continue
  …..
if(Qn)
  Allow Users(Qn,1)
End
```

Assume, we have a total of N active queues (Q_1, Q_2,….Q_n)at a given point of time such that Qp > Priority Qp + 1.

In this paper, in order to dynamically schedule the active queues, the ratio of the number of users permitted from Q_1: Q_2 :….Q_n would be N: $N-1$: $N-1$: ….N. Hence, N users of Q_1 are given the highest priority followed by N-1users from Q_2 and so on. In this manner, we are able to provide equality.

For example, if we there were five active queues namely Q_1, Q_2, Q_3, Q_4 & Q_5 in order of priority. A maximum of five users would be permitted from Q_1, followed by four users from Q_2 and so on. In this manner we are able to reduce the average waiting time of the Lower Priority Queue members.

The first X_T networks of highest priority are then selected from the IW-DR Scheduling Algorithm, to compete for X_T channels, which boils down as a subcase of Case 1 ($X_T = Y_T$).

As depicted in Fig. 2, the interrupted SUs are given a higher priority as compared to the newly arrived SUs. The selected channels are then entitled to compete among themselves for a possible network, based on the Game Algorithm.

Game Algorithm:

```
M -> Number of Networks
N -> Number of Channels
for(P = 0.01 - > 0.99)
  StartTime = CurrentTime
  (P, 1 - P) - > (SwitchProbability, StayProbability)
  while(!EquilibriumState)
    SimulateGame(M, N, P)
  EndTime = CurrentTime
  Time[P] = EndTime – StartTime
for(P = 0.01 -> 0.99)
if(Time[P] = min(Time[ ]))
    OptimizedProbability = P
end
```

Game Algorithm has been used to experimentally simulate a game similar to our scenario, we then calculate the time taken to reach equilibrium for each value of P, ranging from 0.01 to 0.99.

This process is repeated 100 times for each ($M\ N\ P$,,) tuple and then the mean equilibrium time is calculated. The optimized probability for a corresponding ($M\ N$,) tuple is the one for which the equilibrium time is the least. Thus an ($M\ N\ P$,, $_0$) tuple is the output for a given input tuple ($M\ N$,).

3 Proposed Algorithms

In order to be really cognitive, a Cognitive Radio Network should be equipped with abilities of learning and reasoning. In our paper we have used the following regression techniques:

3.1 Simple Linear Regression

It is called a Simple Linear Regression if there is only one independent variable and is called a Multiple Linear Regression if it has more than one independent variable. Mathematically it is denoted as:

$$f(x) = w_0 + w_1x_1 + w_2x_2 + \ldots w_dx_d = w_0 \sum_{j-1}^{d} w_ik_i \tag{1}$$

It is called a linear regression since it it a linear function of parameters ($w = w_0$, w_1, w_2,….w_d) and input variables $x = (x_1, x_2, \ldots x_d)$.. The parameter w_0 allows for any fixed offset in the data. We extend the class of models by considering linear combinations of fixed nonlinear functions of the input variables, of the form:

$$f(x) = w_0 \sum_{j-1}^{m-1} w_j\phi_j(x) \tag{2}$$

where $\phi_j(x)$ is known as basic functions. In the case of Linear Regression, $\phi_j(x) = 1$. By denoting the maximum value of the index j by $M-1$, the total number of parameters in this model will be M.

3.2 Polynomial Regression

Polynomial Regression is a more versatile algorithm as compared to Linear Regression, however, it is quite similar to too, the primary difference being that the basis function would be of the form:

$$\phi_j(x) = x^j \tag{3}$$

where the degree of the polynomial is $M - 1$. Depending on the value of M, we can have a Constant Polynomial ($M = 0$), First Order Polynomial ($M = 1$), Second Order Polynomial ($M = 2$) and so on. We choose the degree that best fits our training dataset.

3.3 Support Vector Regression

Support Vector Regression uses the same principles as the SVM for classification that is to find a hyperplane that separates the data in a multidimensional space with as maximal separation between the data points and hyperplane as possible. In Support Vector Regression, our goal is to find a () such that it has a deviation of at most , that is the errors are fine as long as they are within the limits of . We define our linear function as:

$$f(x) = wx + b \tag{4}$$

The main concern is to reduce the error. Which can be modelled as an optimization problem:

$$\min imixe \frac{1}{2} \left\| w^2 \right\| \tag{5}$$

Such that,

$$y_i - wx_i - b \leq \varepsilon \tag{6}$$

$$wx_i + b - y_i \leq \varepsilon \tag{7}$$

3.4 Decision Tree Regression

Decision Tree Regression uses a decision tree (as a predictive model) to go from observations about an item (represented in the branches) to conclusions about the item's target value (represented in the leaves). The most popular algorithm to build

the decision tree is the CART (Classification and Regression Trees) which uses the Gini Index as the metric:

$$Gini\ Index = 1 - \sum_{i=1}^{c} (p_i)^2 \tag{8}$$

where C, is the various classes and Pi is the probability of each class.

3.5 Random Forest Regression

Random Decision Forest is an ensemble learning method for regression, where a multitude of decision trees are constructed at training time and the mean prediction of the individual trees is outputted. It acts as a solution for the overfitting problem sometimes faced in Decision Tree Regression. The importance of each feature on a decision tree is calculated as:

$$norm\, fi_i = \frac{fi_i}{\sum\limits_{j\ \varepsilon\ all\ features} fi_j} \tag{9}$$

where *normfi* is the normalized importance of feature i and is the importance of feature i. Then feature importance values from each tree are normalized:

$$RFfi_i = \frac{\sum\limits_{j} norm\, fi_{ij}}{\sum\limits_{j\ \varepsilon\ all\ features\ k\ \varepsilon\ all\ trees} norm\, fi_{jk}} \tag{10}$$

where *RFfij* is the importance of feature i calculated from all trees in the Random Forest model.

4 Performance Evaluation

For all simulation purposes, we have used Python in Spyder (Scientific Python Development Environment), which is an open source integrated development environment (IDE) that is included with the Anaconda framework.

In order to stand by its definition, cognitive radio networks need to be armed with the capabilities of learning and reasoning. Moreover, it is not feasible for the channels to sense and search for channels, hence the need for self-learning arises. In order to couple learning in games, we need an effective dataset. In our work, we

have simulated such a game environment utilizing which, we obtained the optimal probability for a given number of networks ($N_{N)}$ and available channels ($N_{C)}$.

We simulate the Game Algorithm for various possible combinations of M and N ranging from 10–50 where $M \geq N$, which gives us a total of 820 datasets. Out of which 656 datasets are used for training and 164 are used for testing. The dataset is stored in a database with 3 columns, Number of Channels, Number of Networks and Optimal Probability of Switching (M, N, P_0).

In this work, we have proposed the use of five different regression algorithms: Simple Linear Regression, Polynomial Regression, Support Vector Regression, Decision Tree Regression, and Random Forest Regression.

Figure 3 illustrates the experimental values of the probability as obtained from the Game Algorithm. As read from the graph, the probability of switching drops as the number of competitors raises in the system.

Figure 4 depicts the results obtained from Linear Regression on Optimal Probability. The nature of the result is right however it is not the most optimal solution.

Alternatively, we implement Polynomial Regression - an algorithm quite similar to Linear Regression, but a bit more versatile. In this case, we have used a polynomial regression of degree 3 as it most advantageously fits our dataset. Figure 5 depicts the results obtained on performing Polynomial Regression.

Figure 6 depicts the Optimal Probability Vs Customers graph as obtained from Support Vector Regression using the 'rbf' kernel.

The results obtained from Decision Tree Regression are presented in Fig. 7. For unsurpassed results we have set the parameter 'max_depth' to 3 and 'random_state' to 0.

In Fig. 8 we represent the results obtained on performing Random Forest Regression. In order to fit the data accurately, we have set parameters 'n_estimators' to 100, and 'min_samples_leaf' to 2.

In Table 2 we have portrayed the numerical values of the optimal probability of switching for 10 networks retrieved from the experiment as well as using the

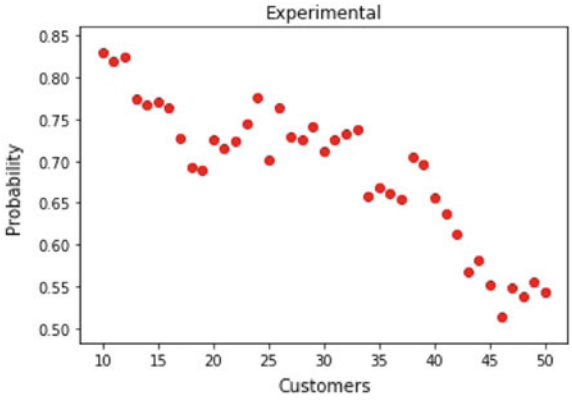

Fig. 3 Experiment – optimal probability vs customers

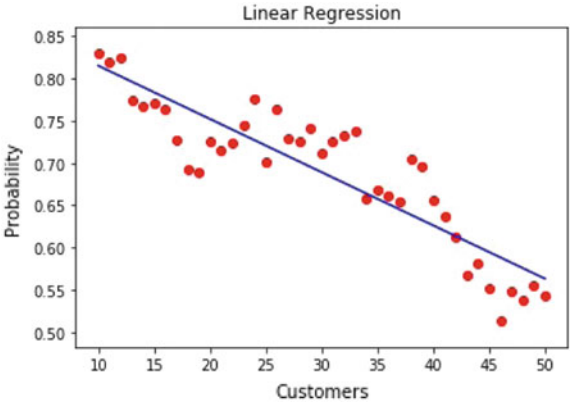

Fig. 4 Linear regression – optimal probability vs customers

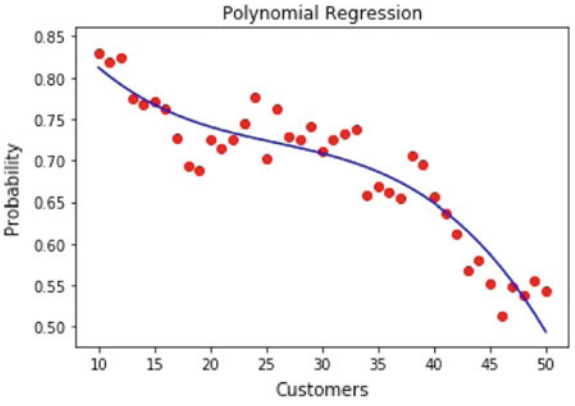

Fig. 5 Polynomial regression – optimal probability vs customers

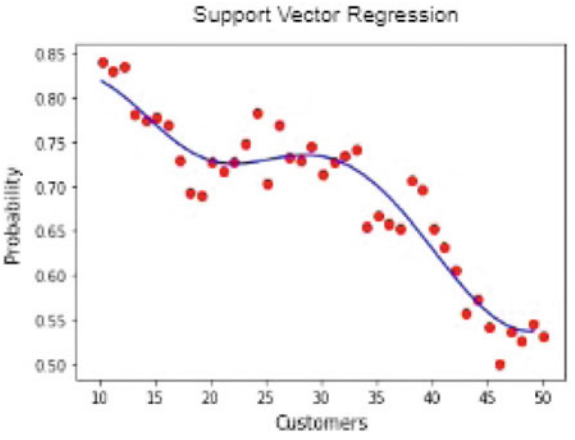

Fig. 6 Support vector regression – optimal probability vs customers

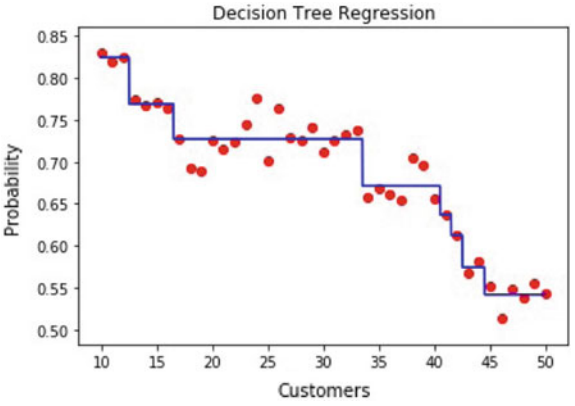

Fig. 7 Decision tree regression – optimal probability vs customers

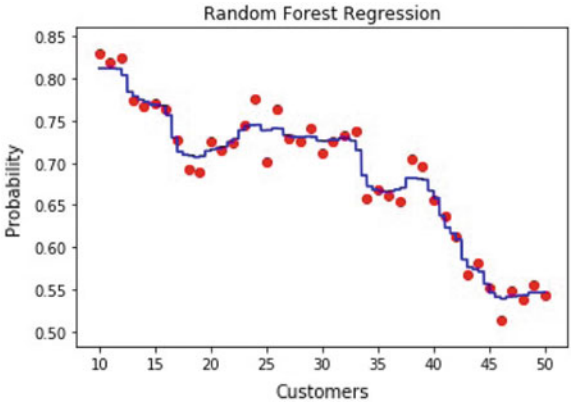

Fig. 8 Random forest regression – optimal probability vs customers

Table 2 Numerical Comparison between the probabilities as obtained from different strategies

	Exp	SLR	PR	SVR	DTR	RFR
10	0.8295	0.818	0.818	0.81	0.819	0.809
15	0.7708	0.788	0.759	0.743	0.77	0.7708
20	0.7247	0.758	0.742	0.721	0.727	0.715
25	0.7019	0.728	0.721	0.7291	0.727	0.7404
30	0.7114	0.698	0.71	0.7291	0.727	0.7254
35	0.669	0.668	0.689	0.7054	0.678	0.669
40	0.6557	0.638	0.662	0.637	0.678	0.6557
45	0.5519	0.608	0.578	0.548	0.535	0.5519
50	0.5433	0.578	0.492	0.551	0.535	0.5561

regression algorithms, with an interval of 5 customers. Furthermore, in order to analyse the efficiency of the five regression algorithms: Simple Linear Regression (SLR), Polynomial Regression (PR), Support Vector Regression (SVR), Decision

Table 3 Mean square errors of the proposed five regression algorithms

SLR	PR	SVR	DTR	RFR
0.00078	0.00052	0.00044	0.00024	0.00022

Table 4 Root mean square of the proposed five regression algorithms

SLR	PR	SVR	DTR	RFR
0.0280	0.0228	0.0210	0.0157	0.0150

Table 5 Comparison of mean quare error of various prediction algorithms

Existing		Proposed	
Linear	SVR	Linear	SVR
0.03345	0.181004	0.00078	0.00044

Tree Regression (DTR), and Random Forest Regression (RFR), we calculate their Mean Square Error using our dataset. This has been depicted in Table 3.

In [10] Linear Regression, Support Vector Regression and Elastic Net Regression were used as the predictive algorithms. However, in this work we have implemented Regression, Support Vector Regression, Decision Tree Regression, and Random Forest Regression. Moreover, as depicted in Table 4, this work has enhanced the results of Linear Regression by 97.7% and that of Simple Vector Regression by 99.8% when compared to [10] (Table 5).

In addition, [10] didn't support the case where the traffic of SUs surpasses the number of available channels. However, in this work with the use PRP M|M|1. Queuing Networks and IW-DR Scheduling Algorithm, this issue has been resolved.

5 Conclusion

In this paper, a dynamic non-cooperative game was implemented to help improve Dynamic Spectrum Allocation. In order to steer the traffic of Secondary Users, this work proposes the use of a PRP M|M|1 Queuing Network. Additionally, IW-DR Scheduling Algorithm was introduced to provide equality among the various classes of users in the queues. Further, in order to induce self-learning in our noncooperative game we propose the use of five different regression algorithms: Simple Linear Regression, Polynomial Regression, Support Vector Regression, Decision Tree Regression, and Random Forest Regression, and analyse and compare their results along with the existing work.

References

1. Mitola III J (2000) Cognitive Radio: An integrates Agent Architecture for Software Defined Radio. Doctoral Dissertation, KTH, Stockholm, Sweden
2. Mitola J III, Maguire GQ Jr (1999) Cognitive radio: making software radios more personal. IEEE Pers Commun 6(4):13–18
3. Costlow T (2003) Cognitive radios will adapt to users. IEEE Intell Syst 18(3):7
4. Jayaweera SK, Christodoulou CG (2011) Radiobots: Architecture, algorithms and real time reconfigurable antenna designs for autonomous, self-learning future cognitive radios. University of New Mexico, Technical Report EECE-TR-11-0001
5. Song C, Zhang Q (2010) Intelligent dynamic spectrum access assisted by channel usage prediction. In: IEEE Communications Society
6. Krishnamurthy V (2009) Decentralized spectrum access amongst cognitive radios - an interacting multivariate global game-theoretic approach. IEEE Trans Signal Process 57 (10):3999–4013
7. Han Z, Zheng R, Poor H (2011) Repeated auctions with Bayesian nonparametric learning for spectrum access in cognitive radio networks. IEEE Trans Wirel Commun 10(3):890–900
8. Jayaweera SK, Li T (2009) Dynamic spectrum leasing in cognitive radio networks via primary-secondary user power control games. IEEE Trans Wirel Commun 8(6):3300–3310
9. Jayaweera SK, Vazquez-Vilar G, Mosquera C (2010) Dynamic spectrum leasing: a new paradigm for spectrum sharing in cognitive radio networks. IEEE Trans Veh Technol 59 (5):2328–2339
10. Thapaliya A, Sengupta S (2017) Understanding the feasibility of machine learning algorithms in a game theoretic environment for dynamic spectrum access. In: SumerSim-SPECTS, Bellevue, Washington, USA
11. Sengupta S, Chandramouli R, Brahma S, Chatterjee M (2008) A game theoretic framework for distributed self-coexistence among IEEE 802.22 networks. In: IEEE Conference and Exhibition Global Telecommunications (GLOBECOM), pp 1–6
12. Huang D, Miao C, Miao Y, Shen ZI (2009) A game theory approach for self-coexistence analysis among IEEE 802.22 networks. In: 7th International Conference onInformation, Communications and Signal Processing, pp 1–5
13. Zakariya AY, Rabia SI (2016) Analysis of an interruption-based priority for multi-class secondary users in cognitive radio networks. In: IEEE ICC 2016 - Cognitive Radio and Networks Symposium, pp 1–6
14. Zhang Y, Jiang T, Zhang L, Qu D, Peng W (2013) Analysis on the transmission delay of priority-based secondary users in cognitive radio networks. In: International Conference on Wireless Communications and Signal processing, pp 1–6
15. Neel J, Reed JH, Gilles RP (2002) The role of game theory in analysis of software radio networks. In: Proceeding of the SDR 02 Technical Conference and Product Exposition, pp 1–7

Classification Accuracy Comparison for Imbalanced Datasets with Its Balanced Counterparts Obtained by Different Sampling Techniques

Tilottama Goswami and Uponika Barman Roy

Abstract Machine learning (ML) is accurate and reliable in solving supervised problems such as classification, when the training is performed appropriately for the predefined classes. In real world scenario, during the dataset creation, class imbalance may arise, where one of the classes has huge number of instances while the other class has very less in numbers. In other words, the class distribution is not equal. Such scenarios results in anomalous prediction result. Handling of imbalanced dataset is therefore required to make correct prediction considering all the class scenarios in an equal ratio. The paper mentions various external and internal techniques to balance dataset found in literature survey along with experimental analysis of four different datasets from various domains- medical, mining, security, finance. The experiments are done using Python. External balancing techniques are used to balance the datasets- two oversampling SMOTE and ADASYN techniques and two undersampling Random Undersampling and Near Miss techniques. These datasets are used for binary classification task. Three machine learning classification algorithms such as logistic regression, random forest and decision tree are applied to imbalanced and balanced datasets to compare and contrast the performances. Comparisons with both balanced and unbalanced are reported. It has been found that undersample technique loses many important datapoints and thereby predicts with low accuracy. For all the datasets it is observed that oversampling technique ADASYN makes some decent prediction with appropriate balance.

Keywords Imbalanced datasets · Re-sampling techniques · Machine learning · SMOTE · ADASYN · Random Undersample and NearMiss- Implementation

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_5

1 Introduction

To work with any machine learning task, the understanding of the dataset is always recommended. Once the characteristic of the dataset is known the task of choosing appropriate algorithm becomes simple. The real time dataset population usually has unequal distribution of classes, as it depends on available case studies. For example, datasets used for supervised binary classification task, it may happen that the target class (say 0) has extremely high number of instances whereas the other class (say 1) has very low number of instances. Such kind of abnormal data distribution is called imbalanced data.

Datasets which classifies rare events are basically imbalanced. For example fraud data, theft data, pathogenic result data, finance data and etc. At such datasets, the rare events come in minority class whereas the rest of the data represents the majority class. To classify without taking the imbalance into account, it ends up giving excellent accuracy while training but is a disaster during testing phase with the rare event instances. This happens because the algorithm runs on the majority class neglecting the rare events. To handle such imbalance data, methods are found in literature survey to handle the imbalanced dataset [1–3]. There are two types of methods- internal [3] and external [4] as shown in Fig. 1. The external methods are the techniques implemented at the data level before running any algorithm on it. The internal methods are the algorithm level implementation where it improves the efficiency of the algorithm.

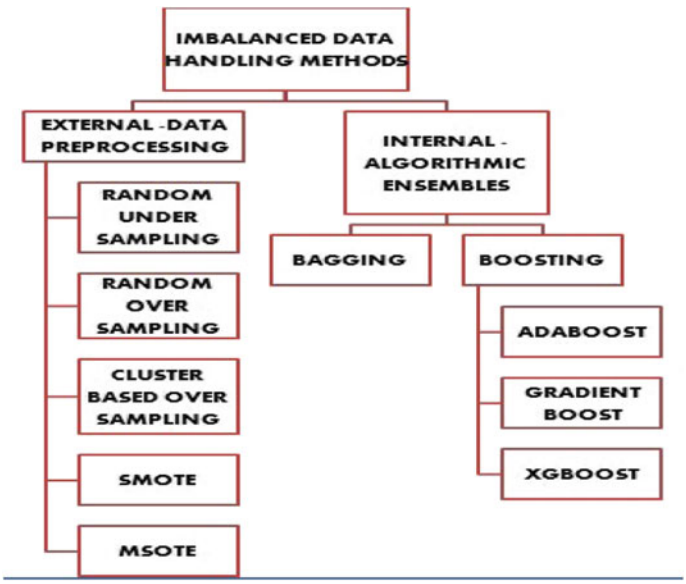

Fig. 1 Flowchart to represent imbalanced data handling methods

The paper is organized as follows. Section 2 discusses the external methods of handling the data imbalance; the Sect. 3 discusses the internal methods of handling the data imbalance. The Sect. 4 of the paper discusses four case studies of four different imbalanced datasets from various domains, and how to balance with the implementation of Synthetic Minority Oversampling Technique (SMOTE), Adaptive Synthetic Sampling Approach (ADASYN), Random Under sampling and Near Miss undersampling. The Sect. 5 briefly analyzes the result obtained from the ML classification tasks implemented on the imbalanced dataset as well as the balanced dataset. Finally the last sixth section concludes the paper.

2 Imbalance Data Handling: External Methods

There are several ways of handling the imbalanced data. External process is one which performs the data preprocessing before running the algorithm on it. In data preprocessing, the data is re-sampled, i.e., the minority class instances are over-sampled or the majority class instances are under sampled [2, 3]. The five techniques are as follows –:

2.1 Random Under Sampling

To classify the rare events, the majority class instances undergoes the under sampling. The technique of under sampling takes limited number of instances of the majority class randomly which equals the number of minority class instance exists. This gives the equal distribution of both the classes. Though it gives improved run time but it may eliminate some important features as it randomly picks the instances. This results in a low accuracy model [3].

2.2 Random Oversampling

In this method the minority class instances are duplicated randomly to expand its frequency. Thereby it matches to the number of majority class instances. To do this, it does not go through any missing of important data rather it duplicates but it over fits the likelihood [3, 5].

2.3 Clustering Based Oversampling

This is an oversample technique which follows the K means clustering algorithm. Considering the value of K it finds the centroid and makes the various clusters. Each of the clusters of respective classes are oversampled into equal number of instances. But the centroid calculation is very significant and any changes in the calculation may affect the clustering [6].

2.4 Synthetic Minority Oversampling Technique (SMOTE)

The traditional method of random oversampling replicates the minority class instances thereby leads to the over fitting problem. To eliminate such condition, instead of replicating samples SMOTE helps in generating synthetic samples of the minority class. This enhances the accuracy of the model.

SMOTE which has different number of generated synthetic samples based on density distribution is termed as *Adaptive Synthetic Sampling Approach (ADASYN).* This adaptive SMOTE generates different number of synthetic samples for each minority class instance [3].

Similarly, there are two types of SMOTE as Borderline SMOTE and Safe Level Smote. The borderline instances are more significant to make any kind of classification. Therefore oversampling the borderline instances of the minority class is a good approach in preprocessing the data [7].

Safe Level SMOTE is the method which gives some safe level value to the rare event instances so that it generates synthetic samples within a safe zone. This safe level value is always near the K nearest neighbors. If the value reads approximately zero, the instance is eliminated as noise else if it is near to the K value the instance is safe [3, 7].

2.5 Modified Synthetic Minority Oversampling Technique (MSMOTE)

This is a modified approach of SMOTE. In this technique it does not focus into the minority class internal distribution. Measuring the distances among the samples of the minority class, it segregates them into Safe sample, border sample and noise sample. The samples that aid the performance of the classification are categorized as safe sample. The samples that effects the performance of the classification negatively is taken as noise sample. Rest samples are the border line samples [8].

The technique picks up the samples randomly from the K nearest neighbors for the safe samples, it picks up from the nearest neighbors for the borderline samples

and neglects the noise samples. Then it follows the same strategy as that of the SMOTE discussed above.

3 Imbalance Data Handling: Internal Methods

In this section, the paper deals with the imbalance data handling at the algorithm level, i.e., post to data level. Unlike previous section the data preprocessing is not required rather the classification algorithms modify their existing performance. This method builds a two level classifier from the data level and then aggregates their accuracy. It is categorized into Bagging and Boosting.

3.1 Bagging Ensemble

This method help in diminishing the over fitting by separately training two level bagging classifiers and then aggregating. This is the abbreviation of Bootstrapped Aggregation. Each of the classifiers acts on the original data with 'N' times replacement and gets trained. The two types of Bagging are Under Bagging and Over Bagging. The under bagging is simply a combination of under sampling and bagging whereas over sampling is the combination of over sampling and bagging. Both the techniques sample the minority class and majority class using Bootstrap process [4].

3.2 Boosting Ensemble

Boosting ensemble aims at "boosting" or improving the weak learners into a strong learner. Here also there are two stages of classifications, for the weak learners and then for the strong learners. It is again categorized into AdaBoost, Gradient Tree boost and XG boost [4, 9].

Adaptive Boosting Ensemble (ADA-BOOST)- This is the most traditional boosting technique. Initially it trains all the instances with equal weights. After training the learners, those which turn out difficult to classify are given extra focus by the ensemble in the next level. Each time the loop iterates weights are increased to give more focus on the weaker learners.

Gradient Tree Boosting Ensemble- Gradient Tree Boosting works like the ADA-BOOST that it improves the weak learners into the strong learners. But the difference lies in the methods they follow.

Gradient Tree follows the Decision tree classifier. It makes the initial learners, predicts the dataset and then calculates the loss. Depending on the loss it builds the next improved training set and the cycle repeats [9].

Extreme Gradient Boost Ensemble (XG-BOOST)- This is the modified structure of the Gradient Boosting Ensemble. This is faster and flexible. The data preprocessing like missing value handling or data evaluation is its intrinsic property. This method give a backward pruning unlike the traditional boosting method and thereby eliminates the over fitting entirely. The major success of XG-BOOST is because of its scalability. It works ten times faster than traditional gradient tree. This scalability is the result of various advanced optimization techniques in its algorithm [9, 10].

4 Case Studies

The case studies are done on four different datasets- Santender financial dataset and credit card fraudulent dataset obtained from Kaggle competition, seismic bumps dataset and breast cancer dataset from UCI repository [11–14]. All the datasets are imbalanced at different ratios. The oversampling techniques (SMOTE and ADASYN) and undersampling techniques (Random Undersampler and Near Miss) are applied on each of the dataset. The performance analysis is reported using the classification algorithms like Logistic Regression, Random Forest Classifier and Decision Tree Classifier for all the techniques applied to all four distinct datasets from various domains.

5 Result Analysis

It is seen experimentally that the datasets (from four different domains) gives relatively lower accuracy when undersampled while balancing. This infers that while undersampling the datapoints are eliminated which lose the important values. This results in lower accuracy while prediction.

This experiment is executed on Santender financial dataset of 200,000 attributes and 201 features. This dataset is having an imbalance ratio of 9:1. Figure 2 shows how the sampling techniques balances the data and its performance change is observed (Tables 1 and 2).

Table 1 Santender financial data

Classification methods	Unbalanced dataset	External methods for balancing			
		SMOTE	ADASYN	Random	Near Miss
LR	90.39	78.75	68.07	77.75	78.86
RF	89.9	86.38	99.652	78.46	74.015
DT	83.54	70.69	100	67.51	62.94

LR: Logistic Regression, RF: Random Forest, DT: Decision Tree

Table 2 Fraud credit card data

Classification methods	Unbalanced dataset	External methods for balancing			
		SMOTE	ADASYN	Random	Near Miss
LR	99.91	98.72	97.68	97.28	76.05
RF	99.94	99.94	99.98	97.69	58.02
DT	99.76	99.76	100	91.89	35.09

LR: Logistic Regression, RF: Random Forest, DT: Decision Tree

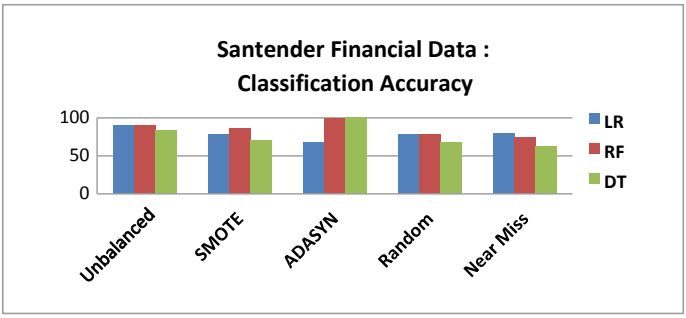

Fig. 2 Bar chart to represent the performance of sampling techniques on Santender dataset

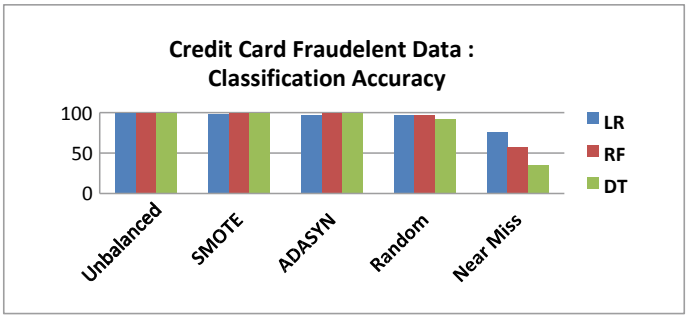

Fig. 3 Bar chart to represent the performance of Sampling techniques on credit card dataset

Table 3 Breast cancer dataset

Classification methods	Unbalanced dataset	External methods for balancing			
		SMOTE	ADASYN	Random	Near Miss
LR	84.48	72.41	67.2	62.06	65.51
RF	70.68	70.68	96.55	81.03	75.86
DT	70.69	67.24	98.22	81.034	82.75

LR: Logistic Regression, RF: Random Forest, DT: Decision Tree

Table 4 Seismic bumps dataset

Classification methods	Unbalanced dataset	External methods for balancing			
		SMOTE	ADASYN	Random	Near Miss
LR	99.91	98.72	97.68	97.28	76.05
RF	99.94	99.94	99.98	97.69	58.02
DT	99.76	99.76	100	91.89	35.09

LR: Logistic Regression, RF: Random Forest, DT: Decision Tree

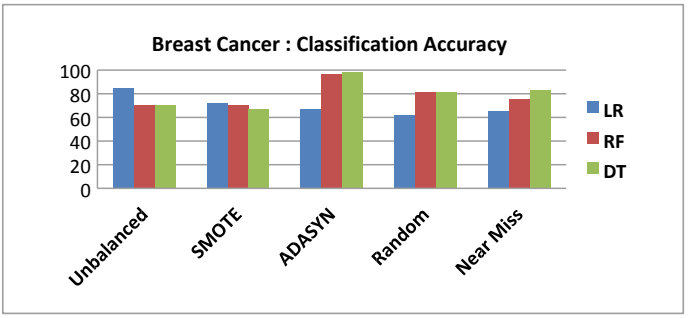

Fig. 4 Bar chart to represent the performance of sampling techniques on breast cancer dataset

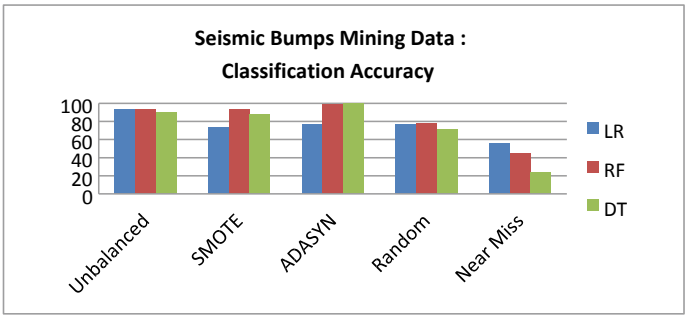

Fig. 5 Bar chart to represent the performance of sampling techniques on Seismic dataset

This experiment is executed on a fraud credit card dataset of 284, 807 attributes and 30 features. This dataset is having an imbalance ratio of 577:1. Figure 3 chart shows how the sampling techniques balances the data and its performance change is observed (Tables 3 and 4).

Another experiment is executed on a breast cancer dataset of 286 attributes and 9 features. This dataset is having an imbalance ratio of 2.4:1. Figure 4 chart shows how the sampling techniques balances the data and its performance change is observed.

The next experiment is executed on a seismic bumps dataset of 2584 attributes and 19 features. This dataset is having an imbalance ratio of 14:1. Figure 5 chart shows how the sampling techniques balances the data and its performance change is observed.

6 Conclusion and Future Work

In this paper the data class imbalance concept and its handling methods both at the data level and algorithm level techniques are discussed. The paper also demonstrates the implementation of SMOTE, ADASYN, Random Undersampling and Near Miss on four real time data from various sectors. The internal and external methods along with their sub categories give a clear light on what kind of method is to be applied at data level and that for the algorithm level. It has been found that undersample technique loses many important datapoints and thereby predicts with low accuracy. For all the datasets it is observed that oversampling technique ADASYN makes some decent prediction with appropriate balance. The paper aims at future to deal with the combination of data preprocessing and algorithm ensemble techniques along with comparative study with various performance metrics.

References

1. Mitchell T (1997) Machine Learning. McGraw Hill, New York ISBN 0070428077
2. Furundžić D, Stanković S, Dimić G (2014) Error signal distribution as an indicator of imbalanced data. In: 12th Symposium on Neural Network Applications in Electrical Engineering (NEUREL), pp 189–194
3. Gosain A, Sardana S (2017) Handling class imbalance problem using oversampling techniques: a review. In: 2017 International Conference on Advances in Computing, Communications and Informatics (ICACCI), Udupi, pp 79–85. https://doi.org/10.1109/icacci.2017.8125820
4. Li C (2007) Classifying imbalanced data using a bagging ensemble variation (BEV). pp 203–208. https://doi.org/10.1145/1233341.1233378
5. Shukla P, Bhowmick K (2017) To improve classification of imbalanced datasets. In: 2017 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), Coimbatore, pp 1–5. https://doi.org/10.1109/iciiecs.2017.8276044

6. Santos MS, Abreu PH, García-Laencina PJ, Simão A, Carvalho A (2015) A new cluster-based oversampling method for improving survival prediction of hepatocellular carcinoma patients. J Biomed Inform 58. https://doi.org/10.1016/j.jbi.2015.09.012. ISSN 1532–0464
7. Wang J, Xu M, Wang H, Zhang J (2006) Classification of imbalanced data by using the SMOTE algorithm and locally linear embedding. In: IEEE 2006 8th international Conference on Signal Processing, Guilin, China, 16–20 November 2006. https://doi.org/10.1109/icosp.2006.345752
8. Hu S, Liang Y, Ma L, He Y (2009) MSMOTE: improving classification performance when training data is imbalanced. pp 13–17. https://doi.org/10.1109/wcse.2009.756
9. Gao X et al (2017) An improved XGBoost based on weighted column subsampling for object classification. In: 2017 4th International Conference on Systems and Informatics (ICSAI), Hangzhou, pp 1557–1562. https://doi.org/10.1109/icsai.2017.8248532
10. Dubosson F, Bromuri S, Schumacher M (2016) A python framework for exhaustive machine learning algorithms and features evaluations. In: 2016 IEEE 30th International Conference on Advanced Information Networking and Applications (AINA), Crans-Montana, pp 987–993. https://doi.org/10.1109/aina.2016.160
11. https://www.kaggle.com/c/santander-customer-transaction-prediction/data
12. https://www.kaggle.com/mlg-ulb/creditcardfraud
13. https://archive.ics.uci.edu/ml/machine-learning-databases/00266/
14. https://archive.ics.uci.edu/ml/machine-learning-databases/breast-cancer/

CNN Model for American Sign Language Recognition

Tilottama Goswami and Shashidhar Reddy Javaji

Abstract This paper proposes a model based on convolutional neural network for hand gesture recognition and classification. The dataset uses 26 different hand gestures, which map to English alphabets A–Z. Standard dataset called Hand Gesture Recognition available in Kaggle website has been considered in this paper. The dataset contains 27,455 images (size 28 * 28) of hand gestures made by different people. Deep learning technique is used based on CNN which automatically learns and extracts features for classifying each gesture. The paper does comparative study with four recent works. The proposed model reports 99% test accuracy.

Keywords Deep learning · Convolutional Neural Networks · American Sign Language · Gesture recognition

1 Introduction

Nearly 5% of the world's population is said to be hearing impaired, this creates a major problem for the communication with the deaf and the dumb, specially abled persons. To decrease the communication gap between hearing impaired community and the normal persons, ideas have evolved over the years based on technology. The National Institute on Deafness and Other Communications Disorders (NIDCD) indicates that the 200-year-old American Sign Language is a complete, complex language (of which letter gestures are only part) but is the primary language for many deaf North Americans. ASL consists of approximately 6000 gestures of common words which help deaf people to communicate; finger spellings use one hand and 26 gestures to communicate the 26 letters of alphabets. The evolution of

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_6

machine learning and its application has been increasing rapidly in the present decade. Convolutional Neural Networks (CNN) is popularly used to train machines to recognize and classify images. The paper is divided into 5 sections. Section 2 discusses related work, Sect. 3 puts forth the proposed methodology. Section 4 details out the experiment and result analysis. Finally the paper concludes with future work in Sect. 5.

2 Related Work

It can be found from the literature survey that the solution to this problem statement has evolved from 70's till date. Mostly the earlier solutions were based on Human Computer Interaction (HCI).

Gloves
First work was started by the MIT in the year 1977 [1] called the Sayre glove. Zimmerman has developed Data glove in the year 1982, more advancements were made to it in which light tubes were removed and replaced by fiber optics. A better system in gloves were released which includes Power Glove, Super Glove, P5 Glove (2002). All these works were purely based on sensors and mostly come under HumanComputer Interaction (HCI) systems.

Microsoft Kinect
American Sign Language (ASL) is recognized as the most used sign language when compared to many other languages [2], which include British Sign Language (BSL), Korean Sign Language (KSL), Chinese Sign Language (CSL). Microsoft Kinect [3] is one of the works which has used ASL. Hand joint constraints and perpixel classifications were taken as the main criteria for recognition. This work was further advanced with CNN and a new model was built in the year 2014 by Lionel Pigou [4], but experimented with Italian sign language instead of ASL and obtained an accuracy of 91.7%. Similar work also can be found in the paper [5].

Video-Based
The author in [6] has used Latent space hierarchical attention network (LSHAN) which is an advancement of Long Short Term Memory (LSTM). It has been used for video-based sign recognition for German Sign Language and CSL for classification. When Recurrent CNN and LS-HAN are applied on Continuous SLR on RWTH-PHOENIX-Weather it was observed that LS-HAN performed better than CNN for that particular dataset, LS-HAN has given an accuracy of 0.616 where as Recurrent CNN was able to give only 0.613. Similarly OpenNI and Depth Image was applied in different works [7].

Convolutional Neural Network
After the emergence of Convolutional neural networks, many works have been done on this problem till date [10–12]. In one of the works the author has taken

ASL language consisting of Aa-Bb and also 1 to 10 digits [8]. Inception v3 [9], is another version of image classification which is similar to CNN but instead of layers like convolutional, pooling and softmax being on top of one another, the layers are made to run parallel to one another. Principal Component Analysis has been used for recognition of the images.

3 Proposed Methodology

This section will discuss the proposed methodology, techniques, datasets used. The dataset for this work is taken from the open-source website, the dataset is called as the Sign-language MNIST [13], available on Kaggle. The dataset is patterned to match with the classic MNIST. Each training and test case represents a label (0–25) as a oneto-one map for each alphabetic letter A–Z (and no cases for J = 9 or Z = 25 because of gesture motions).

A train-test split ratio of 0.2 is applied for the given dataset. A random_state seed is used so the randomness of the results can be duplicated. The function will rearrange the images to reduce training loss.

Convolutional Neural Networks is chosen as the deep learning methodology for the development of this model. Four convolutional layers are added to this model along with Max pooling layer. Batch Normalization is used to accelerate and make the network stale during the training of deep neural networks. This may require the use of much larger than normal learning rates, which may further speed up the learning process. Batch normalization offers some regularization effect, reducing generalization error, conceivably no longer requiring the use of dropout for regularization. CNN's use a range of filters to the raw pixel data of an image to extract and acquire higher-level features, which the model can then utilize for classification. CNN's includes three segments: Convolutional layers, which employ a particularized number of convolution filters to the image. For each sub region, the layer performs a set of mathematical processes to produce a single mark in the output feature map. Convolutional layers then typically implement a ReLU activation function to the output to inject nonlinearities into the model. Pooling layers, which down sample the image data extracted by the convolutional layers to reduce the dimensionality of the feature map to reduce processing time. A regularly used pooling algorithm is max pooling, which extracts sub regions of the feature map, keeps their greatest value, and discards all other values. Dense or fully connected layers perform classification on the features extracted by the convolutional layers and is down sampled by the pooling layers. In a dense layer, every node in the layer is joined to every other node in the previous layer.

When compiling the model, categorical_crossentropy is chosen as the loss function and Adam optimizer.

- The cross-entropy loss determines the error rate between the predicted value and the real value. Categorical is used because there are 25 classes to predict from.
- The Adam optimizer is an elevation over Simple Gradient Descent. The optimizer is accountable for updating the weights of the neurons via back propagation. It measures the derivative of the loss function concerning each weight and decreases it from the weight.

Now that the model has been compiled and trained, a check was done if it's good. First, train accuracy was computed and then test accuracy.

4 Experiment and Result Analysis

The CNN model description of input and output layers can be visualized as follows as seen in Table 1. The experiments are carried out using Python and Keras library.

Table 1 Architecture of CNN model

Layer (type)	Output shape	Param #
conv2d_1 (Conv2D)	(None, 26, 26, 32)	320
batch_normalization_1 (Batch)	(None, 26, 26, 32)	128
conv2d_2 (Conv2D)	(None, 24, 24, 32)	9248
batch_normalization_2 (Batch)	(None, 24, 24, 32)	128
max_pooling2d_1 (MaxPooling2D)	(None, 12, 12, 32)	0
conv2d_3 (Conv2D)	(None, 10, 10, 64)	18,496
batch_normalization_3 (Batch)	(None, 10, 10, 64)	256
max_pooling2d_2 (MaxPooling2D)	(None, 5, 5, 64)	0
conv2d_4 (Conv2D)	(None, 3, 3, 128)	73,856
max_pooling2d_3 (MaxPooling2D)	(None, 1, 1, 128)	0
flatten_1 (Flatten)	(None, 128)	0
dense_1 (Dense)	(None, 128)	16,512
dense_2 (Dense)	(None, 25)	3225

Total params: 122,169
Trainable params: 121,913
Non-trainable params: 256

Layers

```
conv1 = Sequential() conv1.add(Conv2D(32,
kernel_size=(3,3),activation = 'relu
', input_shape= input_shape ))
conv1.add(BatchNormalization())

conv1.add(Conv2D(32, kernel_size=(3,3),activation = 'relu
' ))
conv1.add(BatchNormalization())
conv1.add(MaxPooling2D(pool_size = (2,2)))
#conv1.add(Dropout(0.2))

conv1.add(Conv2D(64, kernel_size=(3,3),activation = 'relu
' )) conv1.add(BatchNormalization())
conv1.add(MaxPooling2D(pool_size =
(2,2)))
#conv1.add(Dropout(0.2))
 conv1.add(Conv2D(128, kernel_size=(3,3),activation =
'rel u' )) conv1.add(MaxPooling2D(pool_size = (2,2)))
 conv1.add(Flatten())
conv1.add(Dense(128,activation = 'relu'))
conv1.add(Dense(25, activation = 'softmax'))
```

Regularization Function

```
history1=conv1.fit_generator(batches,steps_per_epoch=2196
4//128,epochs=30,validation_data=val_batches,validation_s
teps=5491//128, use_multiprocessing=True)
```

Parameters

Activation Function: 'Relu',
Number of convolutional layers: 4,
Epochs: 30,
Batch Size:256,
Regularization function,
Test Accuracy:99.3%.

Table 2 Accuracy comparisons with related works

Method	Test Accuracy
Microsoft Kinect [3]	0.92
LS-HAN [9]	0.616
Inception v3 [12]	0.90
CNN with Image processing [11]	0.95
Proposed Methodology	**0.99**

Result Analysis

The proposed model increased the final layer filter value from 128 to 256 and also increased the number of epochs from 10 to 50. The test accuracy has been increased 94 to 97%. By changing the filter of the dense layer from 128 to 256 there has been a slight decrease of around 0.5% in the accuracy of the model. Total parameters increased from 311,737 to 446,137 by changing the value of the dense layer. By using sigmoid as activations function instead of Relu, has decreased the value of accuracy of the model. Relu proved to be better activation function than sigmoid as shown by many experiments. When epochs were increased to 70 the accuracy has gone down to 95%, the main reason being over fitting. At last by using regularization, after normal training of the model, achieved a test accuracy of 99%, which shows that regularization helps in increasing the accuracy in this model after normal training of the model.

When compared to the Glove-based works, Video Based works, Microsoft Kinect and other related works, the accuracy of the proposed model proved to be better. It is also cost effective when compared with Glove Based technology, Microsoft Kinect and Video Based works as referred in Table 2.

5 Conclusion and Future Work

The paper contributes a improved CNN model which has given better accuracy in gesture recognition based on American Sign Language. The authors have compared with 4 previous works and found the proposed methodology produces best accuracy. In future, the work can be taken to next dimension to be more interactive by capturing the live video and display the results on the screen, thereafter convert to speech. Different datasets for sign languages can be further tested with the proposed method.

References

1. Premaratne P (2014) Human Computer Interaction Using Hand Gestures, vol XV, pp 158–174. ISBN 978-981-4585-68-2
2. Hiddinga A, Crasborn O (2011) Signed languages and globalization. Lang Soc 40(4):483–505
3. Dong C (2015) American sign language alphabet recognition using Microsoft Kinect. Masters Thesis, 7392. https://scholarsmine.mst.edu/masters_theses/7392
4. Pigou L, Dieleman S, Kindermans P-J, Schrauwen B Sign language recognition using convolutional neural networks. In: European Conference on Computer Vision (ECCV 2014) Workshops. Springer, pp 572–578
5. Vishwas S, Hemanth Gowda M, Vivek Chandra HN Tannvi (2018) Sign language translator using machine learning. Int J Appl Eng Res 13(4):1–5 ISSN 0973-4562
6. Huang J, Zhou W, Zhang Q, Li H, Li W (2018) Video-based sign language recognition without temporal segmentation. In: 32nd AAAI Conference on Artificial Intelligence (AAAI-2018), New Orleans, Louisiana, USA, 2–7 February 2018. arXiv:1801.10111
7. Suarez J, Murphy RR (2012) Hand gesture recognition with depth images: a review. In: 2012 IEEE RO-MAN: The 21st IEEE International Symposium on Robot and Human Interactive Communication, Paris, France, 9–13 September 2012
8. Dia J, Patil D, Raut P, Lopes M (2019) Sign language interpretation using deep learning. IOSR J Eng (IOSRJEN) 09(4):17–25 ISSN (e) 2250-3021, ISSN (p) 2278-8719
9. Das A, Gawde S, Suratwala K, Kalbande D (2018) Sign language recognition using deep learning on custom processed static gesture images. In: 2018 International Conference on Smart City and Emerging Technology (ICSCET), 5 January 2018. ISBN 978-1-5386-1185-2
10. Ji Y, Kim S, Lee K-B (2017) Sign language learning system with image sampling and convolutional neural network. In: 2017 First IEEE International Conference on Robotic Computing, Taiwan, 10–12 April 2017. ISBN 978-1-5090-6724-4
11. Huang J, Zhou W, Li H, Li W (2015) Sign language interpretation using deep learning. In: 2015 IEEE International Conference on Multimedia and Expo (ICME), Italy, 29 June–3 July 2015. ISBN 978-1-4799-7082-7
12. Nagi J., Ducatelle F, Di Caro GA, Cireşan D, Meier U, Giusti A, Nagi F, Schmidhuber J, Gambardella LM (2011) Max-pooling convolutional neural networks for vision-based hand gesture recognition. In: 2011 IEEE International Conference on Signal and Image Processing Applications (ICSIPA2011), Malaysia, 16–18 November 2011. ISBN 978-1-4577-0242-6
13. https://www.kaggle.com/datamunge/sign-language-mnist

Power Quality Issues in Commercial Load - Impact and Mitigation Difficulties in Present Scenario

Karuna Nikum, Rakesh Saxena, and Abhay Wagh

Abstract Power quality in electric power grid and at consumer side network is a very significant contributing factor to the development of any country in terms of economics. It is essential to achieve this through maintaining the system power quality. The major division of loads categories are residential, commercial and industrial type. In this paper, a commercial load is taken as a case study and covering wide range of power quality issues related to harmonic distortions, low power factor, unbalancing, triplen harmonic current and high neutral current problems. In the era of growing mitigation techniques, it is very difficult to choose one and find best one. Depend on various parameters the best suitable solution is split capacitor shunt active power filter is proposed and validate with MATLAB simulation to verify the results. The impact and power quality issues in commercial load is ignored earlier but now it's time to pay attention on such type of loads to minimize the bills and other bad power quality dependent expenses. This case study offered a detailed power quality analysis and solution including economic analysis to go for easily and readily implementable with economical way out.

Keywords Power Quality · Commercial load · Harmonic distortion · Power factor · Triplen harmonic current · Neutral current

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_7

1 Introduction

Mostly all domestic and commercial loads uses three-phase four-wire system and has mixture of single phase and three phase loads includes electric appliances used in restaurants, shops, commercial complexes, offices, hospitals, education buildings, manufacturing facilities etc. [1, 2]. Commercial loads are one of the foremost sectors and affected due to poor power quality (PQ). The use of nonlinear loads affects the PQ of grid system [3, 4]. Both grid as well as users are affected by these generated disturbances by nonlinear loads across the system. There are considerable financial effects allied with poor PQ in terms of productivity loss, breakdowns, premature aging of the components, equipment failure, higher energy charges and above all there is always a risk of fire. The PQ and its mitigation techniques are playing very important role in future electricity network. This area require continuous process for research and development. The transition of load scenario will sooner results in a higher demand for PQ knowledge. In future, the PQ research demands different approaches from experiences. The active power filter (APF) technology is successfully developed for three phase three wire system.

Although three-phase four-wire active filters have been introduced in the 1980's but still research is required for commercial load [5]. Finally, the PQ and its existing mitigation techniques require fundamental as well as advanced research and development as per different loads in future. Further studies including new technology, research and innovations that were not present before introduction of large number of power electronic in existing network should be required. A significant aspect of PQ issues is to be alert of such phenomenon, their nature and its consequences. Good PQ increases efficiencies by saving your time and money, prolonging equipment life, increasing uptime and enhancing safety and compliance [6]. PQ issues, on the other hand, affects the efficiencies resulting in a reduction in profit margin of an organization below the bottom line. Generally, commercial load facing severe problems of excessive neutral current, harmonic currents and unbalancing [7, 8]. In such type of loads, PQ problems over and over again go ignored and overlooked with regular planned maintenance. The PQ complications and difficulties can produce major problems in following area:

- Industrial sector (process control system, safety systems, monitoring devices etc.)
- Public sector (educational buildings, medical facilities, police and air traffic control etc.)
- Business sector (banking sector, inventory and process control, offices etc.)

This types of loads create unbalancing and these unbalancing leads to voltage imbalance, losses, overloading, negative and zero sequence voltages are engenders into the system. If harmonic voltages in excess due to harmonic current from the recommended limits can results replacement of transformers, switchgear and lines at extortionate cost.

2 Problem Statement

A case study of a commercial building shopping mall has taken for harmonic study and its analysis. This shopping mall faces problem of unbalancing, tripping of circuit breaker and overheating of neutral. The system is having three phase, 440 V, 50 Hz supply and short circuit ratio provided by utility is below 20.

Performance measures and guidelines for electrical equipment compatibilities provided by professional standards, regulatory policies and utility procedures. So, as per IEEE-519 std., the maximum total demand distortion (TDD) allowed is 5%. The Table 1 gives type of PQ issues, consequences, mitigation techniques and their economy basis related to commercial load.

2.1 Measurement Results

For accurate assessment and analysis, a detailed PQ audit and monitoring has been done to find origin of the PQ problem. Complete measurements has carried out at all critical locations and recorded for longer duration of time to record number of happenings and period of each event. Measurement analysis were carried out to

Table 1 Commercial load PQ issues and their impact and mitigation

Type of PQ issues	Consequences	Mitigation technique	Cost
Triplen harmonics in neutral	Heating in neutral due to all triplen harmonics	Use large cross section area for neutral APF	Cheap but not longterm solution. Very High
Unbalancing in system	Failures in equipment's and Malfunctioning of protection	Passive power filter	Low (For selective harmonics elimination) Medium
Distortion in current/ voltage		Hybrid power filter	Dependent
Reduction in power factor (PF)	Extra Heating Losses in transformer and reduced PF	De-tuned APFC Use of APF with zigzag/T-type transformer as a grounding filter	Depend on cost of the transformer
		Proper Selection of transformer and its vector group	Reduce cost and size of filter, if properly selected

study the complete profile of voltage, rms current, total harmonic distortions (THD), power factor (PF) and individual predominating harmonics as per IEEE 519 std. This study helps to find safe or unsafe conditions for other electronic components at the showroom building. The measurements has taken at meter 2, 3 and 4 out of five due to the nature of load as given in Table 2.

At Meter 2: Power Quality Parameter Measurement
At meter 2, the rms current and THDi percentage varies from 52 to 62 are shown in Figs. 1 and 2 respectively. The PF vary from 0.85 to 0.87 and individual predominant harmonics third, fifth and seventh are shown in Figs. 3 and 4 respectively. The THDi level of fifth is 50% and seventh is 25%, which are very high and need immediate action to control or bring down to recommended level.

At Meter 3: Power Quality Parameter Measurement
At meter 3, the rms current and THDi percentage varies from 13 to 16 are shown in Figs. 5 and 6 respectively. The PF is around 0.98 and individual predominant harmonics third, fifth and seventh are shown in Figs. 7 and 8 respectively. Here third harmonics are very high around 8% to 10% that adds into neutral current causes overheating of neutral and yield troubled to the system. The seventh harmonics is below 3% and fifth harmonics is around 11% which crosses the limit.

At Meter 4: Power Quality Parameter Measurement
At meter 4, the rms current and THDi percentage varies from 60 to 65 are shown in Figs. 9 and 10 respectively. The P.F is around 0.7 and individual predominant harmonics third, fifth and seventh are shown in Figs. 11 and 12 respectively. The THDi level of fifth is 30% and seventh is 60%, which are very high and need immediate action to control or bring down to recommended level.

All measurement results shows the condition of unbalancing in loads. Current harmonics in phases and high neutral current due to installed mixed single and three phase loads. This building facing frequent PQ issues causing financial loss so they opt PQ audit to prevent losses. The voltage variations and voltage harmonics are within limits but the load current is highly unbalanced at all location specially at meter-3 So, an immediate efforts should be made to balance it first. Predominate harmonics of third, fifth and seventh orders are detected at different locations of

Table 2 Measurement locations

Meter no.	Type of load	Status
1	Fire fighting equipment load	No nonlinear load
2	VRV AC units	Readings taken
3	Lighting panel for all floors	Readings taken
4	120 kVA UPS load	Readings taken
5	Panel no.2, Common panel 1	No nonlinear load

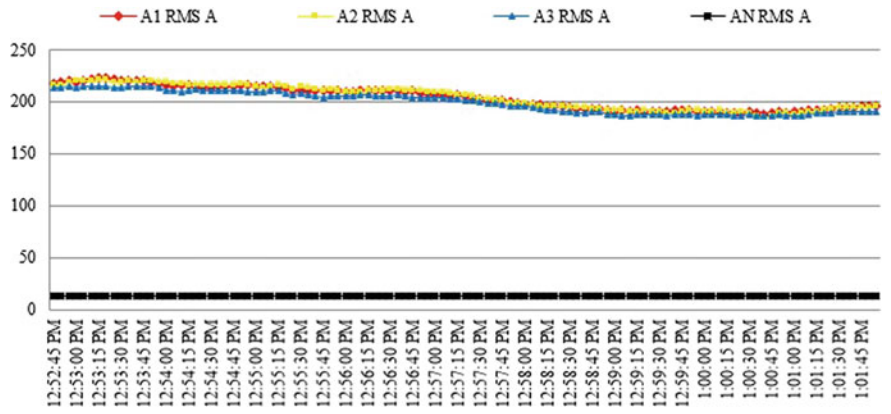


Fig. 1 RMS current

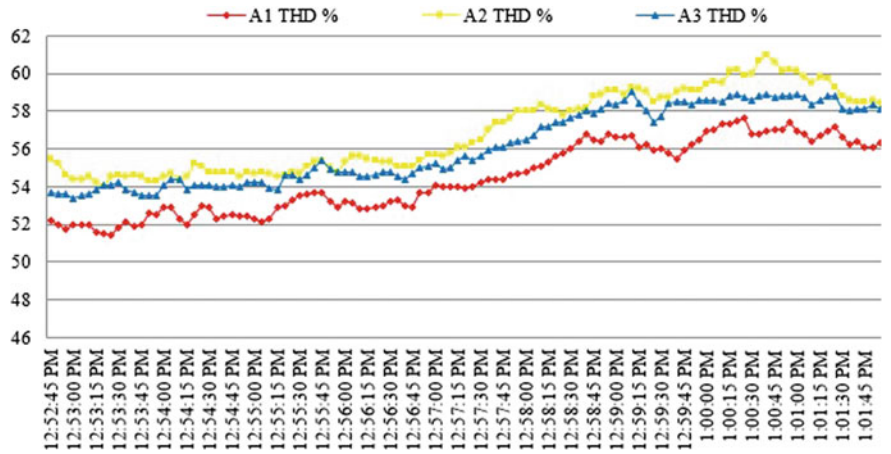


Fig. 2 THD (%) in current

measurements. All these observations with comparison of results are given below in Table 3.

In present scenario, many mitigation methods developed for PQ mitigation and the selection of best suitable technology is also become a complicated task because the performance and design of each technique is depend on characteristics of load [9]. The desirable solution and their cost comparision is given in Table 4. Some of the available solution for the commercial loads are listed below:

- APF
- Passive power filter
- Hybrid power filter (combination of active and passive filter)
- Use of APF (1-ϕ) with zigzag as a grounding filter with VSC (3-ϕ)

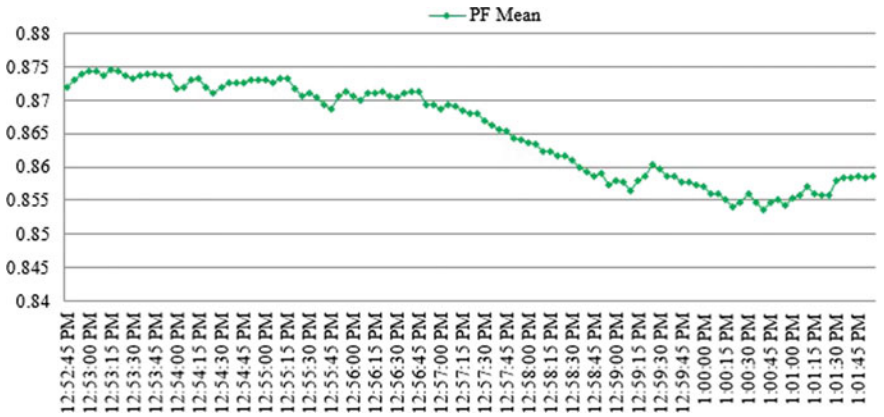


Fig. 3 Average P.F

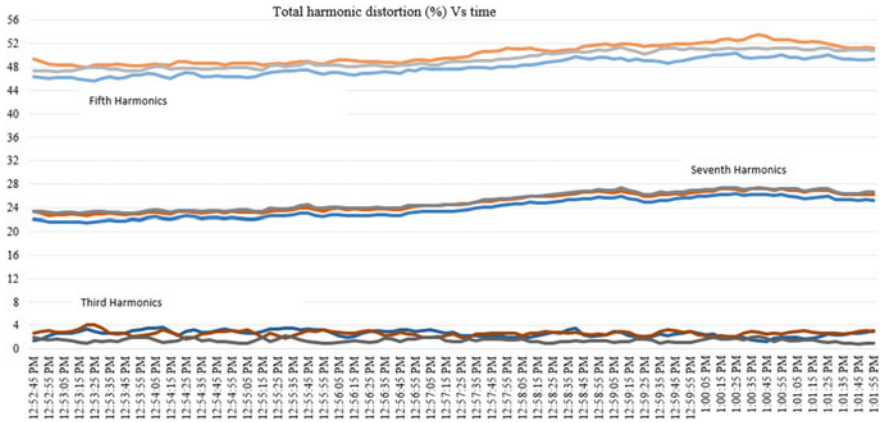


Fig. 4 Predominant harmonic levels in three phases

- Use of APF (1-ϕ) with T-type transformer as a grounding filter with VSC (3-ϕ)
- Use of APF (1-ϕ) with star delta transformer as a grounding filter with VSC (3-ϕ)
- Use of APF (1-ϕ) with star hexagon transformer as a grounding filter with VSC (3-ϕ)
- Selection of transformer and its vector group

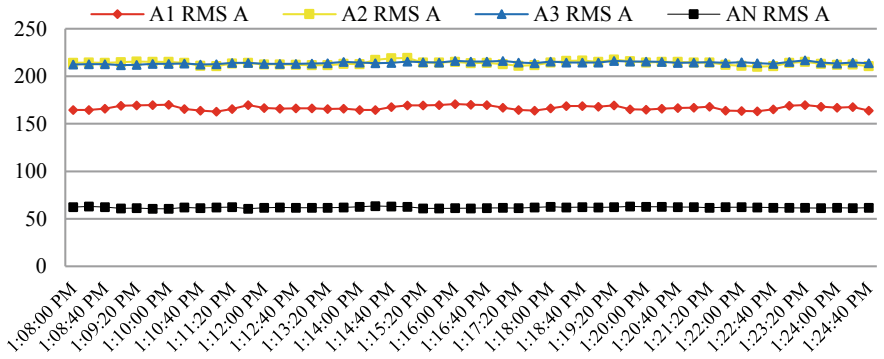


Fig. 5 RMS current

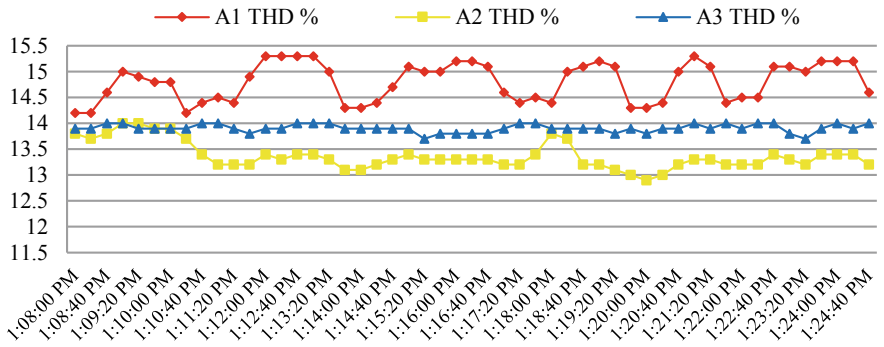


Fig. 6 THD (%) in current

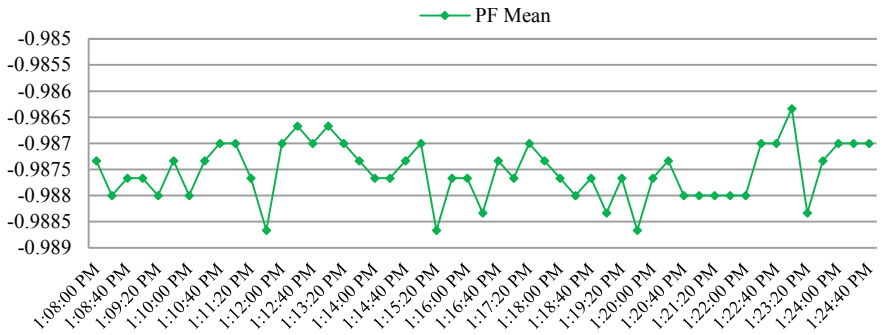


Fig. 7 Average P.F

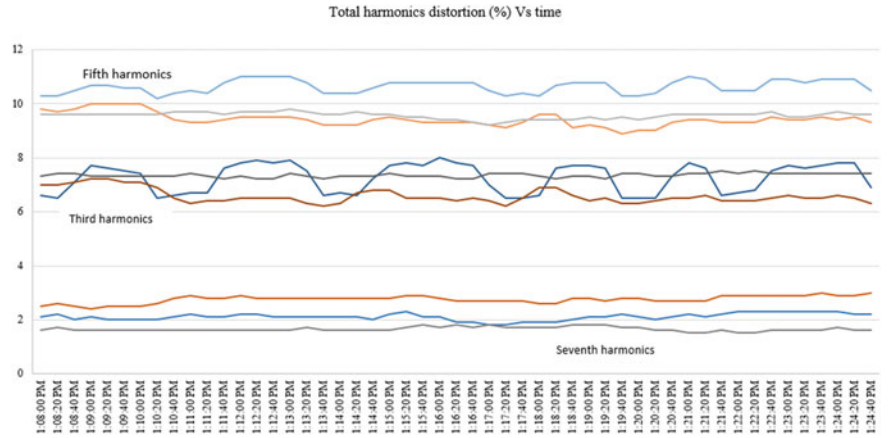


Fig. 8 Predominant harmonic levels in three phases

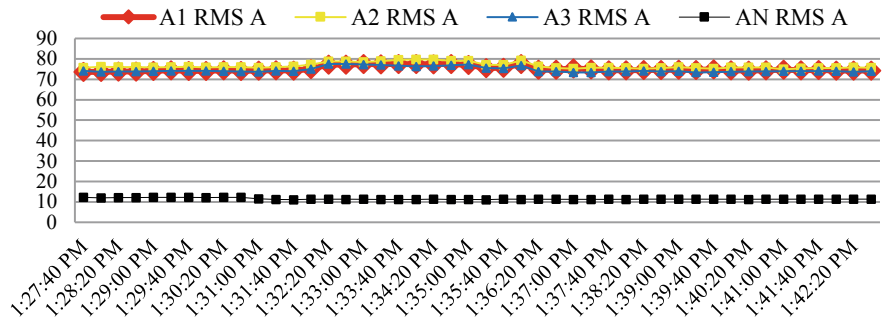


Fig. 9 RMS current

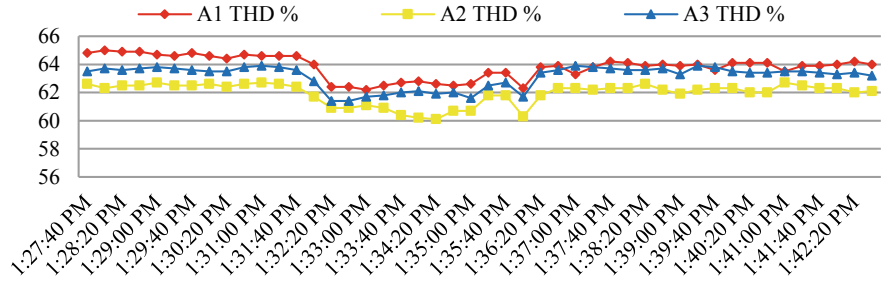


Fig. 10 THD (%) in current

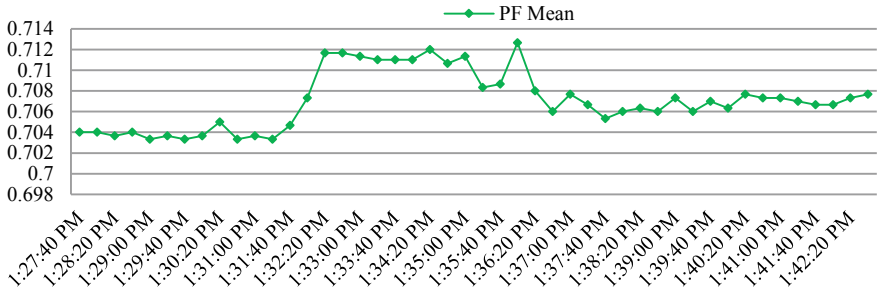


Fig. 11 Average P.F

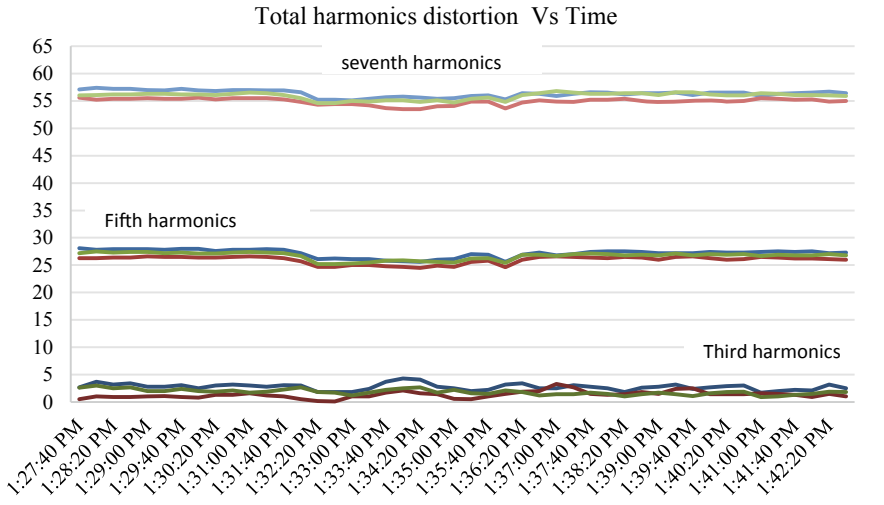


Fig. 12 Predominant harmonic levels in three phases

2.2 Proposed Solution

As per measured data, most of the PQ issues originate within a facility at meter no. 2, 3 and 4. Increasing the size of neutral is only give path to triplen harmonics even though other harmonics are remain in the circuit. The APF are still costly solution and required high maintenance and trained engineer in case of faults. Most of the industrial and commercial loads usually preferred passive solutions to save the initial cost as well as maintenance cost. For this case, passive filters are not feasible because it is observed that harmonic pattern includes other than predominated harmonics and all individual harmonics crosses recommended limit. To save the cost, hybrid solution is generally preferred. It has passive filter for predominant harmonics and for third active filter. It is a good choice but at the same time

Table 3 Comparative analysis of measured results

Measurement parameter	Meter no. 02	Meter no. 03	Meter no. 04
Third harmonics (%)	< 5	10	< 5
Fifth harmonics (%)	50	11	30
Seventh harmonics (%)	26	< 4	60
Ninth harmonics (%)	1	3	1
Eleventh harmonics (%)	6	4	9
Thirteen harmonics (%)	5	4	8
P.F	0.85 lag	−0.98 lead	0.71 lag
THD (%)	62	16	65
Neutral current (Amp)	20	80	18
Fundamental current (Amp)	$I_{R=}$ 180, I_B = 175 I_Y = 178,	I_R = 212, I_B = 165, I_Y = 210, (Highly unbalance load)	I_R = 64, I_Y = 65, I_B = 62

increases the complexity. However, the hybrid filter is not practically feasible because triplen as well as other odd harmonics were also present. So, before suggesting any solution rebalancing of the load in all three phases is required so size of filters will reduced. The suggested solutions are:

- Four leg SAPF
- Three leg SAPF with split capacitor

One of the effective solution in this case is split capacitor type shunt active power filter (SAPF) to compensate supply side current harmonics and compensation is also based on neutral current filtering. It compensate a nonlinear current by receiving its reference by comparing with actual current signal [10]. This solution uses less number of switches and less complexity. In this model a nonlinear load is consist of single phase and three phase bridge rectifiers. The designing and simulation in MATLAB of a split capacitor shunt active filter is discussed which can mitigate the undesired harmonics and validate for similar harmonics conditions. Therefore, after meter no. 2, 3 and 4 a proposed solution is connected for compensation as shown in Fig. 13. Its results shows the source current is sinusoidal in spite of load current is having many disturbances due to harmonics and unbalancing as shown in Fig. 14.

Table 4 Comparative chart for existing solution as per their cost

Available mitigation technique	Function	Economic aspect	Ratings
Use large cross section area for neutral	Not feasible solution	Cheap solution but not long-term solution	
APF (3P4W system)	Remove all types of harmonics in phases as well as in neutral	High in (remove all types of harmonics in phases as well as in neutral)	Rating of APF = $3VI_h + VI_{hn}$
Passive power filter	For selective harmonics elimination and problem of resonance	Low (For selective harmonics elimination)	Depend on harmonic current and value of LC combination
Hybrid power filter	Combination of passive and active filter	Medium	Depends on type of combinations used
Use of APF (1−ϕ) with zigzag transformer as a grounding filter	Only remove neutral harmonics	Depend on cost of the transformer	Rating of (Zigzag Transformer + APF) = $\frac{V_L I_{hn}}{3} + VI_{hn}$
Use of APF (1-ϕ) with zigzag as a grounding filter with DSTATCOM (3-ϕ)	Remove all types of harmonics in phases as well as in neutral	Very High	Rating of (Zigzag transformer + APF + DSTATCOM) = $\frac{V_L I_n}{3} + VI_{hn} + 3VI_h$
Use of APF (1−ϕ) with T-type transformer as a grounding filter	Only remove neutral harmonics	Medium	Rating of (T transformer + APF) = $\frac{V_L I_{hn}}{\sqrt{3}} + VI_{hn}$
Use of APF (1-ϕ) with T-type transformer as a grounding filter with DSTATCOM (3−ϕ)	Remove all types of harmonics in phases as well as in neutral	Very High	Rating of (T transformer + APF + DSTATCOM) $\frac{V_L I_{hn}}{\sqrt{3}} + VI_{hn} + 3VI_h$
Proper Selection of transformer and its vector group	For selective harmonics elimination and problem of resonance	Reduce cost and size of filter, if properly selected	

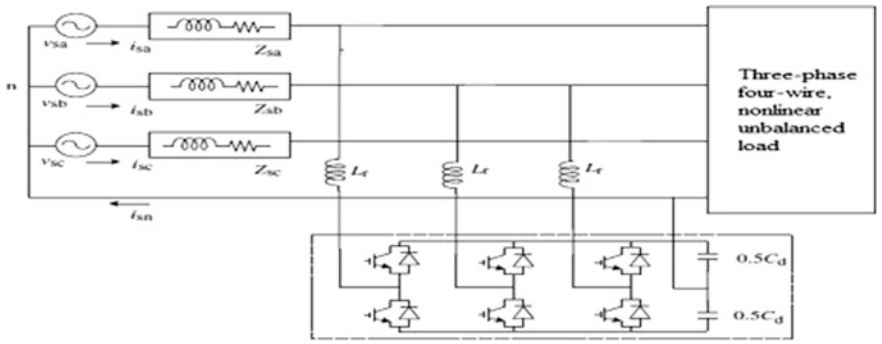


Fig. 13 Split capacitor SAPF with four leg

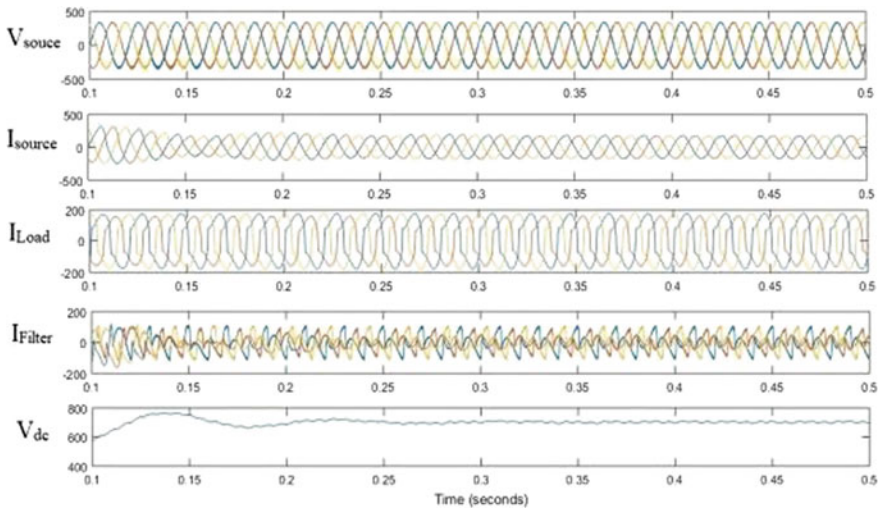
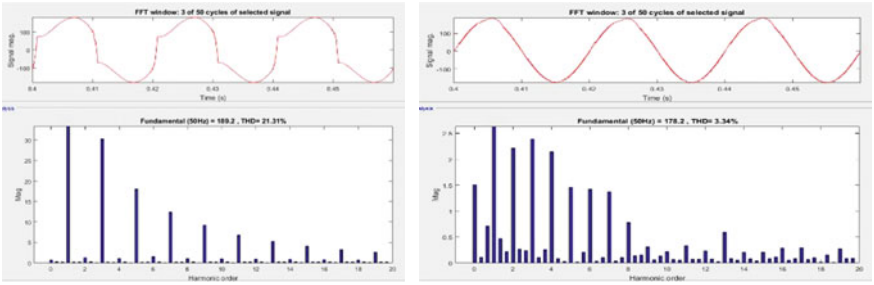


Fig. 14 Results of split capacitor SAPF

Table 5 Simulation results

Phase	THD (%) before compensation	THD (%) after compensation
A	21.31%	3.34%
B	20.64%	3.38%
C	21.26%	3.54%



(a) THD(%) before compensation (b) THD(%) after compensation

Fig. 15 **(a)** and **(b)** FFT analysis of split capacitor SAPF before and after compensation

Table 6 Specification of SAPF

S.N	Parameter	Rating
1	Source Voltage (r.m.s)	415 V
2	System Frequency	50 Hz
3	Source inductance	0.1 mH
4	Source resistance	0.001 Ω
5	DC link Voltage	700 V
6	Dc link capacitance ($C_1 = C_2$)	8500 μF
7	Coupling Inductance	2 mH
8	Load resistance ($R_1$and R_3)	1.6 Ω
9	Load inductance ($L_1$and L_3)	3.5 mH
10	Load resistance ($R_{2)}$	1.7 Ω
11	Load inductance (L_2)	3.5 mH

The THD (%) before and after compensation is given in Table 5 and THD in all phases reduces below 5% also shown in Fig. 15 for phase A.

The rating used in MATLAB simulation parameters and component rating given in Table 6. The design formulae are not discussed here and selection of component decided by its calculation [11].

3 Cost Assessment

The cost of poor PQ is generally underestimate by often reported as maintenance problem or equipment failure. The cost related with PQ problems is vary from inexpensive (small maintenance, loose wiring, replacement of component) costly one such as buying and installing a solution. However, the PQ problem only assess the cost of each solution by “Simple payback method”. To assess accurate cost of

any PQ project must also include "simple payback" as well as "Life cycle cost". The description of both cost are as follows for suggested solution:

- Simple Pay back: It calculated as by dividing capital cost of complete project to the annual savings from project. This gives the result in terms of total number of years to payback the initial capital cost. It is the easiest method for calculation of payback period but take no notice of very important issues.
- Life cycle cost: This includes the assessment of decreased maintenance cost, lower maintenance bills and lower cost due to improved efficiency and reliability after providing the PQ compensation device. All this factors translate to enlarged profit margin. So, it is necessary to estimate both the cost equally whereas life cycle cost assess and address more than capital cost and gives financial benefit for lifetime to any organization.

3.1 Difficulties in Providing Solution for Commercial Load

1. Sometimes PQ problems also quite frequently or repetative be indicative of safety concern and may be require steadfast corrective action.
2. PQ issues often go overlooked and neglected with regular planned maintenance.
3. All new existing and future loads, which are a part of end user (residential/commercial/industrial), should be seriously investigated.
4. The available solution like active filters, DSTATCOM etc. are still very costly solution and passive filters are not always feasible because higher number of individual harmonics crosses recommended limit. Hence, combination of active and passive solution should be promoted by reducing its complexities.
5. The residential or commercial loads uses three phase four-wire system and generating unbalancing in system and harmonics, which are random in nature and leads to increment of zero sequence harmonics current in neutral. So in future, the methods required for accurate assessment, analysis and mitigation of these random harmonics is required.
6. For triplen harmonics, increases the size of neutral is not right solution.
7. Absence of action on harmonics from Electricity Board regarding commercial load.
8. The further study is still required in order to improvement in mitigation technology and simultaneously continuous changing rules and regulations of Electricity supplying agencies in India.
9. Rules and limits should be clearly framed, specified and compulsorily followed throughout India. No ambiguities' should be left. Though in India IEEE 519 standards are accepted and followed few vital points are either not clear or adequate technical information is not provided by electric supply companies. Few examples are given below:

a. Level of lower and upper limits of load between which the harmonic measurements are to be carried out.
b. Short circuits current levels at point of common coupling (PCC) should be informed to each consumers before industries asked to take corrective measures.
c. Norms should be made to dis-allow lead PF conditions or use of fixed capacitor banks for PF improvement and all capacitors must be de-tuned.
d. Type of loads must be categorize and realistic limits must be specified for each type of load e.g. railways, normal industries, fabrication industries, steel industries, commercial loads etc. any other category, which may be useful in categorizing separately.
e. Special attention should be given while selecting transformers of proper vector groups for loads like induction furnaces, large DC motors, large VFDs etc.

10. Further studies are needed for both in simulations and real hardware implementation for low, medium and high voltage networks. A hardware based research required for such systems and should be developed in India instead of directly importing.
11. Lots of research required to manufacture a product, which is compatible for both manufacturer and consumer. The practical solution always has less cost and required less maintenance to become popular choice in market.
12. The analysis of cost is assessed by considering both payback and life cycle cost method.

4 Conclusion

The mentioned case study is an example of 'how poor quality power supply' due to nonlinear and unbalanced load can affect a running business building and be counter productive to their growth. The measurement and analysis facilitated to mapping all PQ issues and possible solution to mitigate the problem. The provided solution is split capacitor SAPF because of less complexity than hybrid filter. Customer always chooses a solution, which has the PQ related issues addressed at lower cost and complexity. Therefore, it is very important to understand how your PQ improvement project should be within a budget of customer. In addition, a solution should fulfill all standards by improvement in technology with economic prospective. Technically better choice in terms of technical complexity, ease of maintenance, availability of components, hence those solutions should be promoted more. The active filters are very costly and too delicate for use in Indian industries especially large size active filters are always problematic. For such solution a lots of research, will be required on hybrid filter. Hence, hybrid systems should be promoted in future.

References

1. Jou HL, Wu JC, Wu KD, Chiang WJ, Chen YH (2005) Analysis of zig-zag transformer applying in the three-phase four-wire distribution power system. IEEE Trans Power Deliv 20 (2):1168–1178
2. Choi S, Jang M (2004) A reduced-rating hybrid filter to suppress neutral current harmonics in three-phase four-wire systems. IEEE Trans Ind Electron 51(4):927930
3. Gruzs TM (1990) A survey of neutral currents in three-phase computer power systems. IEEE Trans Ind Appl 26(4):719–725
4. Wu J-C, Jou H-L, Hsiao H-H, Xiao S-T (2014) A new hybrid power conditioner for suppressing harmonics and neutral-line current in three-phase four-wire distribution power systems. IEEE Trans Power Deliv 29(4):1525–1532
5. Aredes M, Hafner J, Heumann K (1997) Three-phase four-wire shunt active filter control strategies. IEEE Trans Power Electron 12(2):311–318
6. Peng F (2011) Harmonic sources and filtering approaches. IEEE Ind Appl Mag 7(4):18–25
7. Maxim OC, Valery PD, Irina GV, Sergei AT, Victor VN (2018) Harmonics and neutral line current compensation in three-phase four-wire power systems. J Siberian Federal Univ Eng Technol 11(5):550–559
8. Jayalakshmi V (2014) A method to reduce neutral current in three phase four wire electric distribution systems by using active power filter. Middle-East J Sci Res 20(11):1561–1564
9. Key T, Lai J-S (1998) Analysis of harmonic mitigation methods for building wiring systems. IEEE Trans Power Syst 13(3):890–897
10. Cirrincione M, Pucci M, Vitale G, Miraoui A (2009) Current harmonic compensation by a single-phase shunt active power filter controlled by adaptive neural filtering. IEEE Trans Ind Electron 56(8):3128–3143
11. Sreenivasarao D, Pramod A, Biswarup D (2009) Neutral current compensation in three-phase, four-wire systems: a review. Electr Power Syst Res 86:170–180

Optical Networks Implementation Using Survivability Capacity Connectivity Algorithm (SCCA)

K. V. S. S. S. S. Sairam, Shreyas Arunesh, and Pranav Kolpe

Abstract Survivability is the basic phenomena which represent the data protection in terms of connectivity, to overcome Non-observance, Path performance and the integration [1]. Optical networks Multi Configurable Connectivity (MCC) is obtained by the path propagation in terms of short range and/or long range. In this paper multi hop network analysis represents the Capacity Connectivity (CC) and Min- Max Throughput (MMT) [2]. Further it improves the apportionment designed to perform packet scheduling. It represents the NXN topology in which min-max packet transmission and reception, according to the traffic pattern. It also provides multiple channel allocation and maximum channel utilization is achieved. It is expressed in terms of the topology connectivity, in which the traffic flow is distributed towards the adjacent flows. Further, it is non-centralized and globalized in order to achieve portability and extensibility.

Keywords Optical Networks ON · Multi Configurable Connectivity MCC · Capacity Connectivity CC · Min- Max Throughput MMT

1 Introduction

Earlier the work has been carried out with network distribution model i.e. 1xN which comprises of centralized technique. It enhances the path connectivity and depicted the path distribution by using optical network projections in terms of

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_8

single hop capacity connectivity. The network implementation by using span connectivity exists and the importance of cost effectiveness is routed through different digital signal levels [3]. This paper describes network configurations, T-R flow (Transmission – Reception flow), flexible, scalable and heterogeneous [6, 8]. Further, numerous network capacity connectivity techniques have been described by using spare path, cost results spare capacity in a multilayer optical network environment [4].

Nag et al. [7] depicted the location queuing. The main content was differentiating between transmission and reception of packets with minimum throughput. Further normal topology is presented with minimum number of nodes. Hence it consists of minimum nodes in simple channel for transmission and reception of packets. The disadvantage of this model, cannot provide the multiple path connectivity and also cannot achieve the maximum throughput.

Hemrick et al. [8] depicted the limited channel reuse with minimum to maximum throughput. Their model represents the node and flow connectivity in short haul propagation was estimated and the drawback was global connectivity was not achieved.

Jn et al. [9] has carried out with location of packet transmission and reception with much more connectivity, the main drawback was maximum throughput through multi period connectivity was not achieved.

2 Problem Statement

Multi period capacity connectivity

i. Single and Multiperiod connectivity parameters
ii. Node and Flow Concept
iii. Packet Delivery System
iv. Spatial Channel Capacity
v. Throughput

In this optical channel is distributed for multi period spatial locality [5]. Further the transmitter sends the flow of packets originated from different source to destinations. In order to avoid the rate sensitive and latency in multi hop networks, minimum throughput and maximum QoS by using network capacity greedy algorithm [6]. Further it consists of network optimization parameters to obtain maximum throughput are topology, data rate, node connectivity, flow connectivity, link connectivity end-to-end flow connectivity, then error control connectivity, error recovery connectivity and switching connectivity.

In the previous work Nag Y.N, Hemrick, C.F, Jn J. et al. where described the location connectivity i.e. packet flow connectivity from a single node to multi node. In this the packet flow propagation starts from same node (source) to the different nodes (destination), through which minimum throughput, maximum delay and also

the network complexity congestion was not addressed, as depicted in Single Period Demand Connectivity Table 1.

The salient results of our work provides the spare capacity for NXN topology connectivity, per node cost, non-centralized demand connectivity, restoration connectivity, demand signal connectivity, bandwidth connectivity, multi period connectivity, network control flexibility in survivability capacity algorithm.

This algorithm addresses viz.,

Each packet flow connectivity and additionally maximizes to higher data rate by using optical channel bandwidth.

i. It concentrates on centralized distribution
ii. Maximizing effective channel reuse communication applications
iii. In this each packet flow receives fair path propagation from the physical channel capacity.

The optical network Packet scheduling Algorithm represents the data from transmission to reception site as shown in Fig. 1. The latency is represented by a factor Dp. It should emphasize the connectivity requirement in order to avoid collision. In this case if collision occurs no acknowledgement is transmitted as depicted in Network Capacity Greedy Algorithm in Fig. 2.

Table 1 Single Period Demand Connectivity

SI. no.	No. of nodes	Node connectivity	Reuse connectivity (%)
1.	1	1–5	80
2.	2	2–5	60
3.	3	3–5	40
4.	4	4–5	20
5.	5	5–5	0

Fig. 1 Packet scheduling Algorithm

Dp: delay of a packet
Pn: path value of node n
Txr
Dp = 0
Pn = topology height
While Pn > 0
Pn = Pn - 1 or
Dp = Dp + 1
Rxr

Fig. 2 Network Capacity Greedy Algorithm

N: node connectivity in the graph
N (V): is the adjacent node
Degree of node such that λ1, λ2… λn
Return

Network Capacity Greedy Algorithm represents The wavelength connectivity such as λ1, λ2, …, λn is measured w.r.t. the adjacent node N(V) with the total number of node connectivity in NXN connectivity as represented in Spare Capacity Flow Connectivity in Fig. 3.

The Demand Connectivity is presented in the flowchart as shown in Fig. 4. In this the capacity Network Greedy Algorithm is measured for NXN, where the topology determines the node and flow path. The physical channel capacity bound is measured by its Throughput ratio i.e. Transmitted Packets to simulation time further spatial connectivity reuse is obtained by Throughput ratio towards 100% channel utilization.

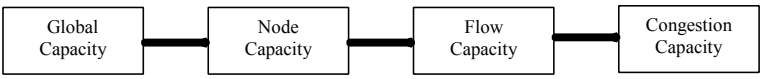

Fig. 3 Spare Capacity Flow Connectivity

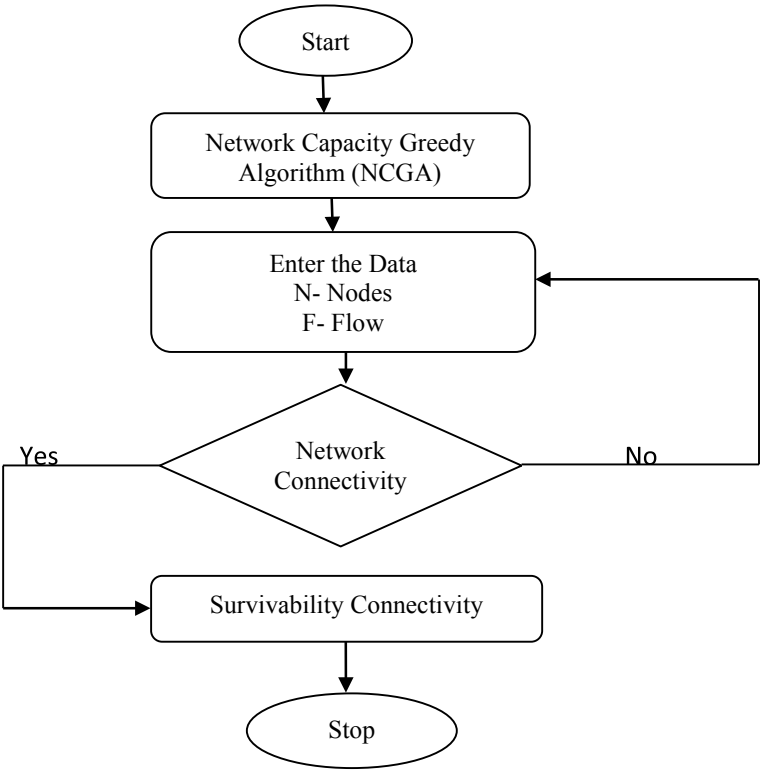

Fig. 4 Demand connectivity flowchart

Further it is enhanced with the parameters node mobility and scalability w.r.t Spatial Connectivity is represented in Fig. 5. It ensures maximum bandwidth in order to transmit and receive the packets i.e. NxN topology. It also provides location dependent and location independent mechanism in order to establish the distributed nature of packets along the NxN paths.

The physical channel capacity, channel bandwidth provides the integral connectivity. In logical layer the topology determines maximum node and flow connectivity. The services are rendered by using various standard protocols by using virtual circuit and datagram circuit in terms of global capacity i.e. NXN with node capacity source to destination, flow capacity direction (error control) and finally congestion capacity as show in Spare Capacity Flow Connectivity Fig. 3.

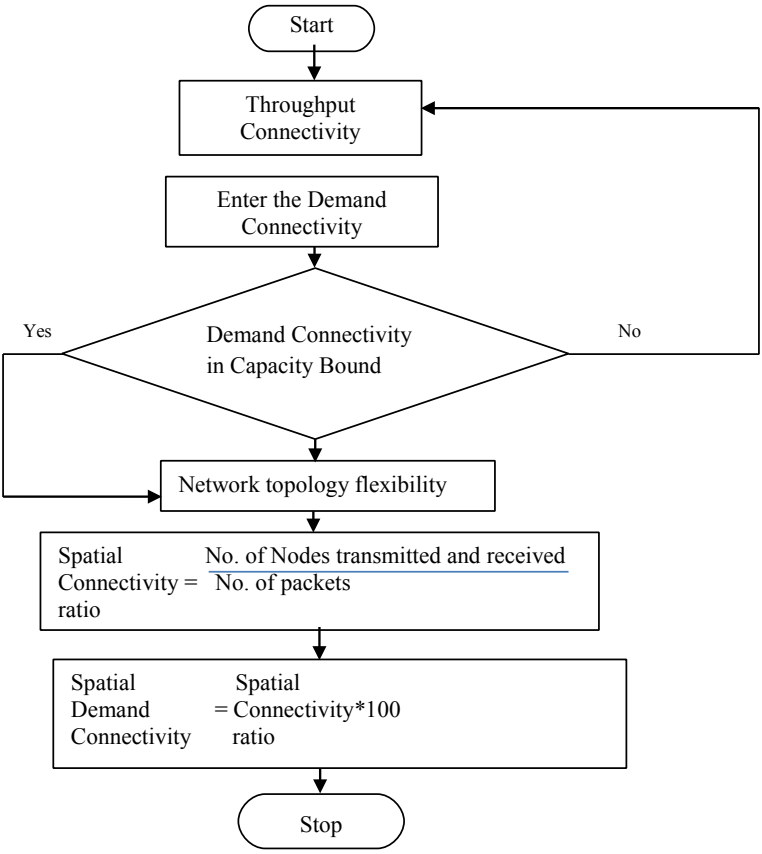

Fig. 5 Spatial connectivity throughput flow chart

3 Result

The numerical results for network capacity greedy algorithm, 9 × 9 node connectivity in Fig. 6. in terms of connectivity results as depicted in Tables 2, 3 4 and 5.

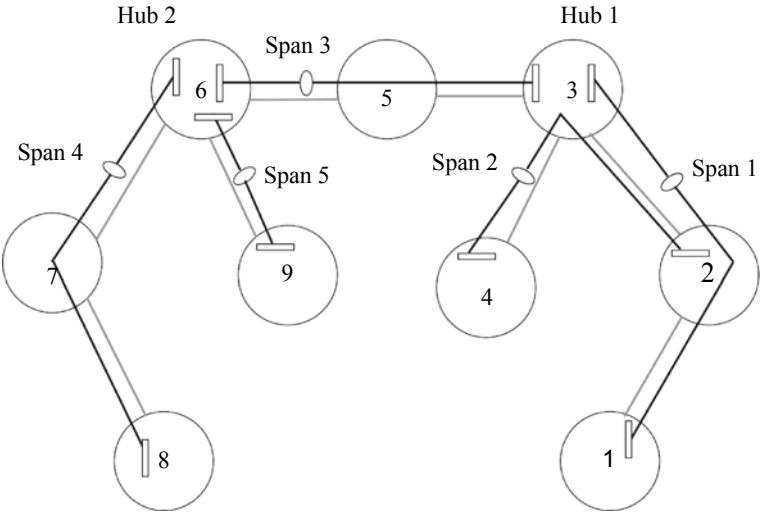

Fig. 6 Fiber network 9 × 9 configuration layout

Table 2 Input parameters

Issues	Algorithm
	Connectivity result
Spatial Connectivity	1
Capacity	1
Spatial End To End Capacity	1
Subordinate	1

Table 3 Input parameters

Path connectivity	Flow connectivity
1–3	1–2–3
1–4	1–2–3–4
1–5	1–2–3–5
1–6	1–2–3–5–6
1–7	1–2–3–5–6–7
1–8	1–2–3–5–6–7–8
1–9	1–2–3–5–6–9

Table 4 Output parameter

Topology Connectivity	9
Connectivity Flow	8
Spatial Connectivity Ratio	250
Spatial Gain	150

Table 5 Packet scheduling throughput

Demand Rate (Mb)	2
IEEE Standard Protocols	IEEE 802.12
Topology Connectivity	22
Connectivity Flow	11
Spatial Connectivity Ratio (%)	520
Special Gain (%)	420

4 Conclusion

In this paper this network capacity is achieved by packet scheduling, packet delivery system location contention, maximum throughput. It can be extended further to evaluate the capacity connectivity by using multilevel queuing algorithm, which describes the multi hop flow propagation in order to attain overall Topology Independent Capacity Connectivity model.

References

1. Sairam K et al (2019) FONI by using survivability approach: an overview. In: ICACNI and Informatics. Springer, Singapore, pp 529–537
2. Singh C et al (2017) Survivable fiber optic networks design by using digital signal levels approach. In: 2017 ICISS IEEE2017, December 2017, pp 84–86
3. Arumugam M (2001) Optical fiber communication—an overview 57(5–6):849–869
4. Sairam K et al (2019) Broadband services implementation by using survivable ATM architecture. SSRN3355302
5. Rajpoot S et al (2017) Future trends in fiber optics communication. Int J Cybern Inform 6(1):2
6. Li X et al (2016) Design of K-node (edge) content connected optical data center networks. IEEE Commun Lett 20(3):466–469
7. Nag YN et al (1984) Shortest path algorithm 14:275–323
8. Hemrick C.F et al (1985) Location mechanism by using spanning tree algorithm 7:39–47
9. Jn J et al (1980) Communication networks methods and design for survivability 37(4):521–531

A Comparison Analysis of Collaborative Filtering Techniques for Recommeder Systems

Amarajyothi Aramanda, Saifullah Md. Abdul, and Radha Vedala

Abstract In E-commerce environment, a recommender system recommend products of interest to its users. Several techniques have been proposed in the recommender systems. One of the popular techniques is collaborative filtering. Generally, the collaborative filtering technique is employed to give personalized recommendations for any given user by analyzing the past activities of the user and users similar to him/her. The memory-based and model-based collaborative filtering techniques are two different models which address the challenges such as quality, scalability, sparsity, and cold start, etc. In this paper, we conduct a review of traditional and state-of-art techniques on how they address the different challenges. We also provide the comparison results of some of the techniques.

Keywords E-commerce · Recommender system · Recommendation · Collaborative filtering · Memory-based collaborative filtering · Model-based collaborative filtering

1 Introduction

E-commerce systems such as amazon, flipkart and ebay, etc., are very popular in the present days' world. Users can gather information about the products of their interest in E-commerce sites without moving from their place and without visiting physical store. However, user faces difficulty to choose the right product from huge

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_9

number of products. To address this, the Recommender System (RS) has been proposed to help him/her [1].

The RS provides recommendations for a set of products/items to its users. Generating right recommendations is a major challenge in RS. To address this, several approaches have been proposed, such as content-based, collaborative and hybrid filtering [4, 12, 13]. In Collaborative Filtering (CF) technique, the items are suggested to a user based on his/her preference history and items that are preferred by similar users. The first CF is Tapestry [13] used for email filtering. The CF is a widely adopted technique for personalized RS. There are several challenges for CF, such as quality, scalability, sparsity and cold start, etc. Techniques like, memory-based CF and model-based CF are popular in the literature to address these challenges.

In this paper, we conduct a review of traditional and state-of-art techniques on how they address the above mentioned challenges. We made an effort to study the different CF techniques, analyze each technique's strengths and situation in which it gives good results. We also provide the comparative analysis of some of the techniques.

The organization of the paper is as follows. In Sect. 2, we provide the overview about CF. In Sect. 3, we describe CF techniques, challenges and metrics. In Sect. 4, We explain the comparative analysis of CF techniques. Finally, we conclude the paper in Sect. 5.

2 Collaborative Filtering Overview

The RS must collect the data about users' preferences to build a model for personalized recommendations [9]. The data gathered for this can be either explicit or implicit. Explicit data can be user's preferences, 1–5 stars, like/dislike, or textual feedback. Implicit data can be derived by monitoring user's activities such as books read, songs heard, items purchased and websites visited. To know the performance of CF techniques, we need to experiment on a dataset. Most widely used datasets are MovieLens and BookLens datasets from GroupLens. Other than GroupLens, there are Netflix, Jester, BookCrossing, Delicious, MSD, and Amazon [12].

Consider a scenario that, there are n number of users, set $U = \{user_1, user_2, \cdots, user_n\}$ and m number of items, set $I = \{item_1, item_2, \cdots, item_m\}$. The item could be a book in amazon.com, URL in del.icio.us, a song in last.fm, a photo on flicker.com, or any product in E-commerce sites, etc. We can represent users and items data as $n \times m$ matrix R and the value of element $x_{i,j}$ in R, is a preference of i^{th} user on a j^{th} item. The preference can be 1 or any value on a given scale (like 1–5 from poor to excellent) if a user prefers an item, otherwise zero. Now, the RS suggests *top-N* items or predicts the rating to the new/active user on item(s) that are not yet bought by him/her.

The basic CF process can be viewed as 3 steps process [15]. (i) The *data representation* is the first step to preprocess the data by removing sparsity,

removing synonymy and reducing the dimensions of data. Further, data is also normalized to prepare for filtering process. (ii) The *neighborhood formation* is the second step, to compute similar interested users, called neighbors. The neighborhood is a collection of similar users. The neighbors are computed by finding similarities/correlations between user's interests/preferences using proximity measures. Proximity measures used in CF are cosine-based similarity, Pearson correlation and Spearman's rank correlation coefficient, etc. [2, 3, 6, 7]. Depending on the type of data and need suitable proximity measure is chosen. The similarity is computed either between users or between items. The correlations between users is called as *user-centric* correlations and is represented as user × user correlation matrix, *UCR*. The correlation between items is called *item-centric* correlations and is represented as item × item correlation matrix, *ICR*. (iii) The *recommendation generation* is third step to generate the recommendations by either predicting the preference of the user on a particular item or listing the *top-N* popular items to the user. The *prediction*, $P_{a,b}$, denotes a numerical value, prediction of likeliness score of user a on a particular item b. The *top-N* recommendations are list of N not yet bought items that the active user will like the most.

3 Collaborative Filtering Techniques

CF techniques can be categorized according to the way they retrieve information from repositories. They are memory-based CF and model-based CF [3, 7]. The memory-based CF techniques use the entire user-item data to compute similarities on the fly and predict or list the *top-N* items for an active user. The model-based CF techniques use precomputed similarities of users/items stored in an offline repository and generate recommendations for an active user. In this section, we explain memory-based CF, model-based CF, challenges and metrics.

3.1 Memory-Based Collaborative Filtering

The memory-based CF techniques further classified as *User-User* CF and *Item-Item* CF. Now, we explain these techniques in the following.

User-User CF: The basic assumption for this technique: many users show interest to buy the items bought by his/her neighbors [8]. This method takes either implicit or explicit feedback matrix R as input. This method can use either low dimensional data representation or high dimensional data representation. The neighborhood is formed from *UCR* using K-nearest-neighbors (KNN) algorithm. The recommendations are generated from neighborhood. The *prediction* can be done by weighted average of nearest neighbors. The neighborhood for active user a are l neighbors, represented as set, $NB_a = \{nb_1, nb_2, \cdots, nb_l\}$. Let $NB_{a,b}$ is subset of NB_a containing all users in NB_a who have rated item b. The weights are

proximity values from *UCR*. Each element, $w_{a,i} \in UCR$, is proximity value between user a and user i, $i \in NB_{a,b}$. The $x_{i,b}$ is rating by user i on item b. The *prediction* for user a on item b is given in an Eq. 1.

$$P_{a,b} = \frac{\sum_{i \in NB_{a,b}} x_{ib} * w_{a,i}}{\sum_{i \in NB_{a,b}} |w_{a,i}|} \tag{1}$$

The Eq. 1 can be enhanced by considering user's average rating μ_a, and is given in [8]. *Top-N* recommendations is an item set, $T = \{t_1, t_2, \cdots, t_N\}$, can be computed by either *most-frequent-item* recommendations or *association rule-based* recommendations [15].

Item-Item CF: The steps followed in this technique are similar to *User-User* CF technique [8]. But, *Item-Item* CF uses, similarities between items instead of users. Neighborhood is formed for each item by using *ICR*. The *prediction* on item b for user a is generated by considering the items similar to item b. Let, $INB_{a,b} = \{inb_1, inb_2, \cdots, inb_l\}$ is neighborhood for item b, rated by user a. The $w_{b,i}$ is proximity value between item b and item i, $i \in INB_{a,b}$. The *prediction* is computed as weighted average of user's ratings on the items in $INB_{a,b}$ [1, 8]. *Top-N* recommendations are computed similar to *User-User* CF except item's neighborhood is considered instead of user's neighborhood.

3.2 Model-Based Collaborative Filtering

The model-based CF techniques are neighborhood-based, latent-factor-based, Bayesianbased and association rule-based. In this section, different model-based CF techniques are discussed.

Neighborhood-based: Neighborhood-based techniques build the model by learning the neighborhood information. The neighborhood is formed using either KNN or clustering algorithms.

Item-based CF: This technique is similar to *Item-Item* CF. But, in *Item-Item* CF the neighborhood is computed on the fly, where as in *Item-based* CF neighborhood is computed offline and stored in a model [2].

Cluster-based CF: This technique forms all users into k partitions from entire user × item data using k-means clustering algorithm, in which a user belongs to only one partition. Each partition is a neighborhood and is of fixed or variable length. The recommendations are generated using neighborhood information [15].

Cluster and Nearest-neighbors-based CF (CNCF): Another variation for clustering is, CNCF technique. The dataset is divided into k partitions (clusters) using k-means algorithm, in which a user belongs to only one partition. The partitions are formed using *user-centric* proximity measure. First, build the model with $k$surrogate users derived from k-centroids of k-clusters. A surrogate user is a centroid for a cluster. Finally, recommendations are generated by finding nearest neighbors for active user from model [2].

Neighborhood with Interpolation Weights CF (NIWCF): This technique is an enhanced version of *item-based* CF. In this method, first step is to normalize the dataset by removing global effects. The global effects are the tendencies and preferences of users that change from time to time, which affects users' true preferences. In second step, neighborhood is formed using *item-centric* correlation. Unlike *item-based* CF all neighbors are not given an equal weightage. In a given set of neighbors, each neighbor is assigned with weight called interpolation weights [5]. Finally, *prediction* of rating for user on item is computed using interpolation weights.

Latent-factor-based: Latent-factor-based techniques extract latent factors from users' preference data, unlike *UCR* and *ICR*, in CF techniques. The latent factors are computed by either dimensionality reduction techniques like singular value decomposition and principal component analysis or matrix factorization techniques.

Singular Value Decomposition (SVD): This is mainly used to reduce the dimensionality by producing low-rank linear approximation [3]. Another variation of SVD is incremental SVD to minimize the computation time by using *folding-in* technique [14].

Matrix Factorization: Matrix factorization (MF) builds the model by factorizing the rating matrix into two lower-dimensional latent feature matrices [3]. The MF maps both the items and users to a joint latent factor space dimensionality [10]. The variations of MF are non-negative matrix factorization (NMF) [11] and probabilistic matrix factorization (PMF) [16].

Bayesian-based: Bayesian-based techniques are based on Na¨ıve Bayes approach. This type of techniques predict each user's unknown preferences based on conditional probability of his/her known preferences. The improved versions of Naïve Bayes approaches are available in [20].

Association rule-based: The techniques use rule-based mining to discover an association between the items [18, 21].

Other Techniques: Other than above mentioned techniques, new research towards applying neural networks to CF [22], graph-based techniques to combine the content and CF techniques [8], context-aware recommendation [19] and so on are in progress. To improve the performance, CF algorithms are combined with sentiment analysis [16].

3.3 Challenges and Metrics

The CF techniques give good results and are widely adopted in RS applications. However, they still have to defeat different challenges [13]. There are two primary challenges for CF techniques. The first challenge is *quality of recommendations*, i.e., suggest the items to users which they like most. The second challenge is *speed/scalability*, i.e., CF algorithm should be able to process millions of neighbors. Different techniques have been proposed in the literature to achieve these.

There are secondary challenges also to address in addition to above. Those are *sparsity* and *cold start*. The *sparsity* is also referred as *reduced coverage* problem. In real world scenario most of ratings/purchase data is empty. For example, as Ecommerce is still growing, users have purchased less than the 10% of items from all items available, keeping rating matrix as almost empty. This leads to poor recommendation accuracy. The *cold start* is a problem of not able to provide good recommendations due to lack of data. This issue can be a *new community* problem for new RS, a *new item* problem for newly launched item or a *new user* problem for new user [23].

Several metrics are available in the literature to evaluate the usefulness of CF techniques. These are divided into two ways: *prediction* and *top-N* recommendations. The *prediction* metrics are: Mean Absolute Error [20] and Root Mean Squared Error [5]. The *top-N* recommendations metrics are: *Precision*, *Recall*, and *F1* [17]. In addition, how good a RS is evaluated by different concepts like Utility, reliability, novelty, diversity, unexpectedness, serendipity and coverage [17].

4 Comparative Analysis

This paper mainly focused on different types of CF techniques, how they are different from each other and what challenge they have addressed, as shown in Table 1. In this table, each row explains a particular technique with information such as: technique, measure used to find similarity, learning algorithm used to build the RS, prediction method, performance of the technique, challenge addressed, and observations we made.

We have observed that, the memory-based techniques improve quality of recommendations, but take more time when the user × item matrix size keep on increasing. The model-based techniques are more scalable, i.e., it takes less time to compute the recommendations even when data size is more. But, if more users/items are added or updated immediately after precomputation, then it gives a poor prediction. In *User-User* CF, choose the appropriate size of neighbors to improve the quality of recommendations and size of neighbors vary from dataset to dataset. When the number of users are large, then *Cluster-based* CF is best suited than *Item-based* CF. If the dataset is with less sparsity, then CNCF will take less time and less space for recommendations. The CNCF is best suited to implement the RS in handheld devices. If one needs to consider the interventions among neighbors then the NIWCF is good, because in this method each neighbor interpolation weight is considered for recommendation generation.

We also observed that, the dimensionality reduction method, SVD, is better considered to address the synonymy and semi-sparsity than neighborhood-based techniques. SVD also gives poor results, in case of higher sparsity. The alternative for this is MF. The advantage of MF is very flexible to add any biases. The biases deal with any data aspects and application-oriented requirements. For example, a

Table 1 Comparison of collaborative filtering techniques

Technique	Measures	Learning algorithm	Prediction	Performance	Criteria	Observation
User-User/ Item-Item [8]	Cosine Similarity	KNN	Weighted Average	Simple to implement	Quality, Scalability	Optimal number of neighbors and low dimensionality improves the performance
Item-based [8]	Adjusted cosine similarity	KNN	weighted Average	Improved performance than memory-based	Quality, Scalability	Regression gives best results when sparsity is more
Cluster-based [15]	Pearson Correlation	K-means	Adjusted weighted average	Simple and high throughput	Quality, Scalability	Poor prediction
CNCF [2]	Pearson Correlation	K-means, KNN	Adjusted weighted average	Reduce time for online computation	Quality, Scalability	Better for low storage and processing capacity
NIWCF [5]	Adjusted cosine similarity	Interpolation weights based	Linear regression	Best results than User/Item-based CF	Quality, Scalability	Interpolation weights avoids biased prediction
SVD [14]	–	SVD	SVD prediction	More scalable and accurate	Quality, Scalability, Sparsity	Expensive
MF [10, 11, 16]	Latent Factors	MF	Latent Factors dot product	Less memory space required	Quality, Scalability, Sparsity, Cold start	Allows to integrate many crucial aspects of data
Bayesian-based [20]	Conditional probability	Bayes classification	Probability based	More accurate prediction	Quality, Scalability, Sparsity	Understanding and justifying is easy
Association rule-based [21]	Item Frequency	Association Rule	Association rule-based	More efficient to analyse user behavior	Quality, Sparsity	Improves the coverage

critical user always rates any item lower than its average rating. So, to estimate the true rating for item by the critical user, biases are added. In practice, remove all users who have given less ratings than predefined minimal value even before preprocessing of the dataset. But, these users also have some significant information about user's interests. In such cases, the PMF gives good results. When items are frequently changing and users are less frequently purchasing them, association rule-based techniques gives good results, example, an auto industry. The major issue in CF is explanation for rating can't be given. It is not easy to interpret the meaning of latent factors in MF techniques. The PMF can alleviate this problem, however, user can't understand completely. In such cases, Bayesian-based CF will give better results. Another way to handle this is combining sentiments into CF techniques to improve reliability of RS. Now a days vendors also collecting textual feedback (sentiment) from users along with rating and like/dislike information. This user feedback gives more insight about user interests. At present, the MF techniques like PMF and NMF are performing better by considering the user sentiments. Choosing best technique is depends upon the nature of dataset and need of application.

5 Conclusion

In E-commerce environment, personalized RS helps the user to choose the item from huge number of items. To build personalized RS, CF is a widely adopted technique. In this paper, we presented an overview of the CF process, memory-based and model-based techniques of CF. This paper, described the challenges of CF and explained each technique with the challenges it addressed. It also described each technique's strengths and situation in which it gives good results. Sentiment analysis further strengthens the CF techniques in giving accurate recommendations. However, there is no single technique that addresses all challenges. We are focusing on this issue as a part of future work.

References

1. Aggarwal CC (2016) Recommender systems. Springer, Cham
2. Al Mamunur Rashid, SKL, Karypis G, Riedl J (2006) ClustKNN: a highly scalable hybrid model & memory-based CF algorithm. In: Proceedings of webKDD
3. Ambulgekar H, Pathak MK, Kokare M (2018) A survey on collaborative filtering: tasks, approaches and applications. In: Proceedings of international ethical hacking conference. Springer, pp 289–300
4. Amin SA, Philips J, Tabrizi N (2019) Current trends in collaborative filtering recommendation systems. In: World congress on services. Springer, pp 46–60
5. Bell RM, Koren Y (2007) Scalable collaborative filtering with jointly derived neighborhood interpolation weights. In: ICDM, vol 7, pp 43–52. ACM

6. Grzegorzewski P, Ziembinska P (2011) Spearman's rank correlation coefficient for vague preferences. In: International conference on FQAS. Springer, pp 342–353
7. Isinkaye F, Folajimi Y, Ojokoh B (2015) Recommendation systems: principles, methods and evaluation. Egyptian Inform J 16(3):261–273
8. Kluver D, Ekstrand MD, Konstan JA (2018) Rating-based collaborative filtering: algorithms and evaluation. In: Social information access. Springer, pp 344–390
9. Konstan JA, Riedl J (2012) Recommender systems: from algorithms to user experience. User Model User-Adap Inter 22(1–2):101–123
10. Koren Y, Bell R, Volinsky C (2009) Matrix factorization techniques for recommender systems. Computer 42:30–37
11. Luo X, Zhou M, Xia Y, Zhu Q (2014) An efficient non-negative matrix-factorization-based approach to collaborative filtering for recommender systems. IEEE Trans Ind Inform 10 (2):1273–1284
12. Najafabadi MK, Mohamed AH, Mahrin MN (2019) A survey on data mining techniques in recommender systems. Soft Comput 23(2):627–654
13. Patel A, Thakkar A, Bhatt N, Prajapati P (2019) Survey and evolution study focusing comparative analysis and future research direction in the field of recommendation system specific to collaborative filtering approach. In: Information and communication technology for intelligent systems. Springer, pp 155–163 (2019)
14. Sarwar B, Karypis G, Konstan J, Riedl J (2002) Incremental singular value decomposition algorithms for highly scalable recommender systems. In: Fifth international conference on computer and information science, vol 27, p 28. Citeseer
15. Sarwar BM, Karypis G, Konstan J, Riedl J (2002) Recommender systems for large-scale ecommerce: scalable neighborhood formation using clustering. In: Proceedings of the fifth international conference on computer and information technology, vol 1, pp 291–324. ACM
16. Shen RP, Zhang HR, Yu H, Min F (2019) Sentiment based matrix factorization with reliability for recommendation. Expert Syst Appl 135:249–258
17. Silveira T, Zhang M, Lin X, Liu Y, Ma S (2019) How good your recommender system is? A survey on evaluations in recommendation. Int J MLC 10(5):813–831
18. Swamy MK, Reddy PK: Improving diversity performance of association rule based recommender systems. In: Proceedings of 26th international conference on database and expert systems applications, Part I. Springer, pp 499–508 (2015)
19. Phuong TM, Phuong ND (2019) Graph-based context-aware collaborative filtering. Expert Syst Appl 126:9–19
20. Valdiviezo-Diaz P, Ortega F, Cobos E, Lara-Cabrera R (2019) A collaborative filtering approach based on Naïve Bayes classifier. IEEE Access 7:108581–108592
21. Yao L, Xu Z, Zhou X, Lev B (2019) Synergies between association rules and collaborative filtering in recommender system: an application to auto industry. In: Data science and digital business. Springer, pp 65–80
22. Zhang S, Yao L, Sun A, Tay Y (2019) Deep learning based recommender system: a survey and new perspectives. ACM Comput Surv 52(1):1–38
23. Zhu Y, Lin J, He S, Wang B, Guan Z, Liu H, Cai D (2019) Addressing the item cold-start problem by attribute-driven active learning. IEEE Trans KDE 32:631–644

Biomimicry for Talent Acquisition

Nikhitha Mittapally, Ashok Baggaraju, and M. Kumara Swamy

Abstract Hiring talented individuals is critical to an organization's success. In the recent times, there has been unprecedented growth in demand for top quality candidates. Talent acquisition in the fierce job market is the biggest challenge faced by recruiters and HR managers today. In this paper, we proposed an approach to tackle this problem using Biomimicry. It is a research stream to seek sustainable solutions to complex problems by observing and drawing inspiration from the patterns and strategies used by nature. Our proposed solution takes the recruitment strategies employed in ant colonies and by swarm of bees as reference and applies these talent acquisition patterns to human recruitment. It turned out to be an excellent fit for tackling recruitment challenge in many industries like IT. The feedback for the application of Biomimicry in real-life recruitment scenarios has been very encouraging and regarded as an innovative and out of the box solution for a widely known, pressing issue.

Keywords Talent acquisition · Biomimicry · Ant colonies · Swarm of bees · Waggle dance

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_10

1 Introduction

Talent acquisition (TA) is the process of finding skilled human resources for organizational needs and requirements. The talent acquisition team in other words the Human Resource (HR) department is responsible for accomplishing this goal. There are several challenges faced by this team. Some of the key difficulties are listed below:

1.1 Challenges in Talent Acquisition

- *Failure to attract talented candidates:* In the candidate-driven market, candidates are approached by multiple Recruiters. Many jobs do not get enough traction due to the archaic strategies used by Recruiters.
- *Talent Engagement gaps:* Lack of communication and understanding between recruiter and candidates usually causes several problems in the recruitment process. After a candidate evinces interest in a job, it's very important to sustain it through top-notch candidate experience that eventually leads to a successful hire. This vital journey often turns out to be a bumpy ride leading to a high drop rate.
- *Speed of hire Vs. Quality of hire:* Organizations want to recruit a candidate quickly as there's direct/in-direct cost involved with 'Time to Hire'. However, it is usually difficult to find the best talent within a small-time span. At times the mad rush affects quality of hire leading to repercussions. Increasing the recruitment speed without compromising on the quality, is a major challenge for the recruiters.
- *Lack of efficiency in the hiring process:* Normally, most of the recruiters waste their valuable time by working on unnecessary and ineffective administrative tasks resulting into duplication of efforts in finding talent, reviewing resumes, etc. It calls for a major shift in approach from how these things are done today.

2 Market Research

- *Kronos Study:* 61 percent of employees thought about searching for a new job in the past year.
- *G*allup estimates disengaged workers cost the economy 350 billion USD a year in lost productivity.
- *R*ight Management report found that 1 in 5 workers are in the wrong job.
- *D*eloitte Global Human Capital Trends: Top Leadership worries (Fig. 1).

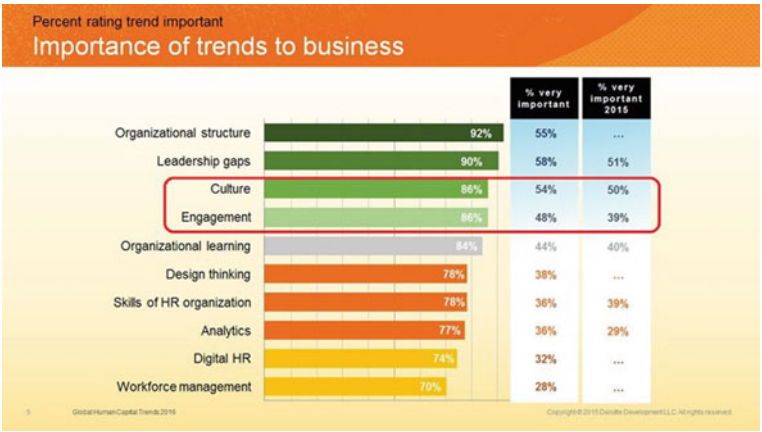

Fig. 1 Deloitte global HCM trends

In this paper, we are proposing an approach to solve some of the key Talent Acquisition challenges.

3 Problem Statement

Organizations today are facing cut-throat competition in attracting and hiring top talent. Right talent for the right position, is the key differentiating factor in sustaining/growing business and staying ahead of competition. It is not enough to just show open job positions and expect candidates to apply [2, 3]. The main aim for HR Managers and Recruiters is to attract talent. Many recruiters follow their own recruiting strategies most widely used one being employer branding. However most of the jobs look alike and very rarely stand out leading to confusion for candidates in identifying the right opportunity and also sail through the recruitment journey to finally end up with their dream job.

4 Proposed Solution

4.1 Biomimicry for Talent Acquisition

Nature has evolved over millions of years and there's probably not a single problem that it has not resolved. It is a treasure trove to explore and find solutions for our problems in hand. All that is required for us is to have an open mind and look for solutions for the complex problems which demand better resolutions than what

exist today. This research stream is being referred as 'Biomimicry' of late which dwells into natured inspired solutions.

Biomimicry is an emerging discipline that studies nature's best ideas and then imitates these processes and designs to solve human problems. It is where the biosphere is mimicked as a basis for design in the fields of architecture, engineering and the business diaspora.

Looking at the several challenges in Talent Acquisition, we thought about seeking inspiration from nature. Our expedition started with curiosity as to how nature handles recruitment. It was very interesting to realize that several other creatures also face the similar challenge of finding and hiring top talent for achieving their goals. What has blown our minds is the way these creatures have solved the problem of Talent Acquisition!

We observed the methodology adopted by "Ants" and "Honey bees" while establishing a new colony and found that this process helps in solving the TA problem [4–6].

Ants Analogy: Ants require talent acquisition for foraging and hunting for new house.

Ant Colonies: Ants nest within fragile rock crevice nests, which frequently become uninhabitable, forcing colonies to find and emigrate to new nests. Thus, they continually look out for a better nest and will move into a different nest if it is a substantial improvement over their existing nest.

Tandem Running: Ants perform Tandem Running (refer Fig. 2) to attract candidates to move to the newly found nest site. It is a form of recruitment in ants in which one individual ant leads another to a better nest site. In tandem running process, the ant recruits some ants and share information about the location of site that she found independently. The tandem followers explore the environment between new nest and old nest, and they return to the old one. The tandem followers often go on to lead new tandem runs, thereby recruiting others for quorum threshold. Ants stop tandem trails after certain threshold and starts migration to the new nest site. Tandem runs speed information flow because tandem followers typically discover new sites much more rapidly than through independent searching.

The process of tandem running is explained in Fig. 2. The process starts when the current nest is not suitable for living due to natural calamities, insect attacks, etc. Generally, few ants take initiation to search for new site. When appropriate nest site found, the ants returns to the old site. They share the new location site with other ants (Fig. 2(d)) and start recruitment process using tandem trials. These tandem followers inspect the new site and return to the old one. If the tandem followers find the new site to be better one, they start tandem trials by recruiting few other ants. The trials continue for certain threshold and the ants start migrating to the new site.

Honeybees Analogy: The TA is made by honeybees when the queen wants to create a new colony and for foraging of food resources [1].

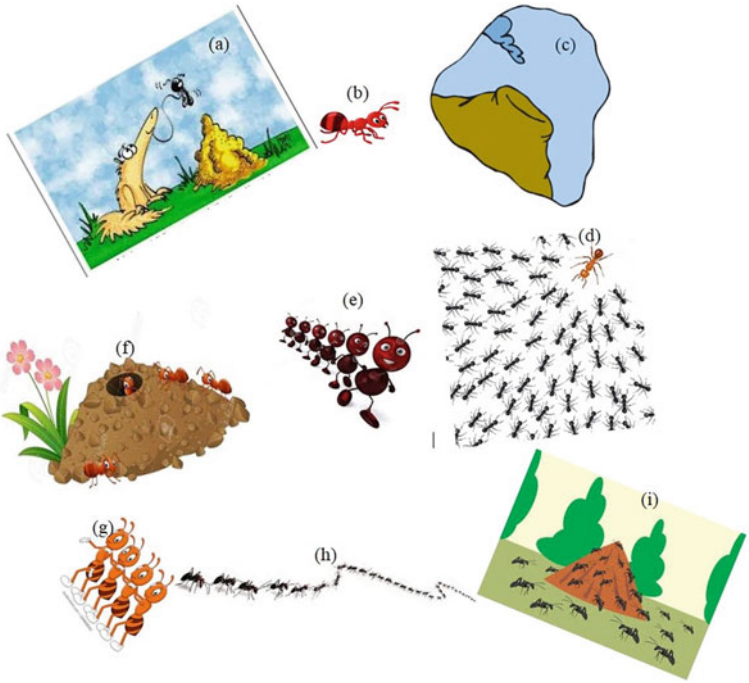

Fig. 2 Tandem running

Honeybees Colony: The princess bee decides to establish new colony, a subset of bees go to search an appropriate place to build new colony.

Waggle Dance: Honeybee forages find resources or new location to establish new colony independently, they return to the hive to share the information of new location with other workers through the code of 'Waggle Dance' (refer Fig. 3). It allows observing bees to learn the location of the new nest from the dancer's independent explorations. Energy expenditure or distance is indicated by the length of time it takes to make one circuit. Direction of food source is indicated by the direction the dancer faces during the straight portion of dance when the bee is waggling. If the bee waggles while facing straight upward, then the food source may be found in the direction of the sun. Some of the bees get attracted and follow the directions communicated through waggle dance and start a colony at newly found location. The princess bee becomes the queen of the newly established colony.

As depicted in Fig. 3, initially, when a new queen bee is identified, it searches for a new site. Few bees take initiative to search new site for starting new colony. When suitable site is found, they return to the old one and start performing waggle dance. Through waggle dance directions to the new site are communicated to the

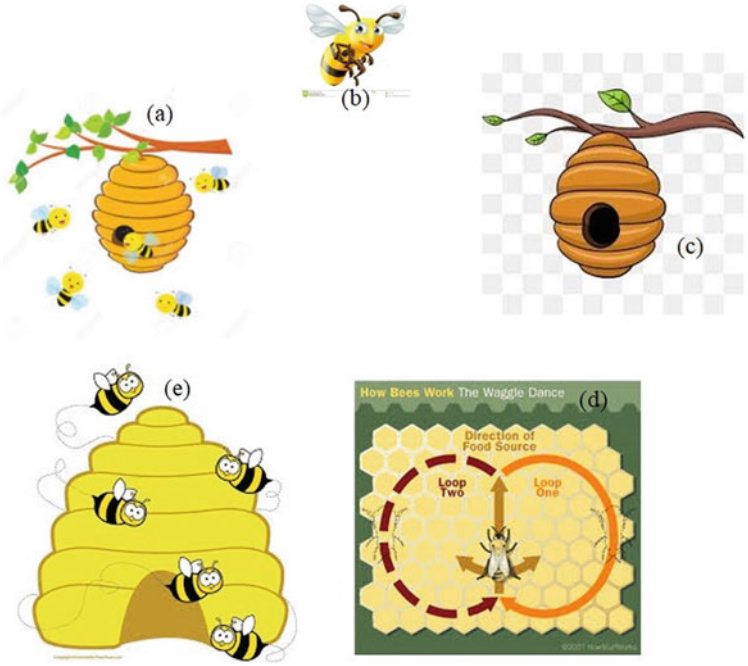

Fig. 3 Waggle dance

other bees. The attracted bees follow the directions and reach the new site. The queen bee starts its own colony with the bees.

4.2 Application of Biomimicry in Human Capital Management

Taking inspiration from ants and honeybees' analogies, we propose a solution to solve the problem of "Attracting candidates for talent acquisition" in HCM (Human Capital Management).

The correlation between Biomimicry and Talent Acquisition problem in organizations is depicted in Fig. 4. The leader ant which initiates tandem running process for searching candidate site is correlated with recruiter, the newly found candidate site is correlated with a vacant job position that needs to be filled, and the tandem followers are correlated with candidates who apply for the vacant job position of an organization.

As seen in Fig. 5, the recruiter creates a job description for the vacant job position and posts it to the job boards. Few interested candidates will apply to the job. The recruiter recruits better one among the applied ones.

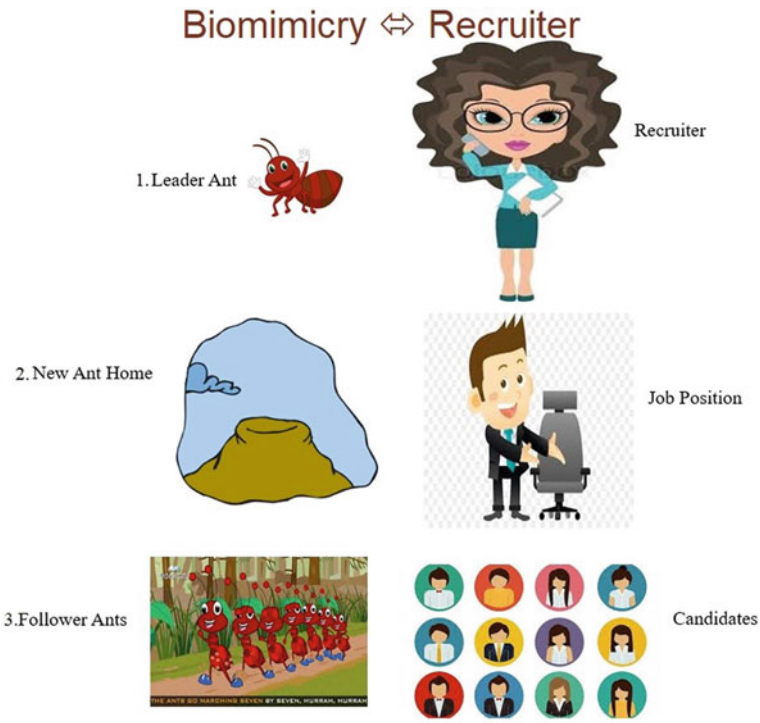

Fig. 4 Biomimicry correlated with recruiter

Recruiter tries to tap on the excitement of the new hires by nudging them to give inputs or reviews from the newly hired candidates on their journey in the organization after a period of a month or two. New hires are encouraged to create Waggle pages with their inputs in the form of comments, audios, videos, etc., and these Waggle pages/Waggle dashboard are shared with the external candidates along with the job description. Sentiment analysis is applied on the inputs collected from the new hires to identify the employee pulse. The inputs with negative sentiment are identified and notified to their respective managers and HR mangers to resolve the issues faced by the new hires and improve the employee engagement in the organization. These reviews are made available to the external candidates who are looking to join the organization.

The external candidates can go through the reviews given by the in-house candidates to get to know more information about the organization apart from job description. It will be a great source to gain first hand insights on the organization culture and gauge the fitment w.r.t their profiles. The external candidates need not collect additional information about the organization from the other sites/sources which usually have inputs from anonymous/unidentified and many a time disgruntled users. The external candidates can get quick clarifications to their queries

Fig. 5 Recruiter's approach after applying methods of Biomimicry

about the organization dynamics, work culture, project scope and more candidates can benefit from this aggregation of data and encourage them to apply for the job. The recruiter now gets more applications from candidates and can choose the best candidate for the position.

5 Experiment with Prototype

We built a prototype on a business organization (anonymous) and results are shown in the screen shots (refer Fig. 6). The Fig. 6 contains three screen shots, the first screen shot is the home page called *Waggle dashboard*. Here, an external candidate can view the job profiles of the organization. The external candidates are referred as visitor bees and the collection of reviews provided by the existing employees are referred as beehive. Here, we show the information about the number of visitor bees who viewed these reviews along with the number of employee reviews in the beehive. The reviews are collected w.r.t job profile. The visitor bee can click on "View Waggle" link to view the reviews in the beehive.

Fig. 6 Prototype screen shots

In the second screen shot, visitor bee can see the list of bees in the beehive network and their reviews. While collecting these reviews, internal bees are supposed to rate on count (in five scale) for few questions. The questions include work culture, on-boarding process, flexibility, benefits of the company, etc. The responses are shown graphically to the visitor bees. There is a representation of a pie chart that shows the number of internal bees which recommend working in the current company.

The third screenshot shows the reviews given the employee bees along their profile. These reviews can be in the form of text, videos, etc. It shows number of visitor bees visited the selected employee bee reviews. They can also see the number of bees found the reviews helpful and the number of bees liked the reviews. The visitor bees can select any employee bee to view their reviews.

6 Key Benefits

- *Organization Branding:* As the new hires create traction with Waggle pages, they serve as Brand Ambassadors and spread the good vibes of the organization culture and attract more candidates who are potential hires.
- *Reduced time to hire:* New hires wear the hat of recruiters in sourcing candidates and can aid in reducing time to hire which would result in huge cost savings for the organization.
- *Improved Candidate Engagement:* Recruiters find it difficult to engage all the candidates who have applied for a job through the recruitment journey. With the proposed approach the task gets decentralized and the new hires/employees who maintain the Waggle pages can take the candidate engagement to a whole new level with prompt responses to queries, aggregation of data, nudging recruiters etc.
- *Referral income for Employees:* The new hires/employees who maintain the Waggle pages can benefit from referral payments as all the candidates who apply through their Waggle pages would become their referrals.

7 Summary and Conclusions

In today's competitive world, finding and hiring the right talent is one of the major challenges faced by business organizations. In this paper, we proposed an approach using Biomimicry, taking inspiration from nature and applied it for recruitment area in Human Capital Management domain. It uses ant colonies and swarm of bees as references and discusses how these techniques can be used in human recruitment context. To attract external candidates, the solution encourages new hires and employees to host Waggle pages which capture their inputs, feedback and insights about the Organization and their work. These Waggle pages are shared with external candidates through Job openings. The external candidates can greatly benefit from the authentic information about the organization instead of relying on information gathered from unverified sources on Internet and also clarify their queries through Question and Answer section. The new hires/employees can also get incentives in the form of referral payouts while contributing to Organization branding and also helping the Organization in hiring the right talent in a short span. The proposed solution is a great fit for recruitment in many industries like IT. It will be a win-win-win situation for candidates-employees-organization. The feedback on the prototype has been encouraging and its been recommended to evolve into a product offering.

References

1. Arizona State University (2019). https://askabiologist.asu.edu/bee-dance-game/introduction.html. Accessed November
2. Glassdoor reviews (2019). https://www.glassdoor.co.in/Reviews/index.htm. Accessed November 2019
3. Indeed reviews (2019). https://www.indeed.co.in/cmp/Indeed/reviews. Accessed November 2019
4. Franks NR, Franklin EL (2012) Individual and social learning in tandem-running recruitment by ants. Anim Behav 84(2):361–368
5. Kaur R, Joseph JP, Anoop K, Sumana A (2017) Characterization of recruitment through tandem running in an indian queenless ant diacamma indicum. In: Royal Society open science
6. Mashingaidze S (2015) Effectiveness of teams: lessons from biomimicry, an ecologicalinquiry e = mc2. Risk Gov Control Financ Mark Inst 5(3):36–43

Deployment of a Simple and Cost-Effective Mobile IPv6 Testbed for the Study of Handover Execution

B. R. Chandavarkar

Abstract In the performance evaluation of any networking system, the testbed approach is more difficult, expensive and time consuming compared to the analytical and simulation approaches; however, the former has the advantage of realistic results. The purpose of this paper is to present, in detail, the deployment of a simple and cost-effective Linux-based Mobile IPv6 Testbed for the study of handover execution with testing checkpoints and debugging procedures. Further, this paper evaluates performance metrics such as bandwidth, packet delay, jitter and handover delay with respect to TCP and UDP traffic, and compares the same with the MIPv6 NS2 simulation results. Numerical results show that there is a marked variance between testbed and simulation results.

Keywords Mobile IPv6 · Handover · Wireshark · TCP · NS2

1 Introduction

Any type of networking system for the purpose of evaluation can be modelled using an analytical, simulation or testbed approach [1]. Each of these approaches has its own merits and demerits, as shown in Table 1. The testbed approach may become complicated with future heterogeneous wireless network deployment because of wireless networks' hardware and software heterogeneity.

The core issue in heterogeneous wireless network testbed deployment is handover (handoff) execution, preceded by handover decision and handover information gathering [2]. Handover execution is the process of switching the ongoing session of a Mobile Node (MN) from the previous accessing network to the new accessible network or Point of Attachment (PoA) for seamless communication. The Handover process may result due to weak received signal strength of the currently

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698,
https://doi.org/10.1007/978-981-15-7961-5_11

Table 1 Comparison of system modelling approaches [1]

Approach	Merits	Demerits
Analytical	Cost-effective, provides an abstract view of the components interacting with one another	Not feasible for large and complex systems, and too many assumptions result in inaccurate results
Simulation	Cost-effective, simple, fast to implement, uses less abstraction, and feasible for large and complex systems	Too many details result in an unmanageable simulation
Testbed	Realistic results and actual modelling of the system	Expensive, complex, timeconsuming, and diverse specifications and knowledge of the hardware and software are needed

accessing network or better Quality of Service (QoS) attributes of the newly accessible networks to the MN. Mobile IPv6 (MIPv6) [3] is one of the network layer protocols used by MNs for handover execution in homogeneous and heterogeneous wireless networks.

The major problem with the MIPv6 testbed available in literature is the lack of detailed testbed deployment information, testing checkpoints and debugging procedures. The main challenges in any testbed deployment are its complexity, cost and time. This motivated us to propose a detailed simple and cost-effective Linux-based MIPv6 testbed deployment procedure, enabling the research community to use the same for realistic results.

The rest of paper is organized as follows: Sect. 2 discusses related work in the MIPv6 testbed, addressing drawbacks; Sect. 3 presents an overview of MIPv6; Sect. 4 presents the deployment of a simple and cost-effective Linux-based MIPv6 testbed with testing checkpoints and debugging procedures; Sect. 5 illustrates the performance analysis of the deployed MIPV6 testbed for TCP and UDP traffic with NS2 simulation comparisons. Finally, conclusion and future directions of research are given in Sect. 6.

2 Related Work

This section of the paper presents, in brief, the survey conducted with respect to MIPv6 testbed deployment. Even though extensive research papers are available addressing MIPv6 testbed deployment, they all lack in presenting the MIPv6 testbed deployment in detail with testing checkpoints and debugging procedures.

K. C. Chua et al. [4] presented the Mobile IPv4 implementation in Linux kernel. Radoslaw Ruchala et al. [5] measured the data streaming QoS during handover in MIPv6 testbed; however, the major drawback of their paper is the lack of information to deploy the MIPv6 testbed and the unavailability of the Mobile IP for

Linux (MIPL) used for the testbed deployment. Similarly, Shariq Haseeb et al. [6] deployed the MIPv6 testbed using MIPL implementation to study performance metrics, but the drawback of their paper is the lack of testbed deployment with debugging information. S. R Azzuhri et al. [7] also presented the deployment of MIPv6 testbed with lack of testbed deployment and configuration details. Julien Montavont et al. [8] presented the shortcomings of the MIPv6 implementation in Linux compared to FMIPv6, using testbed. The major issues addressed by the authors are resolved in the current implementation of MIPv6.

Hence, the papers available in literature either used the older version of the MIPL addressing the drawbacks of MIPv6 implementation, or failed to provide easy, cost-effective and detailed information to deploy the MIPv6 testbed. This motivates us to build a simple and cost-effective Linux-based MIPv6 testbed by providing detailed deployment information, testing checkpoints and debugging procedures.

3 Mobile IPv6 Overview

Mobile IPv6 [3] is a network layer protocol that supports seamless handover of MNs between accessible networks. A MN which supports MIPv6 maintains the continuity of ongoing communication with the other communicating node (it may be a source or destination) referred to as Correspondent Node (CN) even after the MN changes its PoA. To support seamless communication, a MN is identified in the entire network by the permanent Home Address (HoA) and a Foreign Network (FN) dependent Care of Address (CoA); CoA varies when MN changes its PoA. When MN handovers to a new accessible network, it updates its CoA using Binding Update (BU) message to the Home Agent (HA) of the Home Network (HN) to which MN belongs. Further, HA responds to MN's BU message using Binding Acknowledgement (BA) message. If a MN handovers to a newly accessible network during communication with the CN, the MN also updates its CoA with the CN using BU message followed by a BA message sent by the CN to MN, thereby avoiding triangular routing of the packets. The entire handover message exchange between the HA, MN and CN can also be protected by IP Security (IPsec) [9].

4 MIPv6 Testbed Setup

Figure 1 shows the MIPv6 testbed setup of entities MN, HA, Router (R) and CN deployed using low-end desktops. Table 2 shows the hardware and software specifications of the testbed entities with the approximate cost of the entire setup excluding the low-end desktops being 42USD.

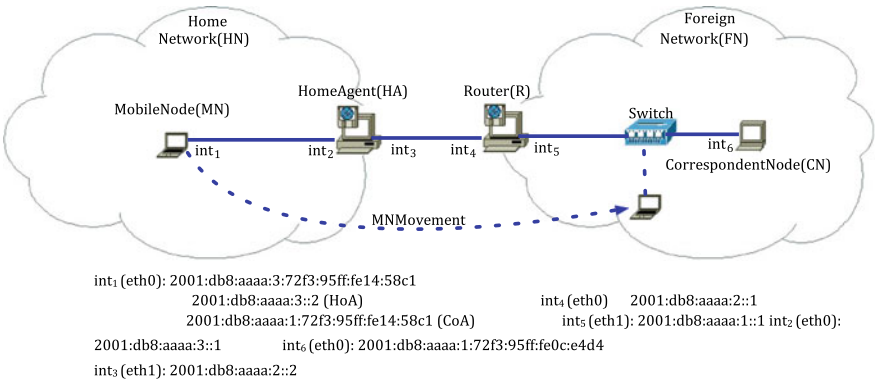

Fig. 1 MIPv6 testbed setup

Table 2 MIPv6 testbed specifications

Entity	Hardware	Software
Mobile Node (MN) and Correspondent Node (CN)	Intel Core i7 CPU 870@2.93 GHz, Intel 82578DM Gigabit Ethernet (eth0).	Ubuntu 12.04, Kernel 3.8.2, 32-bit OS, Jperf 2.0.2, Wireshark 1.6.7
Home Agent (HA) and Router (R)	Intel Core i7 CPU 870@2.93 GHz, Intel 82578DM Gigabit Ethernet (eth0), Realtek RTL8139/8139C/8139c+ (eth1).	
Switch	Netgear 10/100 Mbps Fast Ethernet (FS608)	

As shown in Fig. 1, interfaces of the testbed entities HA (int_2 and int_3) and R (int_4 and int_5) are configured with the static global IPv6 address, and interfaces of the entities MN (int_1) and CN (int_6) are dynamically configured with the IPv6 address through Stateless Address Autoconfiguration using the advertised prefix of HA and R [10]. The mobility of the MN in the testbed is introduced manually by disconnecting the MN's interface (int_1) from HN and connecting it to the switch in the FN. The following subsection explains the deployment of HA, R, MN and CN in the testbed.

4.1 MIPv6 Testbed Configuration

The first step in the MIPv6 testbed deployment is to enable MIPv6 in Linux kernel, followed by configuring UMIP in each entity [11]. UMIP (**U**sagi Patched **M**obile **IP**v6 Stack) is the MIPv6 implementation for the Linux kernel. After the successful execution of the first step, entities in the testbed are ready (presence of the MIPv6 daemon: *mipv6d*) for the next step of deployment, i.e., configuring the interface in

MN, HA, R and CN, and routing table in HA and R. After this step, the entities in the setup should be able to *ping* each other with their IPv6 addresses. This is a very important checkpoint of the testbed to proceed further with the remaining steps of the deployment. The following subsections explain the remaining steps of the testbed deployment, which is unique with respect to each of the entities.

4.2 Router Advertisement Daemon (Radvd)

This subsection explains the router advertisement daemon (*radvd*) configuration in HA and R [12]. The purpose of the router advertisement daemon is to broadcast the router prefix at regular intervals which will be used by the MN and CN to self-configure IPv6 address using their respective 48-bit MAC address. The IPv6 address generated by the MN or CN being in the foreign network is referred to as Care of Address (CoA). As shown in Fig. 1, FN for MN is the HN for CN. Similarly, the CoA of the MN represents the present location of the MN in the entire network. Successful execution of the *radvd* in HA and R can be verified by executing the command *radvdump* in HA and R.

Table 3 shows one of the router advertisement daemon (*radvd*) configuration file (*radvd.conf)* of HA and R for the testbed shown in Fig. 1.

Table 3 *radvd.conf* in HA (int_2) and R (int_5)

Home Agent (HA)	Router (R)

# cat /etc/radvd.conf interface 	
eth0
{
AdvSendAdvert on;
AdvIntervalOpt off;
AdvHomeAgentFlag on;
MaxRtrAdvInterval 3;
MinRtrAdvInterval 1;
HomeAgentLifetime 10000;
HomeAgentPreference 20;
AdvHomeAgentInfo on; prefix
2001:db8:aaaa:3::1/64
{
AdvRouterAddr on;
AdvOnLink on;
AdvAutonomous on;
AdvPreferredLifetime 10000;
AdvValidLifetime 12000;
};
};
	# cat /etc/radvd.conf interface
	eth1
	{
	AdvSendAdvert on;
	AdvIntervalOpt on;
	MinRtrAdvInterval 1;
	MaxRtrAdvInterval 3;
	AdvHomeAgentFlag off; prefix
	2001:db8:aaaa:1::1/64
	{
	AdvOnLink on;
	AdvAutonomous on;
	AdvRouterAddr on;
	};
	};

The option 'AdvSendAdvert' indicates whether or not the router should send periodic router advertisements and responds to router solicitations. 'AdvIntervalOpt' indicates the router advertisement interval's minimum (MinRtrAdvInterval) and maximum (MaxRtrAdvInterval) value in sec. 'AdvHomeAgentFlag' indicates that the router advertisement sending router is able to serve as MIPv6 Home Agent with the HA information option 'AdvHomeAgentInfo'. 'HomeAgentPreference' indicates the preference (integer) of the HA by sending this router advertisement with the lifetime 'HomeAgentLifetime' (sec).

With the 'AdvRouterAddr', the address of the interface is sent instead of the network prefix with the lifetime 'AdvValidLifetime' (sec) used for on-link determination 'AdvOnLink' with autonomous address configuration 'AdvAutonomous'. 'AdvPreferredLifetime' indicates the lifetime of the generated IPv6 address by the MN and CN through Stateless Address Autoconfiguration in sec. '2001:db8:aaaa:3::1' and '2001:db8:aaaa:1::1' represents the IPv6 address of the HA interface (int_2) and R interface (int_5) during broadcasting the router advertisement by HA and R respectively.

The *radvd* configuration of R is similar to HA, except the options 'HomeAgentLifetime', 'HomeAgentPreference' and 'AdvHomeAgentInfo' are not defined in R. In the case of R as a HA in the FN, *radvd* configuration of R will be same as HA (Table 3).

4.3 MIPv6 Daemon (Mip6d) Configuration Without IPsec

The next very important step of the MIPv6 testbed deployment is configuring the MIPv6 daemon i.e., *mip6d* [13]. This daemon is present in all MIPv6 enabled entities MN, CN, HA and R. In the testbed shown in Fig. 1, *mip6d* is enabled in MN, CN and HA but not in R; since MN belonging to HA is executing the handover in the deployed testbed and CN is stationary. *mip6d* addresses handover execution and is essential in the entities which are involved in the handover execution procedure. The binding messages BU and BA are exchanged during handover execution and can be protected with IPsec using keys shared by the MN and HA. This subsection illustrates the *mip6d* configuration without IPsec represented by the option 'UseMnHaIPsec' in MN, HA and CN being *disabled* as shown in Table 4.

Table 4 shows one of the MIPv6 daemon (*mip6d*) configurations file (*mip6d.conf)* of MN, HA and CN for the testbed shown in Fig. 1.

'NodeConfig' indicates the role of the host as MN, HA or CN along with the interface of MN, CN and HA enabled for the route optimization using 'DoRouteOptimizationCN' by eliminating triangular routing of the packets without IP security indicated by 'UseMnHaIPsec' being *disabled* in MN and HA. This is followed by support for debug messages 'DebugLevel'. As shown in Table 4, in MN *mip6d.conf* file '2001:db8:aaaa:3::2' indicate the HoA (permanent) of the MN

Table 4 *mip6d.conf* in MN, HA and CN without IPsec

Home Agent (HA)	Correspondent Node (CN)
# cat /usr/local/etc/mip6d.conf NodeConfig HA; DebugLevel 10; DoRouteOptimizationCN enabled; Interface "eth0"; UseMnHaIPsec disabled;	# cat /usr/local/etc/mip6d.conf NodeConfig CN; DebugLevel 10; DoRouteOptimizationCN enabled;
Mobile Node (MN)	
# cat /usr/local/etc/mip6d.conf NodeConfig MN; DebugLevel 10; DoRouteOptimizationCN enabled; Interface "eth0"; UseMnHaIPsec disabled; DoRouteOptimizationMN enabled; UseCnBuAck enabled; MnHomeLink "eth0" { HomeAgentAddress 2001:db8:aaaa:3::1; HomeAddress 2001:db8:aaaa:3::2/64; }	

Table 5 MN's interface configuration

(a) Before Handover	(b) After Handover
eth0 Link encap:Ethernet HWaddr 70:f3:95:14:58:c1 inet6 addr: 2001:db8:aaaa:3:72f3:95ff:fe14:58c1/64 Scope:Global **inet6 addr: 2001:db8:aaaa:3::2/64 Scope:Global** inet6 addr: fe80::72f3:95ff:fe14:58c1/64 Scope:Link UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1 RX packets:248414 errors:1 dropped:0 overruns:0 frame:1 TX packets:454393 errors:0 dropped:0 overruns:0 carrier:0 collisions:7509 txqueuelen:1000 RX bytes:59890219 (59.8 MB) TX bytes:410172850 (410.1 MB) Interrupt:20 Memory:fb300000-fb320000 **ip6tnl1** Link encap:UNSPEC HWaddr 20-01-0D-B8-AA-AA-00-03-00-.. inet6 addr: fe80::72f3:95ff:fe14:58c1/64 Scope:Link UP POINTOPOINT RUNNING NOARP MTU:1460 Metric:1 RX packets:11 errors:0 dropped:0 overruns:0 frame:0 TX packets:17 errors:0 dropped:0 overruns:0 carrier:0 collisions:0 txqueuelen:0 RX bytes:860 (860.0 B) TX bytes:13066 (13.0 KB)	eth0 Link encap:Ethernet HWaddr 70:f3:95:14:58:c1 inet6 addr: 2001:db8:aaaa:1:72f3:95ff:fe14:58c1/64 Scope:Global inet6 addr: fe80::72f3:95ff:fe14:58c1/64 Scope:Link UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1 RX packets:248444 errors:1 dropped:0 overruns:0 frame:1 TX packets:454416 errors:0 dropped:0 overruns:0 carrier:0 collisions:7509 txqueuelen:1000 RX bytes:59893991 (59.8 MB) TX bytes:410178062 (410.1 MB) Interrupt:20 Memory:fb300000-fb320000 **ip6tnl1** Link encap:UNSPEC HWaddr 20-01-0D-B8-AA-AA-00-01-00-.. **inet6 addr: 2001:db8:aaaa:3::2/128 Scope:Global** inet6 addr: fe80::72f3:95ff:fe14:58c1/64 Scope:Link UP POINTOPOINT RUNNING NOARP MTU:1460 Metric:1 RX packets:11 errors:0 dropped:0 overruns:0 frame:0 TX packets:17 errors:0 dropped:0 overruns:0 carrier:0 collisions:0 txqueuelen:0 RX bytes:860 (860.0 B) TX bytes:13066 (13.0 KB)

used by the other communicating devices in the network to communicate with the MN, in-spite of MN location is in HN or FN.

4.4 Testing of MIPv6 Testbed

Table 5(a) shows interface configuration details of the MN generated using *ifconfig* when MN is in HN (before handover) with *mip6d* in MN is under execution. As shown in Table 5(a), 'ip6tnl1' represents the tunnel indicating the successful

execution of *mip6d* in MN and HA. A very important point to be noted in Table 5 (a) is that the HoA of MN '2001:db8:aaaa:3::2' is assigned to the interface 'eth0' when MN is in the HN. The HoA is the permanent static IPv6 address of the MN used to communicate with MN when it is in HN or FN.

Table 5(b) shows interface configuration details of the MN generated using *ifconfig* when MN is in FN (after handover) with *mip6d* in MN is under execution. As shown in Table 5(b), after MN handover to FN, HoA of the MN is used to identify the other end of the tunnel created between HN and MN. The tunnel between HN and MN is used to redirect the packets intended to MN when it is FN and also, this is the way packets are sent to MN after handover without route optimization (triangular routing).

Further, Table 6(a) shows the binding update list (*bul*) entries in MN before and after handover to FN. In MIPv6 enabled entities *mip6d* daemon (after its successful execution) runs at port '7777'. Using *telnet* with port '7777' *bul* entries in MN can be checked for BU sent to HA and CN before and after handover to FN as shown in Table 6(a). Execution of *bul* in MN with no results indicate the presence of MN in HN. In the case of MN communicating with CN during handover, *bul* results into a details indicating the BU message sent to HA and CN (if MIPv6 is enabled). Moreover, MN send BU only to HA in the case of no communication with CN during handover.

Similarly, Table 6(b) shows the binding cache (*bc*) entries in CN (if MIPv6 enabled) after MN handover to FN. Using *telnet* with port '7777' *bc* entries in CN can be checked for BU received by CN after MN handover to FN as shown in Table 6(b). Similar results can also be observed in HA with *bc*.

Table 6 MN and CN binding details

(a) MN's BU List before and after Handover	(b) CN's Binding Cache after MN Handover to FN
brc@MN: $ **telnet localhost 7777** Trying 127.0.0.1... Connected to localhost. Escape character is '^]'. mip6d> **bul** mip6d> **bul** **== BUL ENTRY ==** Home address 2001:db8:aaaa :3:0:0:0:2 Care-of address 2001:db8:aaaa:1:72f3:95ff:fe14:58c 1 CN address 2001:db8:aaaa :3:0:0:0:1 lifetime = 11996, delay = 11396000 flags: IP6 MH –BU –HOME IP6 MH BU ACK ack ready lifetime 11990 / 11996 seq 58919 resend 0 delay 11396(after 11390s) mps -1437558206 / 10796 **== BUL ENTRY ==** Home address 2001:db8:aaaa :3:0:0:0:2 Care-of address 2001:db8:aaaa:1:72f3:95ff:fe14:58c 1 CN address 2001:db8:aaaa:1:72f3:95ff:fe14:56c 6 lifetime = 420, delay = 420000 flags: IP6 MH –BU –ACK ack ready RR state ready lifetime 415 / 420 seq 36772 resend 0 delay 420(after 416s) mip6d> bul	brc@CN: $ **telnet localhost 7777** Trying 127.0.0.1... Connected to localhost. Escape character is '^]'. mip6d> **bc** mip6d> **bc** hoa 2001:db8:aaaa:3:0:0:0:2 status cached coa 2001:db8:aaaa:1:72f3:95ff:fe14:58c1 flags A- - - local 2001:db8:aaaa:1:72f3:95ff:fe14:56c6 lifetime 414 / 420 seq 8774 unreach 0 mip6d>

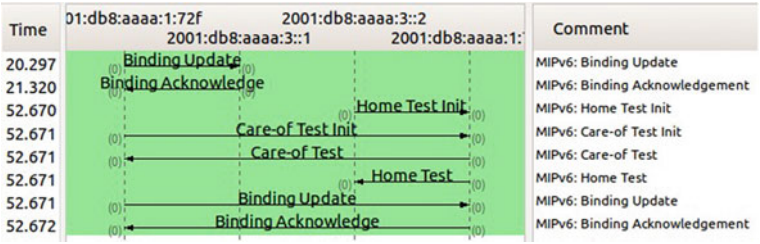

Fig. 2 MIPv6 Handover Messages Captured by Wireshark MN updates its CoA with the CN to eliminate triangular routing of packets and this is also referred to as route optimization (RO)

Table 7 TCP and UDP traffic performance in MIPv6 testbed

Metrics	MN's Location	Jperf TCP	Jperf UDP
Bandwidth (Kbps)	Home Network	3353	499
	Foreign Network	5258	512
	Without RO	1082	282
Delay (ms)	Home Network	0.05	0.05
	Foreign Network	0.075	0.025
	Without RO	0.5	0.4
Jitter (ms)	Home Network	Minimum	0.049
	Foreign Network	High	0.136
	Without RO	High	0.2

Figure 2 shows the flow of binding message (BU and BA) exchange between MN, HA and CN captured using Wireshark after MN handover to FN. As shown in Fig. 2, the first two messages (BU and BA) represent the MN updating HA with the new CoA after MN handover to FN. The next four messages (HoT, HoTI, CoT and CoTI) exchanged between MN and CN indicate the procedure to check the authenticity of MN, before MN updates its new CoA with the CN. After the successful exchange of HoT, HoTI, CoT and CoTI,

Hence, the successful deployment of the MIPv6 testbed is completed. In the next section the deployed MIPv6 testbed is used to study performance metrics such as bandwidth, delay, jitter with respect to the TCP and UDP application.

Table 8 Comparison of results of MIPv6 testbed and NS2 simulation w.r.t binding update delay

Environment	Home network to foreign network		Foreign network to home network	
	To HA	To CN	To HA	To CN
Testbed	1.017262 s	1.108 ms	0.0208 s	2.485 ms
Simulation (UDP)	9 ms	9.78 ms	9.6 ms	9.11 ms
Simulation (TCP)	41.4 ms	27.3 ms	36 ms	45 ms

5 Results and Analysis

To study the performance of MIPv6 testbed with respect to TCP and UDP traffics, tools such as *ping*, *jperf*, and Wireshark are used. Table 7 shows the performance of TCP and UDP application in the MIPv6 testbed. As shown in Table 7 bandwidth, packet delay and jitter of TCP and UDP application are obtained for before handover, after handover with RO and after handover without RO. After MN handover to FN, MN and CN being in the same network (FN), bandwidth is high after MN handover to FN with RO compared to before handover and handover without RO.

Further, the MIPv6 testbed topology is repeated in network simulator NS2 to compare testbed results with simulation results with respect to binding delay, i.e., time taken to send BU and receive BA message. The NS2 simulation is carried out with the topology shown in Fig. 1 for the packet size 1 KB, rate 100 K and the interval 0.01 s. Further, the link bandwidth is 100Mbps with propagation delay of 1.8 ms. Table 8 shows the comparison between MIPv6 testbed and NS2 simulation results with respect to the BU delay.

Numerical results show that there is a variance between the testbed and simulation results.

6 Conclusions and Future Work

The main essence of this paper is to present the deployment of simple and cost-effective Linux-based MIPv6 testbed with testing checkpoints and debugging procedures. This paper also presented comparisons of TCP and UDP application performance in the MIPv6 testbed. Further, BU delay of MIPv6 testbed was compared with MIPv6 NS2 simulation results. Numerical results showed the variance between testbed and simulation results.

The demonstration of a simple and cost-effective Linux-based MIPv6 testbed, for future work opens a new platform for researchers to implement and verify innovative ideas for realistic results.

References

1. Jain R (1991) Art of Computer Systems Performance Analysis Techniques For Experimental Design Measurements Simulation and Modelling. Wiley Computer Publishing, Wiley
2. Kassar M, Kervella B, Pujolle G (2008) An overview of vertical handover decision strategies in heterogeneous wireless networks. Elsevier Comput Commu 31:26072620
3. Perkins C, Johnson D, Arkko JRFC 6275 Mobility Support in IPv6, July 2011. http://www.ietf.org/rfc/rfc6275.txt. Accessed 12 October 2015
4. Chuaa KC, Li YZ, Foo CC (1999) On a Linux implementation of mobile IP and its effects on TCP performance. Elsevier Comput Commun 22:568–588
5. Ruchala R, Zielilski K (2006) Measurements of data streaming QoS during handover process in mobile IPv6 Testbed. In: 2nd international conference on TRIDENTCOM 2006
6. Haseeb S, Kurup G (2007) Performance analysis of MIPL based mobile IPv6 testbed. In: IEEE International Conference on Telecommunications and Malaysia International Conference on Communications, Penang, Malaysia, 14–17 May 2007
7. Azzuhri SR, Suhaimi S, Daniel K, Wong, Ali NMd (2008) Mobile IPv6: simultaneous and consecutive mobility experiments on MIPL testbed. In: 4th International Conference on WiCOM 2008
8. Montavont J, Ivov E, Noel T (2007) Analysis of mobile IPv6 handover optimizations and their impact on real-time communication. In: IEEE WCNC 2007
9. Devarapalli V, Dupont F (April 2007) RFC 4877 Mobile IPv6 Operation with IKEv2 and the Revised IPsec Architecture. http://www.ietf.org/rfc/rfc4877.txt. Accessed 12 October 2015
10. Thomson S, Narten T, Jinmei T (September 2007) IPv6 Stateless Address Autoconfiguration. https://tools.ietf.org/html/rfc4862. Accessed 12 October 2015
11. UMIP - Mobile IPv6 and NEMO for Linux. http://umip.org/. Accessed 12 October 2015
12. Ubuntu manuals. http://manpages.ubuntu.com/manpages/utopic/man5/radvd.conf.5.html. Accessed 12 October 2015
13. mip6d.conf-Linux man page. http://linux.die.net/man/5/mip6d.conf. Accessed 12 October 2015

The Dependency of Healthcare on Security: Issues and Challenges

Lakshmi Jayant Kittur, Richa Mehra, and B. R. Chandavarkar

Abstract Information security and privacy in the sector of healthcare is an important issue that has to be given importance. With the growing adoption of electronic health records of patients, the need of accessing and sharing information between different healthcare professionals is also increasing. This gives rise to the attention that has to be provided for securing the information. Also the adoption of the Internet of Things in wireless body sensor networks, leads to the usage of Cloud and Fog in healthcare systems. Thus pointing towards secure methods of accessing, storing, processing of sensitive data. In this paper, an overview of different issues and challenges pertaining to the security of healthcare systems is presented. Also, the solutions to address the security concerns in the healthcare systems are also discussed.

Keywords Wireless Body Area Networks · Internet of Things · Healthcare systems · Fog computing · Cloud computing · Blockchain

1 Introduction

With the advancement of communication and information technologies, the use of Electronic Healthcare systems is increasing rapidly. The health records of patients are maintained electronically so that it becomes easy to access for patients, doctors and other healthcare workers across organizations.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_12

Many android applications like Self-help Anxiety Management, iCardio [1] are being deployed on Google Play store that help the patients in providing various healthcare services like apps for dealing with anxiety, monitoring ECG, etc.

Also, with the advent of technology like the Internet of Things (IoT), Wireless Body Area networks(WBAN) [2] are being used to monitor the patients health and gather information about various activities.

However, there are various security concerns related to healthcare systems.

The electronic health records are prone to many security threats. The cyberattacks on the healthcare systems may gain access to medical records of patients. Preserving the confidentiality, privacy, integrity of healthcare data is of utmost importance.

Large amount of data is generated by sensors that are in close proximity to human body, the main challenge is how to store this information so that it becomes easy and efficient to process and at the same time maintaining the privacy of the data without being vulnerable to attacks by the hackers. Cloud technology can be used to archive such large amounts of data. Even the sharing of data between multiple users is also easy. However, if the data being stored on the cloud is not encrypted then the data integrity, confidentiality can be at stake. Also, in WBAN, if the data has to be accessed and processed from the Cloud every time then there may be a delay in providing certain services [3]. To resolve such issues, Fog Computing can be used since it provides real-time data analysis and will help to monitor patients in times of emergency. But, the fog nodes may be attacked and sensitive information may be stolen, modified.

The rest of the paper is organized as follows. In Sect. 2, the various issues and challenges related to security and privacy threats related to healthcare systems, electronic health records, usage of Cloud and Fog in healthcare systems, android apps are discussed. In Sect. 3, the possible solutions like encryption in the cloud, using Blockchain technology and many other methods to avoid the attacks on healthcare systems are also discussed. Finally in the last section, the conclusion is presented.

2 Healthcare Systems and Their Security Issues

This section describes the different healthcare systems like issues related to electronic health records s-Health systems, m-Health apps, WBAN, big data healthcare systems, healthcare systems with the usage of fog. Further, it also describes the security issues and challenges in the healthcare systems including the access control system, cybercrimes in healthcare systems.

2.1 Security Issues Related to Electronic Health Records

Electronic healthcare information systems are becoming popular due to its ability to provide assistance in sharing the health care information of the patients with the doctors and other healthcare workers. This will help in providing various healthcare services to the patients in times of emergency and otherwise as the patient record can be accessed electronically from anywhere. It also becomes easy to share the information with the doctors, pharmacists as the data will be digitally stored. The patient details and other health-related data will be stored electronically which is referred to as electronic health records.

However, the security of these electronic health records is very much needed because of the reason that anyone can misuse such records. Hence, preserving the privacy, integrity and maintaining access control over the healthcare records is important.

The various threats concerning Electronic health records are [4]:

1. Masquerading: Here, a user may try to access the health record to which the user is not authorized.
2. Repudiation of actions: Here, the sender or receiver may deny that the information was sent by him/her. On the sender's side, the user may say that he/she never requested for an appointment with a doctor and on the receiver side he/she may say that he/she never received a request though he/she actually received.
3. Denial of Service: In this type of attack, the authorized medical person or the patient may be denied access to the information or resource.

Nowadays, cloud infrastructure is used to store the medical records which will help in accessing healthcare records of patients by doctors, helps them to discuss the issues through video calling and it can also help us to analyze the data to derive various patterns like which doctor is popular, which medical labs are famous, etc. However, the cloud provider is usually a third-party service, hence data may get modified if someone hacks the cloud or even the authorized parties may sell the data residing on cloud without consent of users.

2.2 Security Issues Related to S-Health Systems

With the growing popularity of smart cities, researchers have proposed a s-Health system that uses mobile computing, Internet of Things, Wireless Sensor Networks [5]. The citizens of the smart city are continuously monitored by their location and also important activities about their health are also being captured using sensors. This might be an issue for certain citizens as they may feel that their privacy is at stake. Some people might fear that their health information might be leaked to certain unauthorized parties. The hackers might hack the central database and collect electronic health records. Also, mapping of the real identity of a citizen with

his/her medical conditions may not be liked by the citizens as the fear that if this data is leaked to either their employer or even insurance companies, their jobs may be at stake or the insurance may not be approved. Hence, the confidentiality of the data collected is one of the security issues in a s-Health system.

2.3 Security Issues Related to m-Health Apps

With the rapid advancement in mobile applications, the use of mobile health apps is increasing. Many Google Play apps like Self-help Anxiety Management, iCardio provide help to users in dealing with depression, monitoring various organs of our body and also provide information about various symptoms that the user has [1].

However, many of these apps are released without taking into account the security flaws that may be revealed while using [6]. The issues relating to confidentiality may be seen because of the logging facility that is provided in the android system. The Android logging system helps to collect log output and debugging outputs of the apps. It may so happen that a malicious app having READ LOG permission may try to collect sensitive information related to the patient's health that is stored in the output log of m-Health apps [1].

2.4 Security Issues Related to WBAN

Wireless Body Area Network (WBAN) is used to provide a mechanism that will help to monitor the health records of the patients using wearable sensors as shown in Fig. 1 and thus storing the collected information [2]. Hence, preserving confidentiality, integrity, freshness of data is an important challenge that needs to be addressed. For example, the attacker may attack the ECG monitoring sensor, modify the data and send wrong information to the physician. This may even lead to the death of patients. In another scenario, the attacker may perform Denial of Service (DoS) attack wherein the legitimate users are not only denied access to system resources and services but also they may be denied immediate actions in times of emergency.

2.5 Security Issues Related Big Data Healthcare Systems

Big data in the healthcare system can increase the security and privacy of patient data. In Big data healthcare systems, the data is stored in data centers which is filled with various levels of security. Big data healthcare system collects data from various sources, analyse all of them and then give an improved and smart decision as shown in Fig. 2. To get meaningful health care analytics is not an easy task, it is,

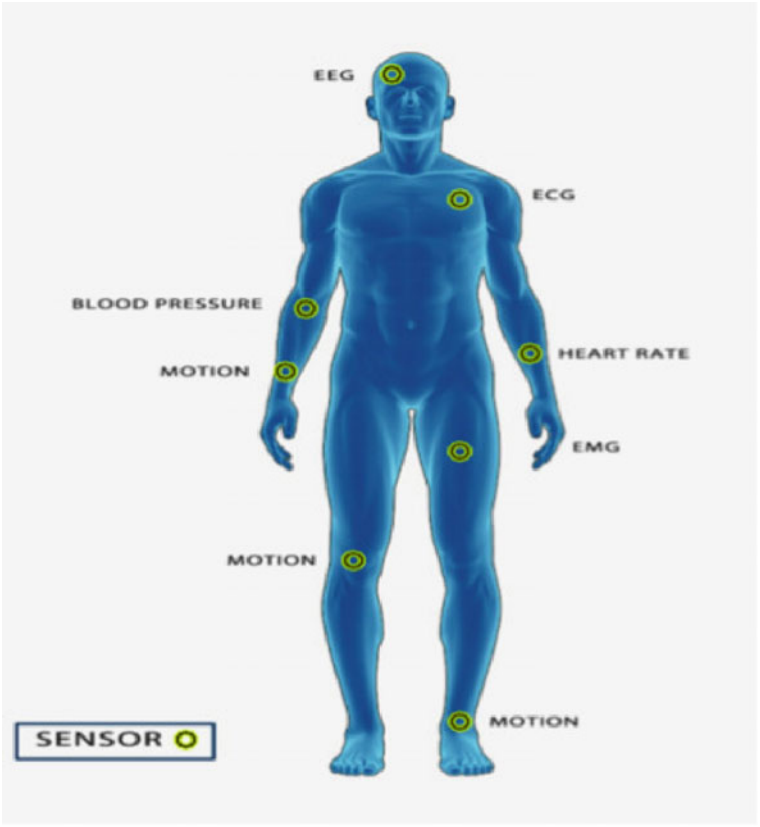

Fig. 1 WBAN sensors [2]

however, filled with challenges and problems to solve. For example, real-time security analysis and prediction of threat source is needed in any healthcare system [8]. At present, it is witnessing various attacks which include Distributed Denial of Service attack and various social engineering attacks, the risk prediction associated with these are difficult without human consideration. Another big challenge is the patient's privacy in big data analytics. Encryption schemes which can run on encrypted data are required to protect the patient identity [9].

2.6 Security Issues Related to Using of Fog in Healthcare Systems

In real-time, the hitches in data transfer, delay in the processing of data in the cloud, and getting the processed results late is not acceptable. Such delays may be

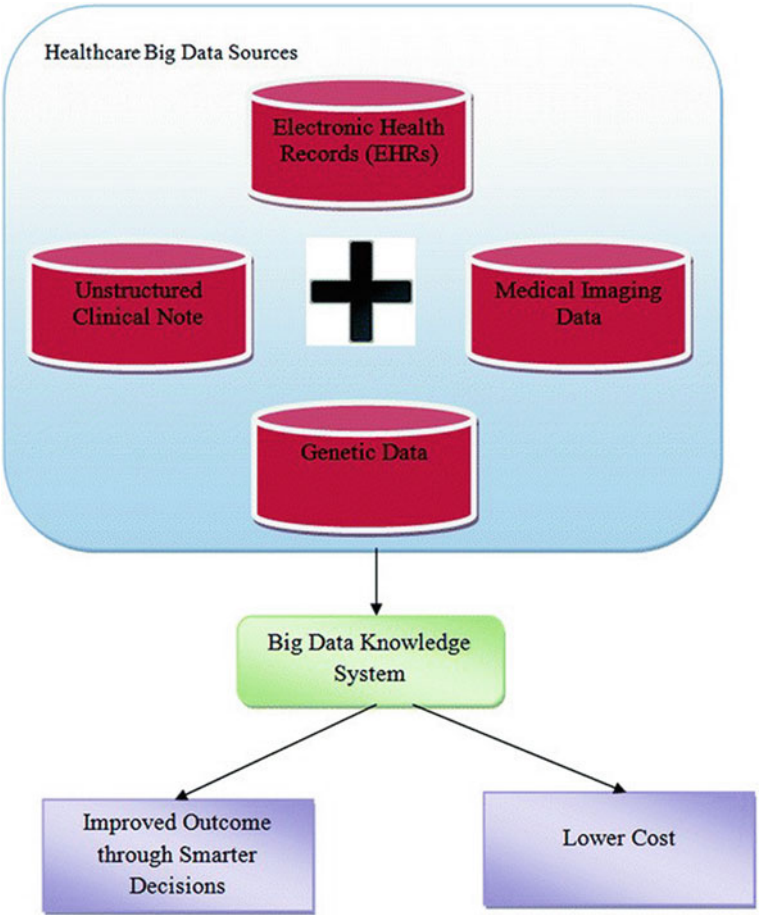

Fig. 2 Big Data health care system [7]

lifethreatening [3]. To solve such issues in Cloud computing, a new computing concept called Fog Computing is introduced that is a sandwich between the Cloud and IoT devices.

Fog Computing provides a virtualized platform that provides storage, computing and networking between data centers (Cloud) and end IoT devices. Data computation application services and storage is provided by both cloud and fog Computing system. As fog nodes can be in some places with weak protection, they may encounter various attacks [10] like attacks from malicious fog nodes and attack from malicious IoT or edge devices of the user. Now identifying these malicious nodes is a crucial task in Fog Computing systems. Certain privileges are there with every node, so it becomes more difficult to prevent an attack. Another attack which

can occur is Man in the Middle attack, patient data that is released can be altered by an external attacker while transferring data between edge and fog nodes.

2.7 Challenges Related to Providing Access Control

An important challenge in healthcare systems is access control [11]. The modern healthcare systems are composed of very large networks, consisting of many roles i.e. a multitude of users, doctors, nurses, pharmaceuticals across organizations. Hence, access to health records should be controlled so that sensitive data is protected from malicious users and hence prohibiting unauthorized access.

2.8 Cybercrimes in Healthcare System

The cyber attacks may disrupt the normal working of medical devices, induce wrong values, hack the sensors worn by the patients. On the other hand, some cyber-attacks on healthcare systems may be for monetary gains [12] wherein they hack the systems and release the systems only when certain ransom is paid to them. The WannaCry ransomware attack that took place in 2017 affected the healthcare sector adversely [13]. Many healthcare systems were totally disabled, which interrupted the medical procedures of the patients.

Although Health Insurance Portability and Accountability Act (HIPAA) has emphasized on compliance of security and privacy rules to protect healthcare data by setting up a framework, just complying to those rules will not ensure the security of the healthcare systems [12].

3 Solutions to the Security Issues in the Healthcare System

In this section, the solutions related to various security issues that can be found while storing healthcare data in cloud, fog, securing the s-Health system, m-Health apps, providing authorization and authentication, access control are discussed.

3.1 Securing Data in the Cloud

In order to secure the data in the cloud when the health records are not stored in an encrypted format is to use blockchain technology [14]. Since blockchain is decentralized and there is no involvement of any third party, the medical records can be stored safely on the blockchain nodes, which will increase the security of

healthcare systems. Since, the attackers are always trying to hack the systems to steal the data, modify the data, blockchain will help to resolve this because the transactions on the blockchain will be immutable and traceable as every transaction is visible to all the nodes on the blockchain [14].

3.2 Security Solutions in the s-Health System

In the s-Health system, the information about the patient's health and location is conveyed to the system [5]. The health system or even the managers of this system might try to associate the identity of the citizens with their medical records, history, or location. This is called identity privacy. Such privacy issues are taken care by using pseudonyms. However, if the main system is attacked, then the identity of citizens may be captured and in such cases, in [5] the authors have suggested the use of geographically distributed pseudonymizers.

3.3 Security Solutions in the m-Health Apps

In m-health apps, the authors in [6] have suggested following requirements to provide:

- The security and confidentiality of data can be provided by using Advanced Encryption Standard (AES) with key size 128bits (minimum requirement) must be used to encrypt patient health records.
- Secure data transfer, Transport Layer Security (TLS) with 128-bit encryption or 256bit encryption methods s be used. It would be desirable to show an icon in the app to indicate data transfer.

3.4 Security Solution in Big Data Healthcare Systems

The core system design of any big data health care system should be security analysis. As the conventional key distribution scheme and many revocation schemes are not to be extended to high number of IoT devices and hence some renewed scalable key management schemes are to be introduced so that there can be proper communication between different edge or IoT devices and networks.

Big data health care system is gaining popularity and hence the concern of privacy of patient's data is also increasing, so to overcome that, various laws that can protect the data need to be applied on patients data [9]. To protect the patients data, the patients information should be made anonymization before it is being

analyzed. Further, various algorithms should be applied which allow an analysis of encrypted data so that the patients identity is not be leaked.

3.5 Security Solution in Fog Computing Healthcare Environment

To keep the patients record secure while transferring data between edge and fog nodes or between different fog nodes, the security while transferring data should be customizable and it should also be robust in resource-constrained fog health care system. There is a need of a flexible and intermittent end to end security mechanism in communication between fog and cloud, which should be able to handle network connection which is unreliable and that could achieve configuration related to security which suits the needs of different application. To protect the identities of edge nodes the techniques that can be used are pseudonyms and homomorphic encryption technique while the data is being uploaded from edge nodes or devices to cloud [15]. Lightweight encryption can also be applied to guarantee confidentiality and integrity, one more alternative is masking algorithm.

To protect data from malicious fog nodes, the first investigation is the interaction between a vulnerable node and the malicious node. Then the review, analysis, and realization of the complex decision-making process is done. To protect patients information from vulnerable node there should be an intrusion detection system which reviews the access rights before analysis is being done [16].

3.6 Solution for Maintaining Access Control

To solve the challenge of providing access control, Role-Based Access Control (RBAC) scheme [17] can be used since it provides tools to manage and implement different access control policies that are based on hierarchies that are usually complex commonly found in healthcare organizations.

3.7 Comparative Study of Different Healthcare Systems

The Table 1 shows the different healthcare systems along with their security problems and suitable solutions

Table 1 Comparison between different technologies used in healthcare system

Type of technology	Problem	Solution
Cloud in Healthcare system	Authorization, access control	Blockchain technology
s-Healthcare system	Privacy, confidentiality	Pseudonyms
m-Healthcare system	Confidentiality, logging	AES
WBAN	Integrity, access control, DoS	RBAC
Big Data in Healthcare system	Real-time security, DDoS	Scalable key management scheme
Fog Computing in Healthcare system	Man in the Middle Attack	Pseudonyms and lightweight encryption

3.8 Providing Authentication and Authorization

To provide secure mechanism for medical data sharing, authors in paper [18] have proposed a system wherein the doctors and the patient upload the medical records and reports to the cloud through authentication provided through symmetric encryption. Also, the patients can authorize the parties to view/upload the medical records. Hence, this ensures that privacy, confidentiality is preserved.

4 Conclusion

Use of computer technology in healthcare systems is increasing rapidly. However, the security of healthcare systems is an important issue. With a large amount of personal data being collected by healthcare systems, preserving the privacy of data is of utmost importance. Also, various attacks may be possible on the sensors that are in close proximity to humans. Use of cloud and fog technology in healthcare systems come with their own security issues. In this paper, we have discussed various issues relating to the security and privacy of healthcare records of patients like confidentiality, integrity, availability, data theft, the attacks possible on fog nodes of healthcare systems. Further, solutions to the above-mentioned issues like preserving the privacy and security of sensitive health information by using blockchain technology, the access control method like RBAC that can be used to implement different access control policies is also discussed. Depending on the technology used in healthcare systems, different security measures can be taken to mitigate threats and attacks.

References

1. He D, Naveed M, Gunter CA, Nahrstedt K (2014) Security concerns in android mhealth apps. In: AMIA annual symposium proceedings, vol 2014. American Medical Informatics Association, p 645
2. Al-Janabi S, Al-Shourbaji I, Shojafar M, Shamshirband S (2017) Survey of main challenges (security and privacy) in wireless body area networks for healthcare applications. Egypt Inf J 18(2):113–122
3. Kumari A, Tanwar S, Tyagi S, Kumar N, Opportunities and challenges (2018) Fog computing for healthcare 4.0 environment. Comput Electr Eng 72:1–13
4. Win KT, Susilo W, Mu Y (2006) Personal health record systems and their security protection. J Med Syst 30(4):309–315
5. Ding D, Conti M, Solanas A (2016) A smart health application and its related privacy issues. In: 2016 smart city security and privacy workshop (SCSP-W). IEEE, pp 1–5
6. Martínez-Pérez B, De La **Torre**-Díez I, Lopez-Coronado M (2015) Privacy and´ security in mobile health apps: a review and recommendations. J Med Syst 39(1):181
7. Manogaran G, Thota C, Lopez D, Vijayakumar V, Abbas KM, Sundarsekar R (2017) Big data knowledge system in healthcare. In Internet of things and big data technologies for next generation healthcare. Springer, pp 133–157
8. Patil HK, Seshadri R (2014) Big data security and privacy issues in healthcare. In: 2014 IEEE international congress on big data. IEEE, pp 762–765
9. Abouelmehdi K, Beni-Hessane A, Khaloufi H (2018) Big healthcare data: preserving security and privacy. J Big Data 5(1):1
10. Zhang P, Zhou M, Fortino G (2018) Security and trust issues in fog computing: a survey. Future Gener Comput Syst 88:16–27
11. Appari A, Johnson ME (2010) Information security and privacy in healthcare: current state of research. Int J Internet Enterp Manag 6(4):279–314
12. Perakslis ED (2014) Cybersecurity in health care. N Engl J Med 371(5):395–397
13. S¸cheau MC, Pop SZ (2018) Cybercrime evolution. In: International conference knowledge-based organization, vol 24, Sciendo, pp 225–229
14. Kaur H, Alam MA, Jameel R, Mourya AK, Chang V (2018) A proposed solution and future direction for blockchain-based heterogeneous medicare data in cloud environment. J Med Syst 42(8):156
15. Wang H, Wang Z, Domingo-Ferrer J (2018) Anonymous and secure aggregation scheme in fog-based public cloud computing. Future Gener Comput Syst 78:712–719
16. Ariu D, Tronci R, Giacinto G (2011) Hmmpayl: an intrusion detection system based on hidden Markov models. Comput Secur 30(4):221–241
17. Gallaher M, O'Connor A, Kropp B, Tassey G (2002) The economic impact of role-based access control. Technical report, National Institute of Standards and Technology (NIST)
18. Chen C-L, Hu J-X, Fan C-L, Wang K. Design of a secure medical data sharing system via an authorized mechanism

One Time Password (OTP) Life Cycle and Challenges: Case Study

Deepak Kumar, Uma Kant Gautam, and B. R. Chandavarkar

Abstract In today's world of the internet, we give priority to secure many of our accounts over this. It could be our social media profile, our cloud storage account, or anything; everything can be accessed only via a login interface. Traditional login systems follow a simple procedure of asking for username and password to authenticate the user. But due to the exponential development in the field of technology, this login interface is vulnerable to many attacks and thus compromising the user's privacy and data. One more level has been added to the login interface known as OTP or One Time Password. The concept of OTP is that a randomly generated fixed digit code is sent to the user's physical device if the entered password is correct. This way, we can be surer that only the appropriate user is accessing the system. This whole system combined known as 2-Factor authentication system. OTP is sent directly to the user's accessible physical device only. It has many other applications like bank transactions, deletion of a social media account or cloud account, and many others. It's because of the dynamic nature of OTP. This paper discusses the lifecycle of the OTP and its issues and challenges in the current world.

Keywords One time password · Event-based OTP · Time-based OTP · OTP generation

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_13

1 Introduction

Advancement in technology each day, increasing the dependency of the individual on these technologies, which make individual work more accessible and efficient. But as technology and reliance are growing, the threats that can create problems are also increasing severely, and we are facing challenges to overcome this threat [1, 2]. Nowadays, everything is online, either it is banking or shopping. So, every individual want to be safe and for that various authentication and authorization steps are formed, and this authentication and authorization [3] It is done by means of a technique called OTP verification.

The usage of OTP of a banking system can be understood with the help of Fig. 1 shown below

OTP stands for One Time Password [4], which may contain numeric or alphanumeric characters that authenticate a user for the transaction or only one login session. OTP is also known as a dynamic password or One-Time Pin. OTP has many advantages over static password. OTP is valid for one time only. Once OTP is used, it can't be used further. In a static Password, if someone got your password, then he can easily access your account. Now, in many cases, the user uses the same password at many accounts. If the password of one account been hacked, then the probability of hacking other accounts will develop. Again, privacy can be imposed on other accounts by using OTP. OTP can also be used as a Two-Factor authorization.

Two-Factor Authentication [5] is basically security process. In Two-Factor authentication, users verify themselves in two different authentication techniques. In the first step, the user enters its password. If the password is correct, then the next

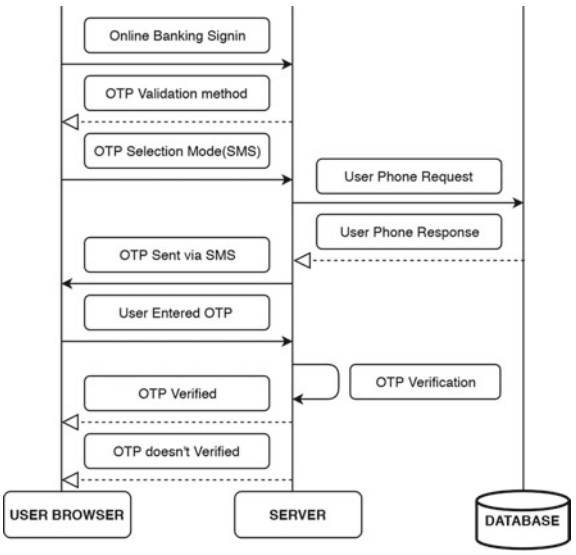

Fig. 1 Use of OTP in banking system

verification step. In the next step, user verification is done via OTP or by activation depends on the application. But OTP is much more popular than activation link because it requires fewer resources than activation link like internet connection. Two Factor Authorization is much secure to protect the legitimate user's credentials and the resources it is using.

The brief introduction is followed by Sect. 2, which covers Authentication Mechanism [3]. It contains a list of a broad class of mechanisms, namely trivial authentication mechanism and 2-Factor authentication mechanism. Section 3 explains [4] OTP Generation Techniques. Section 4 explains the different type of attacks [1] that are used to break an OTP system. Finally, Sect. 5 concludes the paper.

2 Authentication Mechanism

Authentication [3] is the method for a system to check whether the user accessing the system is a genuine user or a malicious one. User authentication used to confirm the identity that the user can access the system or not.

2.1 Trivial Method of Authentication

Trivial method of authenticating a user is also known as single-factor authentication. In this method, we ask a user for his username and a password for the authentication purpose. Figure 2 helps in understanding the working of a trivial authentication system. The problem with this system is that if a malicious user gets access to the password, then that he can access the confidential data of the user without any obstacles. Even the system cannot differentiate between the malicious user and the genuine user because the same password is used to authenticate the genuine user as well.

2.2 2-Factor Method of Authentication

This method helped overcome the problems with a trivial method of authentication [5]. In this, a randomly generated fixed digit code is sent to a user-accessible device with which the user can securely authenticate himself. This randomly generated

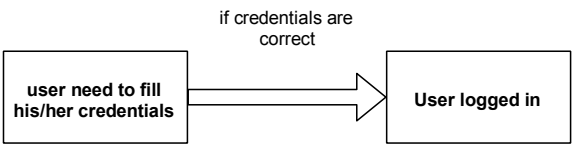

Fig. 2 Approach used before two-factor authentication

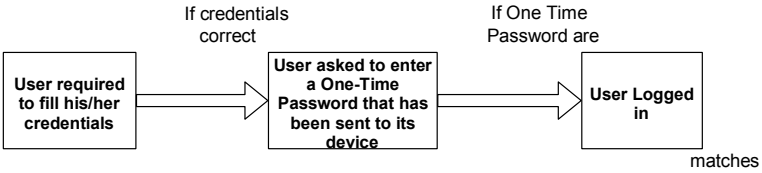

Fig. 3 Two-factor authentication

code is sent to the user after he has entered the correct password. The user set password provides the first level of security, and the randomly generated code provides the second level of security. The randomly generated code is also known as a one time password. This code cannot be used for the next login. In the next login, a new code will be generated. Figure 3 helps in understanding the working of a Two-Factor authentication system [6, 11, 12]. There are two different types of method for delivering the One Time Password:

1. Using SMS (Short Message Service): This technique is widely used nowadays. In this OTP is sent to user's device via in text message or via voice message, and this OTP is used for further authentication of a user. First, OTP is generated; this process takes place on the server-side, and this OTP then sent to Client by text message or voice message, which is going to be authenticated. It becomes the most common and feasible method of OTP delivery.
2. Using Application: For OTP [5] generation at the user side, we use this type of mechanism. Users can access the OTP by scanning a QR code on the screen using any smartphone. Assuming a smartphone supports QR code scanning. It reduces the waiting time for the OTP to be delivered. It also aids in providing more security to users when compared to SMS based delivery.

3 OTP Generation Mechanism

There is some OTP generation mechanism [13] listed below which help us to understand the generation process:

1. Time-based mechanism [4]: In this mechanism, the main component of this OTP generation is time. As time depends on the place because time could be varied according to place. So to overcome this limitation, Unix timestamp is used, which is considered to be independent of the time zone.
2. Event-Based mechanism [7]: This mechanism is used initially for the OTP generation. Main Component of OTP generation is a secret key that is generated by server like in a time-based mechanism, but instead of time here, a counter is used. The counter stored on the server as well as in the token. Counter that resides in token increases when the action on the button of token is executed, while the counter lay on server increases when an OTP validated successfully.

3.1 *Example of Generation of OTP Using Time-Based Mechanism*

Time-Based OTP [7] is the most common and feasible method of OTP generation. This method uses the current time for generating the OTP's. There is the example given that how can we generate an OTP using Time-Based OTP generation algorithm [8]:

1. First server generate a random secret key.
2. This secret key then shared with OTP generating service by server.
3. Using the current time and secret key, a hash-based message authentication code (HMAC) is generated. Cryptographic algorithm SHA-1 is used to generate this hash-based message authentication code.
4. As the server and the user device that is requesting OTP can access dynamic-time. So, Time is the main parameter for a Time-based algorithm. This algorithm takes Unix timestamp, which doesn't depend upon timezone of a particular area. Time is calculated in seconds, and the default starting date is 1 January 1970. Let us consider string generated from HMAC-SHA1 algorithm is "0215a7d8c15b492e21116482b6d34fc4e1a9f6ba".
5. Code generated from HMAC-SHA1 is always 20 bytes long, but we can truncate to generate the desired length of OTP as per user or application convenience. Dynamic truncation is widely used. For the 20-byte code "0215a7d8c15b492e21116482b6d34fc4e1a9f6ba", every character in string hold 4 bits. The entire string is taken as 20 individual one-byte string, as shown in Fig. 4.

6 Here we see the last character, i.e., 'a.' The decimal value of which is used to find the offset from which truncation could be start. Starting from offset 10 to the succeeding 31 bits, we will get the corresponding string '6482b6d3'. Now we have to take our hexadecimal numerical value and convert it to decimal, which supplies 1686288083.

7. Eventually, we need to know what length of OTP is set for the application. We can pad 0's if the number of digits is required else; we can find OTP of the desired length by using modulo 10^{length}. Here Length is the number of digits we want in our OTP. If we take our OTP length as six-digit, then we get "288083" as our TOTP code.
8. A counter is always set to keep track of time elapsed and generate a new code after a predefined period.

9 Now OTP generated after these processes delivered to requesting devices.

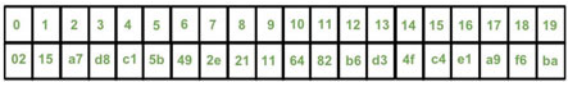

Fig. 4 Mapping of HMAC-SHA1 code to 20-byte [8]

3.2 OTP Generation Process

OTP generates [10] for only a dedicated session, and as soon as the session ended, OTP drops. First, OTP generated using any of the above mechanisms. Initially, its status is default, i.e., SET, and then it delivered to the requested device using SMS, voice call, or by any application. When the user uses that OTP, then OTP status changes to RESET and if OTP matches, then user authenticated else not. If OTP doesn't use for the specified session, then it will be dropped, and OTP status becomes NULL. Here NULL indicates that OTP doesn't use within a period, as shown in Fig. 5.

4 Different Type of Attacks [1]

There are different types of attacks that can cause the OTP theft problem. Here some of the attacks are listed that are commonly known and widely used for OTP cracking or hacking.

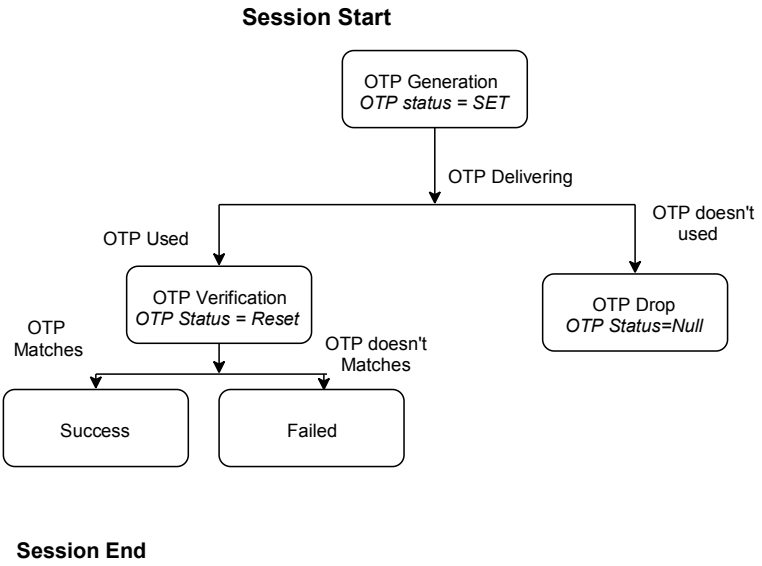

Fig. 5 OTP generation and session

4.1 Brute - Force Attack [9]

This attack is cracking the OTP by trying all possible combinations. Brute-Force attack on OTP is testing each combination of the digit to crack the OTP. Some E-commerce websites are still using 4-digit OTP. As we can try different possible combinations within a fixed session, so there may be a chance that OTP could be a break. One more reason that Brute-Force can work because there limited combinations like 10^4 and in which some combinations never used to make OTP secure. Hence we got fewer combinations to try. That's why maximum applications, E-commerce, and banking websites are switching to 4-digit OTP to 6-digit OTP.

4.2 Session Attack/Hijacking [9]

Session Attack or Hijacking is an intervention on users sessions on a shielded network. It is a security attack that can bother the client to use its OTP within a specified session. IP Spoofing [3] is a well-known method of session hijacking. In this, the attacker directs the IP packets to source-routed to include commands into an ongoing connection that is established between two systems within the network and make himself as a validated user. This attack could be happening because the authentication process is only done at the starting of the session of TCP(Transport Control Protocol).

4.3 SMS Flood Attack/Resource Exhaustion Attack [9]

SMS Flood is used to causing trouble and annoyance or in some cases, crash the hardware. This attack can also result in a denial of service attack as the user is flooded with a massive amount of SMS messages and thereby using the system resources heavily. The target of the SMS Flood attack can be single or multiple, depending upon the intention of the attacker.

5 Conclusion

OTP is an authentication mechanism that is used as an extra layer of protection to an authentication system. It can also be stated as a randomly generated codeword which has a lifetime of only a session. As soon as the session ends, the OTP is dropped, and for new session, a new OTP is generated. This paper discusses the overall lifecycle and challenge of an OTP system. The two broad authentication mechanisms have been considered, namely, Trivial and Two-Factor authentication

mechanisms. OTP generation mechanisms have been discussed briefly. We have also briefly discussed various attacks that can venture into an OTP system.

References

1. Wang D, Wang P (2015) Offline dictionary attack on password authentication schemes using smart cards. In: Desmedt Y (ed) Information security, Springer International Publishing, Cham, pp 221–237
2. Tzemos I, Fournaris AP, Sklavos N (2016) Security and efficiency analysis of one time password techniques. In: Proceedings of the 20th pan-hellenic conference on informatics, PCI 2016. ACM, New York, pp 67:1–67:5
3. Zahid H, Khan U (2010) Comparative study of authentication techniques
4. Hsieh W, Leu J (2011) Design of a time and location based one-time password authentication scheme. In: 2011 7th international wireless communications and mobile computing conference, pp 201–206
5. Jiang X, Ling J (2013) Simple and effective one-time password authentication scheme. In: 2013 2nd international symposium on instrumentation and measurement, sensor network and automation (IMSNA), pp 529–531, December 2013
6. Erdem E, Sandıkkaya MT (2019) Otpaas—one time password as a service. IEEE Trans Inf Forensics Secur 14(3):743–756
7. M'Raihi MPD, Machani S, Rydell J (2011) TOTP: time-based one-time password algorithm. RFC 6238, RFC Editor, May 2011
8. Avantika Bhatia. One time password (OTP) algorithm in cryptography. https://www.geeksforgeeks.org/one-time-password-otp-algorithm-in-cryptography/
9. Khan AA (2013) Preventing phishing attacks using one time password and user machine identification. CoRR, abs/1305.2704
10. Lee YS, Lim H, Lee H (2010) A study on efficient OTP generation using stream cipher with random digit. In: 2010 the 12th international conference on advanced communication technology (ICACT), vol 2, pp 1670–1675, February 2010
11. Zendrato N, Zarlis M, Efendi S, Barus ES, Sulindawaty, Fahmi H (2019) Increase security of IoT devices using multiple one time password. J Phys Conf Ser 1255:012030
12. Eldefrawy MH, Alghathbar K, Khan MK (2011) OTP-based two-factor authentication using mobile phones. In: 2011 eighth international conference on information technology: new generations, pp 327–331, April 2011
13. Hsieh W-B, Leu J-S (2013) A time and location information assisted OTP scheme. Wireless Pers Commun 72(1):509–519

Comparative Study Between RSA Algorithm and Its Variants: Inception to Date

Urvesh Rathod, S. Sreenivas, and B. R. Chandavarkar

Abstract RSA Public Key Cryptography (PKC) otherwise called asymmetric encryption, comprises of two keys known as public key and private key. While the sender utilizes receiver's public key to encrypt the message, the receiver's private key is utilized for decrypting the message, so there is no compelling reason to share a private key as in symmetric cryptography which requires sharing a private key. This paper means to investigate RSA and its variants, study its qualities and shortcomings, and propose inventive answers for conquer the shortcoming. RSA is extraordinary compared to other asymmetric key cryptographic algorithms in correspondence over systems.

Keywords RSA · Cryptography · Public key · Private key · Encryption · Decryption · Factorization · Prime numbers

1 Introduction

In the smart and digital environment, transferring data in a secured way through public channels is very crucial job. Data security corresponds to data Confidentiality, Authentication, Integrity, and Non-repudiation [1]. Along these lines so as to accomplish security objectives, secret/mystery composing was developed as known as cryptography. With the emergence of RSA encryption system in year 1978, prime numbers played a significant role to allow secure transmission and sensitive information over network channels.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_14

RSA [2] is based on increasing two generally huge prime numbers. In this manner, number factorization is the main answer for finding primes in RSA. Today, the factorization of an enormous number is a significant issue and also treated as NP-Hard problem [3]. Higher security can be authorized with bigger prime numbers since prime factorization is very hard and the RSA framework exploits this rich property. In any case, utilizing exceptionally enormous prime numbers for RSA includes progressively computational time in encrypting and decrypting the data, which should be adjusted for continuous applications. With this confinement, pernicious aggressors focus on breaking the RSA framework by finding proficient strategies for prime factorization.

2 Variants of RSA Algorithms

2.1 RSA Algorithm

The first paper for RSA was proposed by Rivest and Adleman [2, 4] which gives answer for encrypting information over an public channel utilizing two keys which are public and private keys, where public key can be sent crosswise over public channel. Once data is encrypted with public key, it can be decrypted only utilizing private key. Numerous variations of this base algorithm had been proposed during the mean time but because of absence of computational resources it was unrealistic to either assault or actualize any algorithms. Yet, more than quite a while numerous attacks on RSA happened till date which incorporates Brute power key inquiry, Mathematical attacks [3], Timing attacks and Chosen Cipher content attacks.

2.2 Efficient RSA

Aboud and Jabbar [5] proposed variant of RSA called Efficient RSA. This Variant uses the concept of linear grouping where h is order of general linear group where values are picked randomly from the ring of natural number *mod n* and n is a result of two enormous prime numbers. The number resulting to co-prime with n forms a linear group of multiplication modulo n with order $g(n)$. Inverse square matrices of rank h and natural number modulo n will create a similar group of same order, and this is obscure in the general plan. In the general plan where n is a result of two particular prime numbers we can discover the order for this group by the accompanying hypothesis:

$$g = (p^h - 1)(p^{h-p}) \ldots (p^h - p^{h-1}) + (q^h - 1)(q^{h-p}) \ldots (q^h - p^{h-1})$$

where g is the linear group of $h \times h$ matrices over natural numbers.

2.3 Dependent RSA

Pointcheval [6] proposed Dependent RSA *DRSA* into provide semantic security to the original RSA problem. The *DRSA* cryptosystem is semantically secure against chosen plain text attacks in the standard model, comparative with another troublesome issue (the inversion problem is identical to RSA as a rule), with an encryption factor multiple times quicker than El Gamal (with comparable security levels: RSA-1024 bits versus El Gamal-512 bits).

Key Generation:

i $n = p * q$, where p and q are enormously large primes.
ii $gcd(e, \varphi(N)) = 1$, where e is relatively prime to $\varphi(N)$.
iii $h: Z_N \times Z_N \rightarrow \{0,1\}^l$, where h is a linear group or hash function.
iv Public key is a pair of (n, e).
v Secret key d = $e^{-1} \ mod \ \varphi(N)$

2.4 Shared RSA

Shared RSA Scheme [7] is the place where the decoding procedure is shared between various PCs and deciphered parallelly. If prime factors of n is known to k systems. Then each system P_i now just have $< p_i, q_i, d_i >$ only part of the key. Moreover, the accompanying four conditions should be fulfilled:

i $p = p_1 + p_2 + ... + p_k$, where p is a large prime number.
ii $q = q_1 + q_2 + ... + q_k$, where q is a large prime number.
iii $e * d$ is congruent to 1 mod $\varphi(n)$.
iv $d = d_1 + d_2 + ... + d_k$, where d is private key

2.5 Carmichael RSA

Carmichael functions are defined as

$$a^m \equiv 1 \, (mod \, n)$$

where n is a positive integer and m is smallest positive integer defined by function of $\lambda(n) = lcm(p - 1, q - 1)$ in number theory and for every integer a that is between 1 and n that is co-prime to n are carmichael functions. de Vries [8] gave a variation utilizing The Carmichael function signified by $\lambda(n)$, where $n = p*q$, where p and q are large prime numbers and is characterized as $\lambda(n) = lcm(p - 1, q - 1)$. $\lambda(n) | \varphi(n)$ since both the Carmichael function $\lambda(n)$ and the Euler Phi function $\varphi(n)$ share

similar divisors. Henceforth any conceivable key sets got utilizing the Euler Phi Function is additionally conceivable utilizing the Carmichael work yet the switch isn't valid. This variant is defined as (*e, d*).

where $n = p * q$ can be given as $\varphi(\lambda(n))$.

2.6 Multi Prime RSA

Another variant of RSA is Multi Prime RSA [9, 10], which uses multiple prime numbers for generation of private key. Individual primes size is not big to reduce computational complexity but the resultant prime after multiplication of these individual primes are big enough so factorization becomes difficult.

Key Generation:

i Let $p_1, p_2, p_3, \ldots, p_n$ are distinct primes.
ii $N = p_1 * p_2 * p_3 * \ldots * p_n$.
iii $\varphi(n) = (p_{1-1}) * (p_2 - 1) * (p_3 - 1) * \ldots * (p_n - 1)$.
iv Public key e is $gcd(e, \varphi(n)) = 1$.
v Private key is d, which is an inverse of n.

2.7 Multi Power RSA

If you stick to some statement like the correct structure is what amplifies security as a component of the bit length of n, at that point $n = p * q$ is conceivably the correct structure. Nonetheless, security isn't the main proportion of a cryptosystem. Clients think about computational efficiency, conservativeness, protection from side-channel attacks, and licensed innovation claims, among different properties. So there might be space for elective key structures. Without a doubt, various options in contrast to $n = p * q$ have been proposed. The way that it is conceivable to utilize $n = p_1^{e_1} * p_2^{e_2} * \cdots * p_l^{e_l}$ was referenced in the RSA patent Collins and Sabin [11]. Different proposition in the writing will in general center around improving efficiency.

Key Generation:

i Let p, q be two large prime numbers.
ii $N = p * p * p * p$ ....*n times* $* q$.
iii $\varphi(n) = (p - 1) * (q - 1)$.
iv Public key e is $gcd(e, \varphi(n)) = 1$.
v Private key is d, which is an inverse of n.

2.8 Common Prime RSA

A variant given by Sarka and Maitra [13] and Hinek 14] the problem with RSA is its computational complexity if we reduce size of keys RSA can be cracked easily thus according to Rivest, Shamir, Adleman the private exponent d $d > N^{0.292}$, where N is multiplication of 2 primes.

[13] says that the algorithm cannot be cracked if private exponent is less than $N^{0.25}$ if primes are common primes. g is a large prime number, let $p = 2 * g * a + 1$ and $q = 2 * g * b + 1$ be primes such that $gcd(a, b) = 1$ and $h = 2 * g * a * b + a + b$ is also prime. The first restriction ensures that $gcd(p - 1, q - 1) = 2 * g$ while the second ensures that $\frac{p*q-1}{2} = gh$ which is approximately closer to $n = p * q$. p and q satisfying the above properties are known as common primes.

2.9 Chinese Reminder Theorem RSA

In this variant Wulansari [12], computation of modular exponentiation at decryption can be reduced by factor of 0.5 at max using CRT.

Key Generation:

i p and q are two relatively large prime numbers such that $p \neq q$.
ii $N = p * q$ and $\varphi(N) = (p - 1) * (q - 1)$.
iii Public key component e such that $1 < e < \varphi(N)$ with $gcd(e, \varphi(N)) = 1$.
iv Private key component $d = e^{-1} \bmod \varphi(N)$.
v $d_P = d \bmod (p - 1)$ and $d_Q = d \bmod (q - 1)$
vi $q_{Inv} = q^{-1} \bmod p$
vii Public Keys are (e, n) and Private Keys are (d_P, d_Q, q_{Inv}, p, q).

In Table 2, we attempted to outline and look at all the variations of RSA algorithms regarding Key Generation procedure, Encryption procedure and Decryption procedure which are talked about in Sect. 2.

3 Results and Analysis

3.1 Architecture and Visualization

We chose python as our scripting language since it gives rich functionalities for accurate simulation results and furthermore gives rich libraries like Gmpy2 and Crypto for handling efficient modular inverse calculation and random primes generation (Table 1).

Table 1 System specifications

CPU	AMD Ryzen 5 3550 H
RAM	8 GB
RAM speed	2666 MHz
Clock speed	2.1 Ghz
Cores	8
Cache size	4 MB
Operating system	Windows 10 Home
Scripting language	Python
Packages used	Gmpy2, Crypto

Table 2 Theoretical analysis of different RSA variants

Variants	Key Generation	Encryption	Decryption
RSA [3]	$d = e^{-1} \bmod \phi(n)$	$C = P^e \bmod n$	$P = C^d \bmod n$
Efficient RSA [5]	$d = (p^h - 1)...(p^h - p^{h-1}) + (q^h - 1)...(q^h - p^{h-1})$	$C = P^e \bmod n$	$P = C^d \bmod n$
Dependent RSA [6]	$d = e^{-1} \bmod \phi(n)$	$C_1 = K^e \ mod \ n$ $C_2 = M * ((K+1)^e \ mod \ n)$	$K = C_1^d \ mod \ n$ $P = C_2/((K+1)^d \ mod \ n)$
Shared RSA [7]	$d = d_1 + ... + d_k$	$C = P^e \bmod n$	$m_i = c^{d_i} \ mod \ n$ $P = p_1 * p_2 * .... * p_k$
Carmichael RSA [8]	$\lambda(n) = lcm(p-1, q-1)$ $d = \phi(n) \backslash \lambda(n)$	$C = P^e \bmod n$	$P = C^d \bmod n$
Multi Prime RSA [9]	$\phi(n) = (p_1 - 1) * ... * (p_n - 1)$ $d = e^{-1} \bmod \phi(n)$	$C = P^e \bmod n$	$P = C^d \bmod n$
Multi Power RSA [10]	$\phi(n) = p^{r-1} * (p-1) * q^{s-1} * (q-1)$ $d = e^{-1} \bmod \phi(n)$	$C = P^e \bmod n$	$P = C^d \bmod n$
Common Prime RSA [13]	$p = 2 * g * a + 1$ $q = 2 * g * b + 1$ $gcd(a, b) = 1$ $h = 2 * g * a * b + a + b$ $gcd(p-1, q-1) = 2 * g$ $\frac{p*q-1}{2} = gh$ $\phi(n) = (p-1) * (q-1)$ $d = e^{-1} \bmod \phi(n)$	$C = P^e \bmod n$	$P = C^d \bmod n$
Chinese Remainder Theorem RSA [12]	$d = e^{-1} \bmod \phi(n)$ $d_P = d \bmod (p-1)$ $d_Q = d \bmod (q-1)$ $q_{Inv} = q^{-1} \bmod p$ $d = (d_P, d_Q, q_{Inv}, p, q)$	$C = P^e \bmod n$	$P_1 = C^{d_P} \bmod p$ $P_2 = C^{d_Q} \bmod q$ $h = q_{Inv} * (P_1 - P_2) \bmod p$ $P = P_2 + h * q$

3.2 *Private Key Generation Analysis*

As appeared in Fig. 1, our simulation visualizes behavior of Multi Power RSA, Multi Prime RSA, Chinese Remainder Theorem (CRT) RSA, RSA, Carmichael RSA and Dependent RSA. For every variant, generation of prime

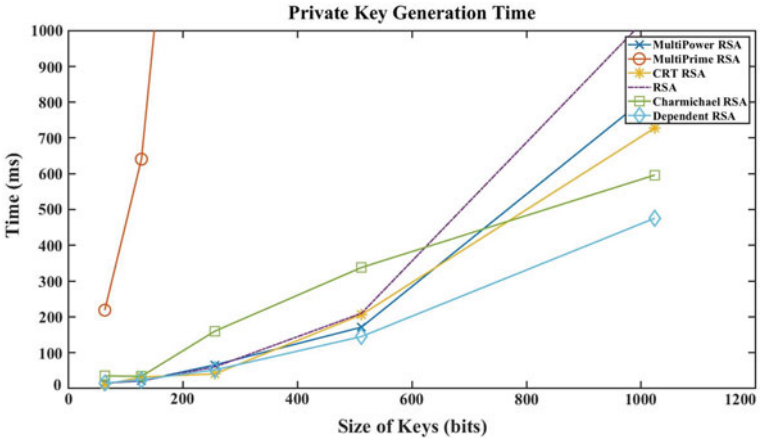

Fig. 1 Comparative chart on RSA variations based on Encryption Time

numbers are different so private key generation results are totally based on the random prime numbers generated during simulation. From Fig. 1, we deduced that Multi Prime RSA and Multi Power RSA takes the most key generation time since generation of primes is a expensive operation. In Multi Prime RSA number of primes used are $n/2$ primes where n is size of key in bits whereas in Multi Power RSA power of primes p and q were raised by $n/2$ where n is size of key in bits. Common prime RSA is another variant which has the elevated key generation time among all the variants because of it multifaceted nature in generation of common primes. Also Fig. 1 shows that Dependent RSA is taking least time to generate prime numbers. The chart

simply rely upon prime generation on the off chance that we set aside prime generation effort to be consistent and, calculation of reverse for private key as integral factor, then carmichael RSA has the least key generation time because of utilizing carmichael functions where the size of carmichael numbers is not as much as Euler totient numbers (Table 3).

Table 3 Time for generating Keys in Common Prime RSA

Prime Size	Time (Micro Sec)
10	27
20	500
40	13576
60	111287
80	553793

In case of Common Primes RSA key generation time is calculated separately for only small key sizes because there are multiple factors for generating prime numbers which makes the algorithm slower as compared to its other variants. If there exist an efficient algorithm for generation of common primes then we can reduce the number of bits in key due to the fact that factorization to common primes are relatively harder than non common primes.

3.3 *Encryption Time Analysis*

As mentioned in Table 2 in encryption column, all the algorithms except Dependent RSA is using same encryption formula but still during simulations, as shown in Fig. 2, we found out that time taken for encrypting data isn't same. Each variant is using 16 KB of data for encoding the plain text except for Multi power RSA and Multi prime RSA where data used is simple "*Hello*" message for encryption. There are few observations which can be inferred from the graph which are listed as follows:

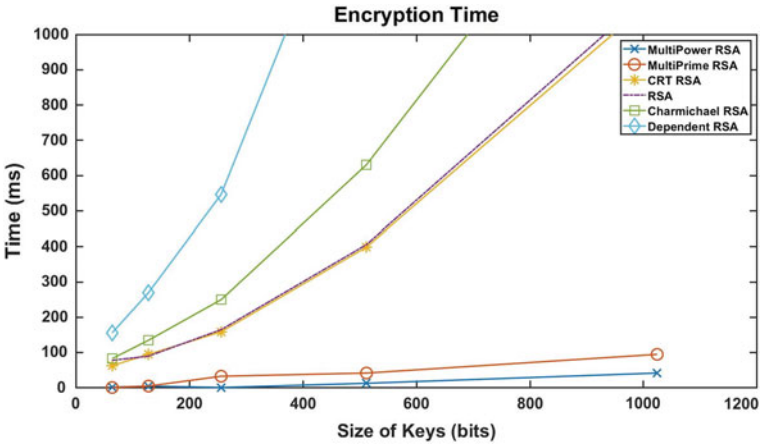

Fig. 2 Comparative chart on RSA variations based on Encryption Time

i Encryption time for 16 KB of data for Multi prime and Multi power RSAwill be high compared to any other algorithm.
ii Carmichael RSA and Dependent RSA encoding time is greater than general RSA while its key generation time was lower compared to general RSA.
iii Chinese Remainder Theorem (CRT) RSA performs similar to general RSA while its key generation time is still better than general RSA with better security.

iv Shared RSA, which is not included in the graph, will be the best algorithm for encoding the data since calculations can be broken and simulated parallelly depending upon number of machines used.

3.4 Decryption Time Analysis

As mentioned in Table 2 in decryption column, all the algorithms except Dependent RSA, Shared RSA and CRT RSA is using same decryption formula but still during simulations, as shown in Fig. 3, we discovered that time taken for decoding isn't same. Each variant is using 16 KB of data for decoding the plain text except for Multi power RSA and Multi prime RSA where data used is simple *Hello* message for decryption. There are few observations which can be inferred from the graph which are listed as follows:

i Decryption time for 16 KB of data for Multi prime and Multi power RSAwill be high compared to any other algorithm.
ii Carmichael RSA and Dependent RSA decoding time is greater than generalRSA while its key generation time was lower compared to general RSA.
iii Chinese Remainder Theorem (CRT) RSA out performs general RSA in key generation time, encryption time, decryption time as well as with security.
iv Shared RSA, which is not included in the graph, will be the best algorithm for decoding the data since calculations can be broken and simulated parallelly depending upon number of machines used.

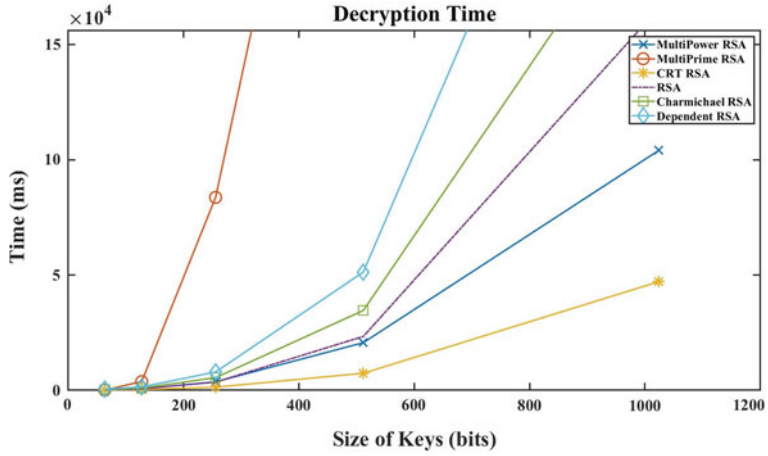

Fig. 3 Comparative chart on RSA variations based on Decryption Time

4 Conclusion and Future Work

In this paper another relative investigation between not many variations of RSA calculation were displayed in five components, which are key length, prime number generation, private key generation, encoding and decoding. We discovered that despite the fact that key generation time of few algorithms is hardly any calculations however it is exchanged off with encoding and decoding time which is some genuine situations should be limited. From the reproduction acquired during exploratory investigation, we discovered that every variation has a few qualities and a few shortcomings and a few variations like Multi Prime RSA and Multi Power RSA can't be utilized when size of the message is huge. Besides we likewise discovered that Chinese Remainder Theorem (CRT) can be utilized as a substitute for general RSA as it out performs general RSA in numerous situations.

As of late in 2009, RSA-768 was cracked by group of mathematicians and analysts and they accepted that RSA-1024 could be broken at any point in the near future. Hardly any Banks far and wide still uses RSA-512 for verifying their client's record in light of the fact that their framework won't enable them to overhaul, as it profoundly increments computational time of exchanges done every second. Individuals are moving towards the era of building smart cities where there exist numerous amounts of minuscule devices. We need algorithms which in lesser key size gives most extreme security and strength to the frameworks where computational power is exceptionally less. So in current situation we need more dominant variation of RSA algorithm for which factorization of number gets incomprehensible.

References

1. Popescul D, Cuza AI (2011) The confidentiality – integrity – accessibility triad into the knowledge security. A reassessment from the point of view of the knowledge contribution to innovation. In: Proceedings of the 16th international business information management association conference (innovation and knowledge management, a global competitive advantage), June 29–30, pp 1338–1345
2. Rivest RL, Adleman AS (1978). A method for obtaining digital signatures and public key cryptosystems. ACM
3. Overmars Anthony, Venkatraman Sitalakshmi (2019) A fast factorisation of semi-primes using sum of squares. Math Comput Appl. https://doi.org/10.3390/mca24020062
4. Shor, PW (1994) Algorithms for quantum computation: discrete logarithms and factoring. In: Proceedings of the 35th annual symposium on foundations of computer science, SFCS 1994, pp 124–134
5. Aboud SJ, AL-Fayoumi MA, Al-Fayoumi M, Jabbar HS (2008) An efficient RSA public key encryption scheme. Jordan, U.K, India. In: Fifth international conference on information technology: new generations
6. Pointcheval D (2008) New public key cryptosystems based on the dependent–RSA problems. In: International conference on the theory and application of cryptographic techniques, Prague, Czech Republic

7. Boneh D, Franklin M (1997) Efficient generation of shared RSA keys. In: Kaliski BS (ed) Advances in cryptology — CRYPTO 1997. Springer, Heidelberg, pp 425–439
8. de Vries A (2003) The ray attack, an inefficient trial to break RSA cryptosystems. ArXiv,cs. CR/0307029
9. Jason Hinek M, Low MK, Teske E (2002) On some attacks on multi-prime RSA. In: International workshop on selected areas in cryptography 10, Heidelberg
10. Deepak Garg SV (2009) Improvement over public key cryptographic algorithm, India. In: IEEE international advance computing conference (IACC 2009)
11. Collins T, Hopkins D, Langford S, Sabin M (1998) (U.S. Patent 5,848,159,Dec.8, 1998). Public key cryptographic apparatus and method
12. Wulansari D, Muslim MA, Sugiharti E (2016) Implementation of RSA algorithm with Chinese remainder theorem for modulus n 1024 bit and 4096 bit, Indonesia. Int J Comput Sci Secur (IJCSS)
13. Sarkar S, Maitra S (2013) Cryptanalytic results on 'dual crt' and 'common prime' RSA. Des Codes Crypt 66(1):157–174
14. Hinek MJ (2007) On the security of some variants of RSA. UWSpace

Ways of Connecting Illiterates with the Security Mechanism: Case Study

Sunny Ranjan Kumar, Meghna Sonkar, and B. R. Chandavarkar

Abstract The digital communication faces lots of security threats and attacks in the network. Thus, security mechanisms are used as a measure to ensure safety and to implement the security services for the text documents, audio, video and other types of data communication over the network. These security mechanisms are helpful to recognise, prevent and recover from security breaches, threats and attacks. Some of the security mechanisms are Cryptography, Public key certification, Authentication, Digital signatures etc. Obviously, these are mostly used by educated people in communication for their data to be remain integrated, confidential and safe.

But, a bitter fact is that there are 30.90% people who are illiterate and have no education background living in our country and their data is also very important to them. So, we have to connect those illiterate people to these security mechanisms, so that they can also communicate without being in fear of the data loss or data manipulation.

There are many ways to connect illiterate people with the security mechanisms such as by using facial recognition and fingerprint as the password in various systems or machines like ATMs, banks, government offices and also provide information and knowledge about the prevention from the possible fraud, theft and malicious activities. This paper discuss those different ways to connect the illiterate people with security mechanisms and enlighten their lives.

Keywords Security mechanism · Literacy · Socio-technical · Cryptography · Digital signature

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_15

1 Introduction

1.1 Security Mechanisms

Security is the major concern when it comes to data communication in the network. Users communicate and share their important data with each other in the network along with that they also want the data to be integrated and secured from the intruders and attacks. As in the modern digital world, where everything is online and available on the internet, the demand of security is also on the peak. This require some mechanisms to provide security services and also assure authentication of users and confidentiality of data. The Security mechanisms provide these features and thus relieve the users that their data is safe and secure.

There are various Security Mechanisms which provide security services to the digital communication over the channel whether its wired or wireless media [1]. Some of the security mechanisms are as follow:-

1.1.1 Encipherment

Encipherment is the process of abstracting or hiding the data to provides confidentiality to data. This process is also used to accompany security mechanisms to provide other security services. Various methods such as Cryptography and Steganography are used for encipherment.

1.1.2 Digital Integrity

The Digital Integrity mechanism appends checksum or a check value to the data. The check value has been created by specific process from the data itself into it. Thus, the integrity of data is preserved by comparing check value which is received to the check value generated while in the process.

1.1.3 Access Control

This method used to prove that user has right access to the resources and data owned by the system. Password and PIN are some of the proofs of access control.

1.1.4 Routing Control

This method include selection and continuous change in different available routes between sender and receiver. This is done to prevent the intruder from eavesdropping on the particular route.

1.1.5 Traffic Padding

In traffic padding, some bogus or fake data are inserted into the data traffic to block the attempt of the opponent to use the analysis of the traffic and its flow.

1.1.6 Authentication Exchange

The sender and receiver exchange some messages along with keys encrypted into the message to prove their identity to each other.

1.1.7 Digital Signature

Digital Signature is an authentication and mathematical mechanism that enables the sender to electronically sign the data by attaching a code which works as a signature along with the original message in the encryption form. Through valid digital signature, the receiver believes that the data is created and sent by authenticated sender and the message is not modified in the transmission. The receiver electronically verify the signature [2]. Public keys and Private keys are used for encryption and decryption purposes.

Digital Signature use to verify the authentication of users, data integrity and non-repudiation. The signer or sender sign the document with his/her secret key and the receiver verify the signature by the public key of signer. Some of the types of algorithms applied in Digital Signature are as follows:

(i) RSA Digital Signature Algorithm
(ii) Digital Signature Standards Algorithms
(iii) Elliptic Curve Digital Signature Algorithms

Each type of digital signature has mainly three phases:

(a) Key Generation phase
(b) Signing Phase
(c) Verification Phase

In cryptography, for fast, efficient and concurrent use of bulk amount of digital signatures, we do the batch verification of digital signatures which reduces the signature verification time at receiver.

1.2 Literacy Status and Technology: Connection Between These Two Affairs

Around 775 million people, above the age of 15 years, worldwide are illiterates which is roughly 17% of total population of adults in the world [3, 4]. They are not

able to read or write properly, not even in their mother tongue or native language. Most of the illiterate people live in the developing countries and the majority of those live in the rural areas. Just if we consider our country, there are around 287 million uneducated people which is largest in the world and cover approximately 37% of world total illiterates [5]. The overall literacy rate of our country is just 69.01%, including literacy rate in both rural and urban areas which is inclusive of all age groups [6, 7].

The business model of mobile phones, technical gadgets and this technological era has compelled everyone to use technology and also proved its feasibility in developing countries which is improving and widening its coverage, despite the infrastructural problems in terms of resources, e.g. the availability of electricity [8]. Most of the technological devices need power and electricity to run and irony is that the lack of electricity and other resources is also a great problem mostly in the rural areas of our country. In the process of digital communication, as the data goes digital, the security risks also increases for every single user who are using these technologies. So, it is also required that the interfaces of these devices should be simple and understandable to every user. Simple User Interfaces of mobile phones, laptops and other technical gadgets provide easy access and convenience in usage to illiterates and semiliterates. Today's model world get changed entirely with the help of resources and technology. This technical generation captured all over the global market and this affects the humans life to as much extent as it can. The technology has established a link between every community of people and connect them in a vast network as shown in the Fig. 1 below.

Fig. 1 Connecting every community of people with internet [9]

So in today's generation, it is mandatory to have knowledge of these technical gadgets and related security mechanism of these, because most of our data is on the internet and it must be secured by us because we can't depend or trust on someone else. There are so many security threats to our data and our other important financial information and regrading that many security mechanisms also available but it is also very important for people to know and understand about these security mechanisms so that if needed they can protect their data from these threats. So, this is very important for illiterates learn and understand these security mechanism. Here, we are discussing the various methods to connect the illiterates and make them understand how to use it so that they can make their data secure.

If we think deep about these situations it doesn't seems that serious, but actually it is a very big problem. Some of the illiterate people follow their old generation lifestyle, while others try to be with new generation of technological era. But due to lack of knowledge they try to seek help from other educated person. Some of them aspire to own the same types of phones as literates and have effective coping strategies to overcome their inability to read both in the physical world and the virtual digital world or the internet. There are also huge amount of data which belongs to them on the world wide web, but they are unable to understand the proper use of these technological gadgets, and thus it will become a havoc if those important and private data is being circulated all over the internet [8].

There are so many security threats regarding to our data and our other important financial information and regrading that many security mechanism's also available but it is also very important for people to know and understand about these security mechanisms so that if needed we can protect us from these threats. So, this is very important to make it learn and understand these security mechanism to illiterates. Here, we are discussing the various methods to connect the illiterates and make them understand how to use it so that they an make their data secure.

A large number of books, articles, news papers, web sites and conferences are dedicated to the design, development, and implementation of good computer system and network security policies, for all types and sizes of organizations. With the available guidelines, one would think that all the currently operating networks, either private or attached to the public internet, have proper and adequate protections, running smoothly in the place. But we all know that this is not the case specially in the present scenario. While intruders are always coming up with new ways to beat the improved security protections, the truth is that sophisticated attacks are often unnecessary because a large percentage of sites have only the most rudimentary security measures in place. While new and additional security protections and protocols are, indeed, necessary, particularly in this era of Internet-based world used in electronic commerce, education system and banking and other private and public sectors.

2 Related Work and Motivation

The paper aims in developing a system which is very helpful for illiterates in secure accessing of their data and various confidential information of theirs. We are trying to elaborate and understand how to make it simpler for them to access their own data by the means of security because it is not possible that they can avoid to use these faster ways of communication mediums social networks e-commerce sites and the payment methods just because these are not so much in practice by illiterate people.

While using the various sites to setting up the password, makes them difficult to remember so they do not want to use their services. But this is not the true way for them to make in use and on other hand, authentication is also an necessary part of the security.

Mobile phones are the most basic way of connecting people with the digital era. Irrespective of their literacy status, that may be they are illiterate, literate or semi-literates, they all have the access to their mobile phones in their day to day life. Mobile wallets are widely used for digital and cashless transactions to minimise the use of cash and to save paper. An example of mobile wallet is shown in the Fig. 2 below. These cashless transactions also require privacy and security, otherwise the money can be stolen from the account of the user. So, restricting the access to an unauthorized person or other than the user is basic way of protecting their confidential data.

Fig. 2 Mobile wallet for cashless transactions [10]

A number of studies have suggested to remove text from user interfaces for illiterates. However, it might be considered as an abjured conclusion based on the reliance on user interface usability testing without considering the longterm appropriation of applications and different roles of text as part of a status symbol, a generic or learned symbol capable of disambiguation, and as an aid in proxy-literacy.

Designing for illiterates should grasp multiple media and create more vigorous and supple interactions in the sociotechnical settings in which they can learn and make use of the mobile devices. And how can we forget the making them aware of how to use various banking sites and the payment gateways that are most critical aspect as hackers and other threats can eat up all their lifetime hard work and savings in the form of money. They need to understand the confidentiality of the OTPs (One Time Passwords), the Internet Banking Id and Passwords, Payment Gateways, Application Passwords etc.

However various security mechanisms are there but still it is of no use if people do not know how to make better use of it. The security mechanisms are basically for internet and technology user and they must have to know about the applications whether they are literate or illiterate.

3 Existing Problem

First of all, the major problem is that most of the illiterate people do not know about the importance and privacy of their data, whether it is personal data like their personal details, details of their relatives etc., which is recorded in hard copies and soft copies as well as they produced or submitted online and uploaded on the internet, like banking websites like in major government agency online services, like “Unique Identification Authority of India (UIDAI)” website or Population Survey website which is “Office of the Registrar General and Census Commissioner, India”. The root cause of the problem is that these people are not educated from beginning and they are completely unaware about the threats to their data and its privacy. That is the reason that they do not show their concern in these security issues and the problem that they can face because of the breach or attack. Moreover, they are also oblivious and do not show their interest in knowing the importance of technology and how it is affecting their lives in the modern world. The use of technology is making life fast, comfortable and secure for the literates and well-educated people, while on the other hand the uneducated people are deprived of these advantages of the technology.

3.1 Language Problem

This is one of the problem with illiterate people that they can not read and write even in their own native language and also it is not possible to make them learn and understand the in just few days or few months. And this makes them to get away from the things they are not use to of it.

3.2 Password

The strong password is the most relevant way of making data secure, and to keep it confidential in every way. Nowadays every mobile application, ATM pins, payment gateways, social networking sites, online banking sites, web sites, e-commerce site, everything is purely dependent on the usage of the passwords or pins. But, it is very difficult to think about the unique password for each website and to remember that. Also as these sites also demands for the combination of everything like special character, numeric, alphabets etc. people just use to avoid these things and needs that to be in a simpler way.

3.2.1 Heedless About Privacy of Passwords and One Time Passwords

People who are illiterate are not aware of how serious it would be of loosing password and sharing One time passwords or ATM pins with anyone. It can possibly effect them to huge extent regarding their Personal as well as Financial Life. As the Passwords and Pins are the base of the Today Technological life, sharing these with others and loosing them can be proved to be havoc.

3.3 Uneducated Children, Youth and Parents Do not Show Their Interest

As there exist monarchy kind of thing in villages and mostly people feel easy to follow the crowd. They do not want to learn new things and also do not show any interest in it. The children and youth follow the foot-steps of their elders and instead of being educated, they start doing the work what their elders are doing in their family. The parents also deny to send their children to school because of the belief that what they are doing, their coming generation will also do the same thing. They do not think about proper growth and development of their children and thus, in the starting phase of their lives, those children deprived of their education.

4 Proposed Solution

As the problems arrive in the path, the solution also exist. Here, we are elaborating some of the proposed solutions to the challenging problem of connecting illiterates, semi-literates to various Security Mechanisms.

4.1 Image Based Password Authentication System

The password and user authentication system based on the images can also be useful in these scenarios [11]. The passwords are not convenient for the illiterates people to memorize, so the idea of using images instead of string of alphabets, numbers and special characters can be very helpful as this may be easy for those people to remember.

We can also focus on the aspect that how illiterate people use appropriate mobile phones and how we can provide design recommendations for interfaces of mobile phone for those users.

Not just the Mobile Phones, the ATM pin, banking Details are also very significant details and this must kept confidential. So, the banks are so far responsible for making them aware of how to use it and they have to arrange seminars also regular to make them aware of how to use it. Not to share ATM pin and Account details are some basic things that they need to understand. Augmented calendars with voice notes, images and drawings or doodles and making the things more interactive are some of the basic ideas for them to make use of these things with interest. These innovative programs also aim at understanding them that how they use appropriate mobile phones and banking systems and how they handle and secure their other data.

4.2 Seminars and Workshops

The uneducated people of villages should be motivated to send their children to school and thus help their children to become educated person in the future. The government also propose some schemes for the welfare of these people and their children.

Workshops and Seminar should be arranged for the uneducated people to make them learn things about user identification and data security. This should be done in the way that those people understand this things easily, like the contents should be in native languages, practicals and experiments should be shown also to them. Examples of seminars and workshops organised for illiterate people in villages to illustrate the process and use of online transaction various government schemes are shown in the Fig. 3.

Fig. 3 Seminar organised in villages under government schemes [12]

They should know about the ways that frauds or intruders can attack their data online, money in ATM by tampering with ATM machines etc. Then we should also show them how to prevent themselves from these threats and how to check that any machine or any website is safe for use or not. They should learn how to check the ATM machine, whether it is tampered or not, before using it. This can be done by picture and video illustrations in the seminars like shown in the Fig. 3.

5 Conclusion

All the people in this world has the right to keep their data and information safe and secure. It does not matter whether they are well-educated, semiliterates or illiterates. They all should be connected to the technology and fulfill their needs and requirements with the help of the technology. All of the people should also be updated with the changes in this modern digital world. The well-educated people are aware about the security threats and attacks in the data communication and internet system, but for the betterment and broad development of country, illiterate people also have to use the fast and secure way for digital transaction and communication. Thus, the security mechanism should be well-known and efficiently used by uneducated people also, so that they can not worry about safety or security of their data and important information.

References

1. Different Security Mechanisms. http://www.ques10.com/p/3422/explain-differentsecurity-mechanisms-1/
2. Digital Signature. http://en.wikipedia.org/wiki/Digital signature
3. Supporting Education—Rotary International. www.rotary.org/en/ourcauses/supporting-education
4. Literacy Rates-UNICEF Data. http://data.unicef.org/topic/education/literacy/
5. Facts on illiteracy in india that you must know. http://www.oxfamindia.org/featuredstories/10-facts-illiteracy-india-you-must-know
6. International Literacy Day 2019: Figures On Language And Literacy In India. http://www.ndtv.com/education/international-literacy-day-2019-figures-on-languageand-literacy-in-india-2097323
7. India—UNESCO UIS. http://uis.unesco.org/en/country/in
8. Knoche H, Huang J (2012) Text is not the enemy: How illiterates use theirMobile Phones. Research Gate, January 2012
9. Digital India. https://i0.wp.com/www.loksansar.in/wpcontent/uploads/2018/04/guj4122018-8.jpg?fit=1181
10. Mobile Wallet. https://p7.hiclipart.com/preview/102/710/514/indian-rupee-signmoney-alipay-minus-10-yuan-activities.jpg
11. Sridhar V (2012) Image based Password Authentication for Illiterates with Touch Screen. Int J Sci Eng Technol Res ISSN 1(3):2278–7798
12. Villagers learning Computers. https://www.gettyimages.co.uk/detail/newsphoto/villagers-learning-computer-farmers-knowing-weather-womens-newsphoto/90564977

Essential Requirements of IoT's Cryptographic Algorithms: Case Study

Shubham Kumar, Zubair Ahmad Lone, and B. R. Chandavarkar

Abstract Internet of Things (IoT) devices are increasing rapidly in today's world, but the security of devices remains a major concern due to the unavailability of the memory and processing power in these devices, which is because of their smaller size. The trade-off lies between security and performance, i.e. if security is increased, which will come with high complexity and hence would deter the performance. On the other hand, if performance has to be increased, it would come with a cost in terms of security. Also, IoT devices can be used as bots as they are globally accessible without much of a security. The most secure cryptographic algorithms use a lot of resources, and in case of IoT, resources are not available on that scale, so there is a need to design a secure algorithm (lightweight cryptography) that would use less resources and hence won't affect the performance either.

Keywords IoT · Lightweight cryptography · Cryptography · KATAN · BEAN · AEL · DESL · GRAIN · Trivium · Quavium

1 Introduction

Cryptography is an art of hiding the information in data in such a way that only the intended recipient will be able to retrieve the information out of the data sent by the receiver. The information is retrieved using the key that the sender and receiver have agreed before the transferring of data. The information is converted to ciphertext using the key(encryption). The data after received by the receiver is again

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_16

converted plain text(decryption) using the key(decryption). The key may be of one of two types:

- Shared Key: Sender and Receiver both uses the same key for encryption as well as decryption.
- Public Key: Sender uses different key (public key) for encryption while the receiver uses different key (private key) for decryption.

These algorithms are implemented with such complex techniques that obtaining the plain text without the key is nearly impossible for the attacker. For this to happen, these algorithms use a lot of computation [1]. These algorithms are working fine until it was used for large systems with large memory and processing power. But nowadays people are moving toward mobile devices because of their small size and easy to carry. Also, smart products are increasing day by day. These devices also need some cryptographic algorithms because the receivers are at the end of these smart devices, and hence information should be available to them. For this problem to tackle, lightweight Cryptography are introduced to provide the security at the level of previously well established standard algorithms like AES, DES but with very less memory consumption and very less computations.

This paper focuses on various requirements needed to build cryptographic algorithms for these IoT devices. This paper is organised as follows: In Sect. 2, Use of Cryptography is shown in the field of IoT, In Sect. 3 lightweight Cryptography is introduced, In Sect. 4 we have shown different types of symmetric lightweight algorithms along with some examples.

2 Cryptography in IoT Devices

IoT requires an uninterrupted network inter-connectivity as well as cloud platform to manage data sharing and storage. However, the IoT, with real-time applications, includes massive data processing and transformation. Nevertheless, ICs deployed in IoT based infrastructures have strong constraints in terms of size, cost, power consumption and security [2]. According to some latest estimations, more than 18 billion IoT devices will be connected via cloud platform by 2020 and amongst those around 57% will be IoT's applications, but the guarantees of confidentiality and data protection are not entirely up to the mark yet. One of the reasons being that generally, we don't have much of the computational capacities as the devices are usually small like smartwatches, RFID tags, mobile apps, etc. [2]. The biggest challenge facing the IoT technology developers is to develop the algorithms that would use less computation, less memory and be able to secure the system as the conventional cryptographic algorithms do. The concept of LWC (Light Weight Cryptography) is a step toward that goal [1]. LWC is in its emerging phase. Nevertheless, the need of the efficient algorithms is an urgent requirement in IoT, and the measure of efficiency would include ultra-high-speed transmission, very

low latency, affordability, open-source capabilities, green networking with minimal power consumption and prevention of possible threats or attacks. so every cryptographic technique used here should consume less memory, less computing storage and less battery usage and it should deliver efficient security and confidentiality in spite of all the constraints listed [2].

There is often a trade-off between the methods used for cryptography and the overall security. More often than not LWC methods have to balance performance/throughput with the power drain and GE (Gate Equivalents).

[3] and hence, cannot perform as well as mainstream cryptography standards such as AES and SHA-256. Along with that, the method also has a low requirement for both types of memory, i.e., main memory, where the technique requires the usage of running memory to perform its operation and Secondary memory, where the program is stored on the device [4].

3 Lightweight Cryptography

To overcome various issues that are related with standard cryptographic algorithms, several new algorithms were introduced, but the trade-off between performance and security led the researchers to come up with this new kind of cryptography - lightweight Cryptography which is exclusively used for low-end devices. The goal is to provide all the functionality provided by classical cryptographic algorithms but with less computation, size and time taken as compared to classical cryptographic algorithms. i.e., It'll provide all the necessary security services like authenticity, confidentiality and integrity with less execution time and less memory utilisation.

Lightweight Cryptography is defined as the cryptography used for resource-constrained devices. As the name suggests, its feature is lightweight, which means it can be easily implemented on a small platform, software as well as hardware [5]. It is important in the field of IoTs because classical cryptographic algorithms are often slow, big or too much energy-consuming of these devices. Various lightweight cryptography created are broadly categorised in terms of key involved, i.e., Symmetric and Asymmetric. Asymmetric is used for key exchange and other similar function while symmetric cryptography is used for data transmission because of better performance in terms of time.

4 Symmetric Lightweight Algorithms

Symmetric is further subdivided into two types on the basis of bits of data received by the algorithm for transformation. They are following

- Stream Cipher: In these kinds of algorithms data are sent as a stream of bits and encryption, and decryption is performed in the same fashion, and hence data can be sent to receiver with very less latency
- Block Cipher: In these kind of algorithms, a fixed size of data is collected first and are transformed by the algorithm before transmission and hence takes much more latency as compared with stream cipher. On the other hand, it provides more security as compared with the stream cipher algorithms [4].

4.1 Symmetric Lightweight Stream Ciphers

These ciphers encrypt/decrypt data as it is coming in from of stream of bit and hence taking the plain text and providing the ciphertext continuously like a pipeline after one pass. Some of stream cipher for lightweight cryptography are following

- GRAIN: GRAIN cipher provides comparatively high security despite using minimal hardware, fewer gates. The cipher is specially designed to be implemented in IoT devices, where the resources like gate count, power consumption and memory are constrained. The cipher outputs one bit/clock. One of the advantages of the GRAIN cipher is that its efficiency can be increased by increasing the hardware. Some of the attacks that have happened over time with the GRAIN ciphers like shortcut key-recovery attack, Related key attacks and the attack that uses conditional differential cryptanalysis as a way to recover two key bits [6, 4].
- BEAN: This cipher is based on the basis of GRAIN stream cipher and hence is more optimised than GRAIN cipher. It uses S-Box along with two FCSRs. One major advantage over GRAIN is that it is software-based, i.e., does not require any additional hardware support for its implementation. It uses nearly the same memory as used by GRAIN but produces in significantly lesser time than GRAIN. The disadvantage of this cipher is that it can be attacked using distinguish-er attack and state-recovery attack, which is possible due to its weak output [4].
- Trivium: A hardware-oriented stream cipher, capable of providing a tradeoff between speed and area, takes less power without much of a difference in operating frequency. It reduces power consumption by about 20%. The most cryptanalytic results on Trivium are obtained by cube attacks and cube testers. The efficiency of the fault injection system ranges from 68% to 100% for the standard version of Trivium. Trivium implementations on FPGA are vulnerable to fault injection attack, irrespective of the implementation of the device used for the implementation of [4].
- Quavium: As name suggests, it is the successor of Trivium cipher providing scalable solution with the same key size as used before (80 bits) and same internal state (288 bits). It uses a 4-round Trivium-like LFSR. Even after increasing the complexity of this cipher, it still generates the random key nearly

as fast as Trivium does. Further, it is optimised for by decreasing the number of round from 4 to 3. it uses less number of logic gates in comparison with Trivium [7, 4, 8].

4.2 Symmetric Lightweight Block Ciphers

Unlike stream cipher, block cipher uses a block of bits and performs some computation on it before generating its output. Due to this process, it requires more time for execution in comparison with stream ciphers. The essential requirement while implementing a block cipher is the designing the Substitution-Permutation Network [9] and Feistel Network [10]. Creation of Substitution-Permutation box in the constrained device is not appreciated so much due to the limit on the memory of the device. This is the reason for not using S-box or use of small S-box in lightweight block ciphers.

- KATAN: It is the smallest known block cipher formed with less than 500 GE. More optimised version KATANTAN is more compact in hardware due to static key used and is programmed in the device and hence cannot be changed. The problem with this cipher is its speed. It gives output at 254 clock per cycle. Still, it is scalable as it can be made three times faster with an increase of negligible area [11].
- AES: AES is the standard cipher suited for software and hardware implementation with versions of 128, 192 and 256 keys. It works very well in larger systems, but not for the constrained device. So ALE (AES-Based lightweight Authenticated Encryption) [12] is introduced, which is efficient for both hardware as well as software implementation. It requires around 2500 GE, which is less than 100 GE overhead compared to plain AES-ECB in the smallest implementation available.
- DESL: Like ALE, researchers also optimised DES for lightweight devices which is strong, efficient and compact. Due to its low memory space-constrained, it is heavily used in RFID. The S-box of DES is highly optimised here, keeping in mind about the attack that may occur due to weakening the S-box. DESL [3] requires 45% less chip size and 86% less clock cycle than the standard AES algorithm with regard to RFID implementation.

5 Essential Requirements in Implementation of Cryptographic Algorithms

IoT device constraint makes several Standard cryptographic algorithms unfavourable to use. Here are some essential requirements for good cryptographic algorithms for IoT devices:

- LFSR: It requires fewer gates and produces output at higher frequency rate, and hence is lighter as well as faster for lightweight devices replacing the counter used earlier for pseudo-random number generator.
- FCSR (Feedback with Carry Shift Register): It is basically LFSR with extra memory to retain carry from one stage to another and hence providing more random sequence [13].
- The avalanche effect [14]: It states that the output should change with more than 50% on change of single bit of the input. It is mainly satisfied by algorithms like AES and DES, but in the case of IOT's cryptographic algorithms, it limits down to 28% or less.
- Substitution-Permutation Network [9]: The lesser the size of S box, the better for IoT in terms of memory but it should be large enough to tackle the possible attacks on this network.
- Feistel Network [10]: It is crucial while making a block cipher. Again the size of the Feistel network is chosen keeping the security and space provided by IoT both in mind.

6 Conclusion and Future Work

In conclusion, we say that IoT devices require not only good lightweight algorithms but also proper design for these algorithms to work fine. As the growth of IoT is increasing exponentially, we need more robust and secure algorithms that would use less resources like power, memory etc. to keep IoTs secure. IoT's are also used in smart grids now, any attack on these systems could lead to a catastrophe. Such feasible measures like those mentioned above are to be taken to minimise the unwanted effects as much as possible. The given solution is useful but does not guarantee the overall securities for these devices. We can achieve avalanche effect from 60% to 70% by using algorithms like AES, Camellia, DES, MMB, but they use more computational power, and in future, we would like to concentrate on decreasing the power consumption to make them more affordable for IoT.

References

1. Shukla A, Tripathi S (2018) A Survey on Next generation Computing IoT Issues andChallenges. Int J Pure Appl Math 118(9):45–64
2. Sallam S, Beheshti BD (2018) A survey on lightweight cryptographical gorithms. In: TENCON 2018-2018 IEEE region 10 conference. IEEE, pp 1784–1789
3. Rolfes C, Poschmann A, Leander G, Paar C (2008) Ultra-light weight implementations for smart devices–security for 1000 gate equivalents. In: International conference on smart card research and advanced applications. Springer, Heidelberg, pp 89–103
4. Gunathilake NA, Buchanan WJ, Asif R (2019) Next-generation light weight cryptography for smart IoT devices: implementation, challenges and applications. In: 2019 IEEE 5th world forum on internet of things (WF-IoT). IEEE, pp 707–710
5. Sadkhan SB, Salman AO (2018) A survey on lightweight-cryptography status and future challenges. In: 2018 international conference on advance of sustainable engineering and its application (ICASEA). IEEE, pp 105–108
6. Hell M, Johansson T, Meier W (2007) Grain: a stream cipher for constrained environments. IJWMC 2(1):86–93
7. Hosseinzadeh J, Hosseinzadeh M (2016) A comprehensive survey on evaluation of lightweight symmetric ciphers: hardware and software implementation. Adv Comput Sci Int J 5(4):31–41
8. Tian Y, Chen G, Li J (2012) Quavium-a new stream cipher inspired by trivium. JCP 7 (5):1278–1283
9. Belazi A, El-Latif AAA, Belghith S (2016) A novel image encryption scheme based on substitution-permutation network and chaos. Sig Process 128:155–170
10. Nyberg K (1996) Generalized feistel networks. In: International conference on the theory and application of cryptology and information security. Springer, Heidelberg, pp 91–104
11. De Canniere C, Dunkelman O, Knežević M (2009) KATAN and KTANTAN—a family of small and efficient hardware-oriented block ciphers. In: International workshop on cryptographic hardware and embedded systems. Springer, Heidelberg, pp 272–288
12. Bogdanov A, Mendel F, Regazzoni F, Rijmen V, Tischhauser E (2013) ALE: AES-based lightweight authenticated encryption. In: International workshop on fast software encryption. Springer, Heidelberg, pp 447–466
13. Klapper A (2004) A survey of feedback with carry shift registers. In: International conference on sequences and their applications. Springer, Heidelberg, pp 56–71
14. Ramanujam S, Karuppiah M (2011) Designing an algorithm with high avalanche effect. IJCSNS Int J Comput Sci Netw Secur 11(1):106–111

Prime Numbers and Its Applications in Security: Case Study

Anshul Kumar Namdeo, Abhay Lomga, and B. R. Chandavarkar

Abstract Prime Numbers are the major building blocks in integer universe. Prime numbers play an important role in number theory and cryptography. With this unique nature of prime number, it is mainly used in security. Many security algorithms have used prime numbers because of their uniqueness. In this paper, we have discussed the importance of prime numbers and their application.

Keywords Key exchange · Encryption · Decryption · Elliptic curve · Cryptography · Digital signatures

1 Introduction

In Number theory, prime numbers are defined as those numbers that have two factors, i.e., one and divisor itself. Prime numbers have been studied thousand of years. The first incident noted around 300 BC when Euclid published several results about prime numbers i.e. There are infinitely many primes and also provided the fundamental theory of arithmetic which states that each integer can be represented as a multiplication of prime numbers. He also showed how a perfect number has developed, a positive integer equal to the sum of its positive divisor using Mersenne primes [1]. A Mersenne prime is a prime number determined by the identity $2^n - 1$. In 200 BC, Eratosthenes created an algorithm for finding out a prime number that we have called the sieve of Eratosthenes [2].

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_17

In 1978, three researchers had used prime numbers to encrypt and decrypt coded messages using prime numbers [3]. The distinctive characteristics of prime numbers are widely applied in cryptographic algorithms, particularly in the key generation process, the strength of a cryptographic algorithm depends on the key and components used to evaluate the security strength is a prime number.

Prime numbers are important as the security of many cryptographic algorithms depends on the fact that getting the product of two large prime numbers is quick and easy, and it isn't very easy to get the result while doing the opposite. The process is called prime factorization, and it is one of the complex problems in number theory to find an algorithm that does it easily. Discovering a large prime number is very difficult, the last largest prime number was found in January 2018 by Jonathan Pace, and it has 23,249,425 digits, the number, known as M77232917 [4].

Prime numbers are also used in telecommunications with the help of a finite field. A Finite Field may be a set containing a limited number of components. We characterize a finite field in cryptography as a set of numbers modulo p where p is a prime number. This is characterized as $GF(p)$ — Galois field of p or with Fp. For Example:-$GF(2)$ or $F2$ is [0, 1]. In this way, if prime number p is taken we can bound the values between zero and $(p - 1)$. This paper is organized into three sections.

Basic Prime Number Security Algorithms- In this section, we described the importance of prime number in security algorithms and how it is used. Advanced Prime Number Security Algorithms- In this section, we described advanced security algorithms that use Elliptic curve Cryptography and prime numbers. Conclusion- In this section, we described the importance of prime numbers and the search for finding a new largest prime number.

2 Prime Number Security Algorithms

Prime numbers have been used in many applications related to security. Following are the algorithms that used prime number are described below-

2.1 Diffie-Hellman Key Exchange

The Diffie-Hellman key exchange is an asymmetric key cryptography algorithm. Martin Hellman and Whitfield Diffie created it in 1976. This algorithm depends on how much difficult it is to compute discrete logarithms [5]. DiffieHellman key exchange use the same private key at both ends at the sender and receiver side so that there is no need to transfer the key from one communication end to another. Diffie Hellman uses prime number because it doesn't break into smaller factors and cracking the code or hash much harder than using a composite number.

- In the implementation of Diffie-Hellman key exchange algorithms, the endusers A and B, when interacting over a private channel, commonly agreed on two positive integers a and b, in which a is a prime number, and a is generated by b. End-user don't bother about the hacking of these numbers. The generator b is a number when it becomes the power to any whole number; the result produced never be the same for any two whole numbers. Mostly the larger value of a is used and a smaller value of b is used.
- A chooses any large value integer $p_A < a$ and make it private. Likewise, choose B, $p_B <$ a, and make it private. This will be "private keys".
- A calculates its "public key" $q_A \equiv g^{pA}$(mod a) and then send it to B using an unsafe connection. B find its public key $q_B \equiv g^{pB}$ and delivers it to A. Here $0 < q_A <$ a, $0 < q_B < a$
- A calculates $r_A \equiv q_B{}^{pA}$ (mod a) and B computes $r_B \equiv q_A{}^{pB}$(mod a). Here $r_A < a$, $y_B <$ a. But $r_A = r_B$, since $r_A \equiv q_B{}^{pA} \equiv (g^{pB})^{pA} = g(^{pA\ pB})$ (mod a) and similarly $r_B \equiv (g^{pA})^{pB} = g(^{pA\ pB})$(mod a). Resultant value is their secret shared key.

Diffie-Hellman is best used for data exchange but is less used to store data for a long period. The Limitations of Diffie-Hellman is that it cannot authenticate. Communications that happened using Diffie-Hellman are inclined to Impersonation Attack and Man-in-the-middle attack [6].

2.2 RSA Algorithm

The RSA algorithm was first published by Ron Rivestt, Adi Shamir and Leonard Adleman by three authors [6]. RSA is an asymmetric cryptosystem. RSA's entire operation consists of key generation, key distribution, message authentication using the public key, and private key decryption. Prime numbers are mainly required in the key generation phase.

2.2.1 Key Generation

- Select two prime numbers a and b that they should be arbitrary, distinct and similar in size to make factorization difficult. This is usually done by the process of testing arbitrary number of correct size with probabilistic primality tests that fastly remove the non-prime numbers. These two prime numbers should be kept secret.
- Compute the multiplication of those two prime numbers. Let that be $p = ab$. Here p is used as the modulus for both keys.
- Calculate $\lambda(p) = lcm(\lambda(a), \lambda(b)) = lcm(a - 1, b - 1)$, where λ is Carmichael's totient function. Here we can also use Euler totient function [7] $\varphi(p) = (a - 1)$

($b - 1$) inplace of $\lambda(p)$. Since $\lambda(p)$ always divides $\varphi(p)$ we use $\lambda(p)$. $\lambda(p)$ is kept private.
- Select an integer x to $1 < x < \lambda(p)$ and gcd(x, λ(p)) = 1; i.e., x and λ(p) are co-prime.
- Determine d as $y * x(mod\lambda(p)) = 1$; i.e., d is the e reverse multiplicative modular (modulo λ(p))

2.2.2 Key Distribution

Key distribution doesn't require any secret route. Suppose *B* wants to send encrypted messages to *A*. *A* has to send his public key (p, x) to *B* for the encryption of the message.

2.2.3 Encryption

B calculates the ciphertext *t* using *A*'s public key $t \equiv s^x(modp)$ where *s* is obtained by the conversion of the original message *M* to an integer and $0 \leq s < p$.

2.2.4 Decryption

A can get his *s* by computing $t^y \equiv (s^x)^y \equiv s(modp)$, and from *s* he can recover the original message by reversing the padding scheme.

The whole security of this algorithm is dependent on two mathematical problems: the factorization of a large number and RSA problem. The decryption of RSA ciphertext is based on the fact that those problems are hard, so no efficient algorithm exists to solve them. The difference between *a* and *b* should be such that they are not too small, and $a - 1$ or $b - 1$ should not have only small prime factors otherwise it will be factored using Pollard's $a - 1$ algorithm [8]. The limitations of RSA is that it is Slow in key generation, signing and decryption. If it is poorly implemented, then it is vulnerable to a GCD attack.

2.3 Elliptic Curve Cryptography

In 1985, Victor Miller and Neal Koblitz planned totally different cryptographical use of elliptic curves. Elliptic curve cryptography provide the same security with a 164-bit key that other cryptosystems do with 1024-bit key. It depends on the mathematical complexity of determining the discrete logarithm problems of the elliptic curve, which address the problems of determining the number of hops or moves. It takes to travel on the elliptic curve from one point to another. Elliptic

curves are the binary curves, and over x-axis it is symmetric. It depends on the formula:-

$$y^2 = x^3 + ax + b$$

The standard variables here are x and y, whereas the curve has coefficients of a and b. If values of a and b change, the elliptic curve adjusts. The determinant $4 = 4a^3 + 27b^2$ for elliptical curves is non-zero. The operations on elliptical curves are point replication, addition, and multiplication. p represents the "max" value on the x-axis, which is also called "modulo value". In ECC, the modulo value represents the key size. The parameters defining the ECC cryptosystem are therefore:- d:- Part of the total points and order of generation point on the curve, F:- Finite field Specification, E:- Generation point, a, b:- Curve coefficient, p:- Order of generation point

2.3.1 Algorithm

The ECC is an asymmetric cryptosystem.

2.3.2 Key Generation

It is used for the identification of public and private keys. The sender encrypts the message using the public key of the receiver and decrypts the receiver using its private key.

- In the interval [1, $p - 1$], the sender selects a random number hA. This is the transmitter's private key.
- The user then produces the public key $FA = hA * E$
- In similar way, the recipient selects a private key hB and produces a public key as $FB = hB * E$.
- The sender generates the security key as "$K = hA * FB$", and the recipient generates the security key as "$K = hB * FA$".

2.3.3 Signature Generation

The following steps are performed for the message to be signed by the sender:-

- Calculate $e = HASH(m)$ hash function – Pick arbitary integer k from [1, $p - 1$].
- Compute pair = (u, v)
- $u = x1 (\text{mod } n)$ in which ($x1$, $y1$) = $k * E$
- $v = k - 1(e + hA * u)$
- Signature is defined by pair = (u, v). It's send to the receiver.

2.3.4 Encryption Algorithm

Message s is sent to the receiver by the sender.

- Let s be any point M on the elliptic curve
- Sender select arbitrary number k in the [1, $p - 1$] interval
- The ciphertext is set as a pair of points ($B1$, $B2$) in which $B1 = k * E$, $B2 = M + (k * E)$.

2.3.5 Decryption Algorithm

For Decryption, following steps are performed:-

- Receiver Calculate $B1$and its private key multiplication.
- The receiver subtracts between the product and the second point $B2$, the original data is $M = B2 - (hB * B1)$

2.3.6 Signature Verification

The receiver must know the sender's public key PA for authentication.

- Receiver checks the (u, v) pair for authentication in the [1, $p - 1$] interval.
- The receiver hash function determined again, e as in the generation of signatures.
- Receiver Calculate $z = v - 1\text{mod}(p)$
- Now, Compute $u1 = e * z \pmod p$ and $u2 = u * z(\text{mod } p)$
- Now, Compute $(x1, y1) = u1 * E + u2 * FA$ – If $x1 = u \pmod p$ is definitive.

The Limitation of Elliptic-curve has that it is slower than symmetric algorithms. It also requires some agreement on which type of curve and parameters are use.

2.4 Paillier Cryptosystem

In 1999, Pascal Paillier introduced the Paillier Cryptosystem. This scheme has the property of the additive homomorphic cryptosystem [9], which states that Knowing the $m1$, $m2$ encryption, and the public key will generate the $m1 + m2$ encryption easily. The Scheme work as follows:-

2.4.1 Key Generation

- Select random prime numbers a and b such that a 6 = b.
- Calculate $p = ab$ and $\lambda = lcm(a - 1, b - 1)$ in which λ is Carmichael's totient function and we also ensure that $gcd(a * b, (a - 1) * (b - 1)) = 1$ that confirms both primes are of same length.
- Choose an integer $x \epsilon Zp^2$ and make sure that the x order is divisible by p by examining the existence of a modular multiplicative inverse specified as $\mu = (L(x^{\lambda} mod p))^{-1}$ where $L(y) = \frac{y-1}{p}$ is used.

Public encryption key (p, x)
Private decryption key (λ, μ)

2.4.2 Encryption

- Let s is the message you want to encrypt.
- Choose arbitary u such that $0 < r < p$ and $u \epsilon Zp^2$. – Compute Cipher text $C = x^s u^p \pmod{p^2}$.

2.4.3 Decryption

- Consider Cipher text T to be decrypt.
- Compute the plaintext message $s = L(T^{\lambda} \mathrm{mod} p^2)\ \mu$ mod p.

There are many applications that uses paillier cryptosystem to implement homomorphic encryption Like CryptDB [10] for columns that require it and it also useful in designing an electronic voting system [11]. The limitations of the Pallier Cryptosystem that it lacks small ciphertexts like what you get with the elliptic curve cryptosystem.

2.5 Elgamal Cryptosystem

Elgamal cryptosystem was first introduced by Taher Elgamal [12] as a publickey cryptosystem. It's similar to the key exchange of Diffie-Hellman. It is also based on the problem of the Discrete Logarithm. Elgamal Cryptosystem algorithms have three components:-

2.5.1 Key Generation

- First, we've to choose a major p prime number. Then we choose the g generator element so that g is the generator of the modulo p multiplicative group that is between 1and $p - 1$.
- Private key x is selected from 1 to $p - 1$numbers.
- Let $y \equiv g^x modp$
- The three parameters (p, g, y) together, they form a public key.

2.5.2 Encryption

Assume that B will send A a secret message. B first converts a plain text to p (numbers range from 1 to $p - 1$). Let m be the plaintext converted. He also chooses a k random number to $1 \leq k \leq p - 1$. This random number k is also called an ephemeral key, and k is changed for every new message. Then B computes $C1$ and $C2$ where $C1 = g^k modp$ and $C2 = (m.y^k) modp$. These two values, together with ($C1$, $C2$) are called ciphertext and are sent to A.

2.5.3 Decryption

A has x as a private key to decrypt B's message. A calculates the $(C1)^x$ modulo p reverse modular, which is $(C1)^{-}x$. Then A can use the formula $C2 * (C1)^{-x} modp = Plaintext$ to get the plain text.

Elgamal cryptosystem's vulnerability is that it's not effective against the chosen ciphertext attack. For example, in a given ($C1$, $C2$) message cipher of m, a valid ($C1$, $2C2$) message cipher of $2m$ can be produced.

2.6 Digital Signature Algorithm

In 1991, the National Institute of Standards and Technology proposed the Electronic Signature Algorithm. DSA is an updated version of the signature schemes Schnorr and ElGamal [13]. It is a digital signature creation method. With the use of a digital signature, we can ensure that no messages sent by a sender can be denied by a sender. This algorithm works as follows:-

2.6.1 Key Generation

- Pick a prime number a such that $2^{M-1l} < a < 2^M$ for $512 \leq M \leq 1024$ where M is multiple of 64 i.e. bit length of 512, 1024 bits in enhancement of 64 bits.
- Pick an another prime number b, where $2^{159} < b < 2^{160}$ i.e. bit length of 160 bits and $b - 1moda = 0$. b is called the prime modulus.
- Select an integer x such that $1 < x < b$, x^a mod b = 1, x = $h^{((b-1)/a)}$ mod b. a is also called x s multiplicative order modulo b.
- Pick a random or pseudorandom integer such that $0 < z < a$. – Calculates $w = x^z$ mod b.

Public key = (b, a, x, w).
Private key = (b, a, x, z).

2.6.2 Signature Generation

- Using a hash algorithm like *SHA*1 we can generate the message digest h, – Create a random number l, such that $0 < l < a$.
- Now, calculate $u = (x^l \text{ mod } b) \text{ mod } a$. If $u = 0$, choose a distinct l.
- Calculate i and $l * i \text{ mod } a = 1$. i is the modular multiplicative inverse of l modulo a.
- Calculate $v = i * (h + u * z) \text{ mod } a$. If $v = 0$, choose a distinct l.

Digital Signature = (u, v)

2.6.3 Signature Verification

- Using the same hash algorithm, generate the message digest h,
- Calculate r, such that $v * r \text{ mod } a = 1$. r is the modular multiplicative inverse of v modulo a.
- Calculate $x1 = h * r \text{ mod } a$. – Calculate $x2 = u * r \text{ mod } a$.
- Calculate $y = (((x^{x1})*(w^{x2})) \text{ mod } b) \text{ mod } a$.
- If $y == u$, the digital signature is conclusive.

The limitation of DSA is that it requires additional time to authenticate because its verification process has complicated remainder operators. So, it requires a lot of time for computation.

3 Advanced Prime Number Security Algorithms

In this section, we describe two advanced security algorithms-

3.1 Elliptic-Curve Diffie Hellman Exchange Algorithm

Elliptic-Curve Diffie Hellman is the version of Diffie Hellman key exchange algorithms for elliptic curve. This algorithm determines the method of how two communication participants generate key pairs and exchange their public keys via insecure channels. It basically solves the problem of the Man-in-Middle attack that occurs in the Diffie-Hellman key exchange. This algorithms works as shown below:-

Suppose we have an elliptic curve over finite prime field E(Fp), and two endusers acknowledge A and B on a point G ϵ $E(F_p)$, which is freely available in the media.

3.1.1 Algorithm

- Public and Private key generated by both A and B on their own.
- Let d_A is Private key of A, Public key of A is $H_A = d_A$G and Let Private key of B is d_B, Public key of B is $H_B = d_B$G.
- Public key exchanged by A and B, i.e., H_A and H_B on unsafe channels.
- A Computes $S = d_A\ H_B$ by B's public key and by its own public key, and B determines $S = d_B\ H_A$ by A's public key and its own private key. Note that Secret Key is the same for both A and B.

The Man-In-the-Middle knows about H_A and H_B, and he will not be able to crack secret key S.

3.2 Elliptic-Curve Digital Signature Algorithm

ECDSA is a form of the Digital Signature Algorithm that uses keys that are calculated from elliptic-Curve Cryptography [14, 15]. It consists of three segments: key generation, signature generation, signature verification. A new phase has to be defined before the key generation starts to build the domain parameters. Domain parameters for an elliptic curve are an elliptic curve F set to a finite field E_q, a base point $x\epsilon$ $F(E_q)$(generator) with order p. The elliptic curve is structured in such a

way that we take $\epsilon(1, q)\ (a, b))$ and place it in the identity. So it is possible to define the domain parameters as q, $F(a, b)$, x, p.

3.2.1 Using ECDSA the Generation of Key Pair

Let us consider a message S, Signatory A. Now A executes the following phases to generate both public as well as private key.

- First of all select unpredictable and a unique integer, k, in the bound $[1, p - 1]$ – Now, Calculate $Y = kx$.
- A's private key = k.
- A's public key is the selection of (F, x, p, Y)

3.2.2 Using ECDSA the Generation of Signature

With the help of A's private key, A generates the signature for message S using the following phases:-

- Select a unpredictable and unique integer d in the bound $[1, p - 1]$.
- Calculate $dx = (x_1, y_1)$, here x_1 = integer.
- Calculate $u = x_1 \bmod p$; and $u = 0$, then proceed to 1.
- Calculate $h = H(S)$, here H is the SHA-512.
- Calculate $v = d^{-1}\ (h + ku) \bmod p$; and if $v = 0$, then proceed to 1. – For message S the signatory A is the integer pair (u, v).

3.2.3 Signature Verification Using ECDSA

The B receiver tests the validity of the (u, v) signature for S message by performing the following:

- To obtain signatory A's public key (F, x, p, Y).
- Verify that values u and v are in the bound $[1, p - 1]$.
- Calculate $z = v^{-1} \bmod p$.
- Calculate $h = H(S)$, where H is hash algorithm used by A.
- Calculate $x_1 = hz \bmod p$. – Calculate $x_2 = uz \bmod p$. – Calculate $x_1x + x_2Y = (x_0, y_0)$. – Calculate $C = x_0 \bmod p$.
- For message S is true if $C = u$.

It is necessary to keep the secret key on the list of ECDSA signatures, and the signatures are the same so that an attacker can measure the private key.

4 Conclusion

Data security is a significant concern in today's world. In this paper, we have discussed the importance of prime numbers and their use in cryptographic techniques for securing the data. Large prime numbers are necessary for the future of computing and cybersecurity, and the search is already going on for finding the most significant prime number and even the Electronic Frontier Foundation is offering a $150,000 prize in order to find the first prime number with one hundred million digits and $250,000 in order to find the first prime with one billion digits. We have discussed the various efficient data security algorithms- ECC, RSA, Diffie-hellman, Digital Signature, ECDSA, Paillier Cryptosystem, Elgamal cryptosystem.

In the future, we emphasize the complexity of various elliptical curve cryptography for providing high data security in almost all low power devices.

References

1. Stillwell J (2010) Mathematics and its history. Undergraduate texts in mathematics 3rd edn, p 40. Springer. ISBN 978-1-4419-6052-8
2. Horsley RS (1772) The sieve of eratosthenes. being an account of his method of finding all the prime numbers. Philos Trans (1683–1775) 62:327–347
3. Kraft JS., Washington LC (2014) Elementary number theory. Textbooks in mathematics, p 7. CRC Press. ISBN 978-1-4987-0269-0
4. Cossins D (2019) The call of the primes pp 38–41
5. Rosen, KH (2011) Elementary number theory and its application, 6th edn, p 368. Pearson. ISBN 978-0321500311
6. Li N (2010) Research on Diffie-Hellman key exchange protocol, vol 4, p 634. IEEE
7. Rivest RL, Shamir A, Adleman L (1978) A method for obtaining digital signatures and public-key cryptosystems. Commun ACM 21(2):120–126
8. Weisstein EW (2003) Totient function. Wolfram Research Inc
9. Zralek B (2010) A deterministic version of Pollard's p-1 algorithm. Math Comput 79:513–533
10. Sridokmai T, Prakancharoen S (2015) The homomorphic other property of paillier cryptosystem. In: 2015 international conference on science and technology (TICST), Pathum Thani, pp 356–359. https://doi.org/10.1109/ticst.2015.7369385
11. Popa, RA, Redfield, CMS, Zeldovich, N, Balakrishnan, H (2011) CryptDB: protecting confidentiality with encrypted query processing. ISBN 978-1-4503-0977-6
12. Anggriane SM, Nasution SM, Azmi F (2016) Advanced e-voting system using paillierhomomorphic encryption algorithm. In: 2016 international conference on informatics and computing (ICIC), Mataram, pp. 338–342. https://doi.org/10.1109/iac.2016.7905741
13. Elgamal T (1985) A public key cryptosystem and a signature scheme based on discrete logarithms. IEEE Transactions on Information Theory IT-31(4):469–472
14. Schneier B (1996) Applied cryptography, 2nd edn, p 644. ISBN 0-471-11709-9
15. Bernstein DJ (2014) How to design an elliptic-curve signature system, 23 March 2014. The cr.yp.to blog

Nonce: Life Cycle, Issues and Challenges in Cryptography

Shivam Sharma, Sajal Jain, and B. R. Chandavarkar

Abstract We all are living in the era of online processing, where the maximum of the information is available online. As the facilities of computer technology have increased, threats of losing personal and sensitive information have also increased. Cryptographic software and algorithms are good at some extent but as we all are seeing several attacks like Plaintext attack, Replay attack on Apply pay, Interleaving attack on PKMv2, etc. show us that our cryptographic software is less likely to be broken due to the weakness in the underlying deterministic cryptographic algorithms.

A nonce is another attempt to improve security from these kinds of attacks. A nonce is an input value that will not repeat in a given context. Nonce use to prevent replay and interleaving attacks. Nonce also protects websites against malicious exploits that are based on Cross-Site Request Forgery (CSRF). The main aim of this paper is to introduce, What is Nonce, how it works and what are the issues and challenges in cryptography that we can solve with Nonce.

Keywords Nonce · Cryptographic software · Replay attack · Interleaving attack · Cross-Site Request Forgery (CSRF) · Pseudo-Random Number Generator (PRNG)

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_18

1 Introduction

The term nonce can mean anything that guarantees made for a single occasion. A nonce may according to the context be a random number, a serial number or a random challenge received from a third party. The term nonce represents the number used only once. The nonce is a cryptographic key which we use with our data and encrypt by cryptographic algorithms. The value of the nonce varies with time. Challenge-response identification (strong authentication) protocol can use time-variant parameter [1].

The nonce generation method is similar to the pseudorandom number (PRN) generation in mathematics. In mathematics, there are various methods to generate pseudorandom number but Linear Congruential Generator is used in many languages and it serves as a default PRNG in some versions of c and c++. Lets's see a mathematical explanation of a Linear Congruential Generator to generate a pseudorandom number [2].

– We will use the recursive relationship for generating sequence of integers X_1, X_2… in the range 0 to n − 1.

$$seed = (a * seed + c) mod n$$
$$or$$
$$X_{i+1} = (aX_i + c) mod n$$

– Assumption made: $n > 0$ and $a <$ n, $c <$ n, $X_0 <$ n
Here a is multiplier, c is increment and n is modulus and initial seed X_0, which is provided by the user.
– The random integers X_i are generated in range [0, n − 1] and converting the integers X_i to random numbers is done as-

$$R_i = X_i n$$

Where $X_i \in (0, 1, ..., n - 1)$ *and* $R_i \in [0, (n - 1)/n]$
Example:
Use $X_0 = 27$, a = 21, c = 47, and n = 100.

$$X_1 = (21 * 27 + 47) \bmod 100 = 614 \bmod 100 = 14, R_1 = 0.14$$

$$X_2 = (21 * 14 + 47) \bmod 100 = 41, R_2 = 0.41$$

$$X_3 = (21 * 41 + 47) \bmod 100 = 8, R_3 = 0.08$$

$$X_4 = (21 * 8 + 47) \bmod 100 = 15, R_4 = 0.15$$

For the understanding purpose, we took small values but large values would be better for generating more safe PRNG. Generating nonce requires uniqueness. A deterministic stateful generator can be used to keep the track of the previously used nonce, a generator should not "wrap around" (reaching a value greater than the nonce length) to be suitable for practical purposes [3]. There is a cryptographically secure pseudo-random number generator which posses the properties, that make it suitable for use in cryptography [4]. A cryptographically secure pseudo-random number can satisfy the requirements of PRNG, but vice versa is not true.

1.1 Types of Nonce

For uniquely identifying a message or sequence of messages, we could use some classes of a nonce [5].

1.1.1 Random Nonce

Random numbers are used in identification and authentication protocols. In this, we choose a random number with uniform distribution from a specified sample space [6].

A random nonce could generate by a hardware device or software program. In this, a server translates the inputs which are in the form of physical measurements like mouse movements, keyboard presses, phase noise or clock signals. This non-deterministic data translate in streams of zeros and ones and stored in a "pool". For generating a random "seed" data is taken from this pool. Now, a random number is generated using this random seed [7]. When a user is not doing any physical movement than random number could use random bits of the initial pool.

1.1.2 Sequential Nonce

A sequential nonce is produced incrementally, both parties follow a predefined policy for message numbering, A message is accepted only if the sequence number has not been used within a specified time and satisfies the agreed policy. It provides guaranteed Uniqueness [8].

The simple policy for generating sequence number starts from zero and increment sequentially for successive messages. There is another policy, we could use sequence number is monotonically increasing.

1.1.3 Timestamp Nonce

Timestamp nonce may be used to provide uniqueness, it may also be used to implement time-limited access privileges. Timestamps work as follows- party one creates a message and obtains a timestamp from its local clock and cryptographically binds with a message. the second party receives this message and obtains the current time from its local clock, subtracts it from the timestamp of the received message. The message is valid or not is known [9].

For the generation of timestamp nonce, In system, there are inbuilt functions to convert current time into a sequence of different characters or other information that is an identification of time, like Unix has inbuilt function strtotime(). After timestamp and nonce with message encrypt by hash function and send this message.

1.2 Why Nonce?

A replay attack is a cyber-attack in which intruder intercepts the message send by the user and modify it or replay the same message in a new transaction. Replay attacks can also cause by stored files, where a file is replaced by an earlier version of a file. This definition is given in the book "Handbook of Applied Cryptography" [8]. We will understand this definition by some examples [10].

Example: Suppose Alice uses Bob's system to access his bank account via the internet banking portal. Alice uses his credentials to log into the portal. Assume bank server uses Session-Id and timestamp that signifies the time till when the session is valid. Along with this sever also uses supercookie and encrypts the value of the session-id cookie and time-stamp cookie. So no one could use a session-id cookie (used to track a user session) value and get access to his account. Alice completes his transaction and logs off from the internet banking portal. He also clears cookies and other temporary files that he used and did everything that keeps one's account secure. Is his account secure? What, If the system he used of Bob is infected with malware. Every request from the browser and each response from the bank's server is intercepted and been sent to the hacker. While Alice is doing his transactions, the intruder copies the value of supercookie and uses it to replay the fund's transfer to intruder's account that Alice had initiated.

Underlying Weakness in This!!
The bank enforced the approach of securing the user sessions however this wasn't enough. The user session is valid for a substantial quantity of time guaranteeing the client is allowed to suppose act in this period. Till the time the session is valid (timeout timestamp has not expired), an equivalent super cookie could use to send multiple requests to the applying server. Along with the session-id timeout timestamp, if we add one more value (one per user) this value will be unique for each response.

Cross-Site Request Forgery (CSRF) is a web security vulnerability that can be exploited in various ways like Delete post from the backend, tempering with the database values or store excess amounts of data in the database that can harm the performance of the site. CSRF attack can be prevented by adding a nonce to URLs or web-forms [6]. The rest of the paper is organized as follows. In Sect. 2 we will present the Nonce life cycle from sender to receiver. In Sect. 3 some problems are discussed that can be solved with the help of nonce. Section 4 presents the solution to the problem discussed in Sect. 3 as well it shows the usage of the nonce in various fields.

2 Nonce Lifecycle

A nonce value used once is not reused for the new connection different from the older one. A nonce is again generated for a new connection with a new random value which should be unpredictable and unique. For the generation of Nonce, we have various methods, in PHP alone we have many algorithms to generate Nonce. The administrator can specify the validity of nonce. For example, Wordpress nonces have a validity value of 24 h. Different algorithms follow a different method to use Nonce but generally, nonce has the following lifecycle [11]:

1. The server sends some challenge (k) or a random value.
2. Client chooses a nonce (n) (different every time).
3. The Client Take his credentials (p), value (k), Nonce (n) and uses hashfunction (h) to for encryption and send to server.
4. Server Check the client's credentials from the database, recompute the value and compare it with the client's values as shown in Fig. 1.

3 Issues and Challenges in Cryptography

While transmitting secure information there comes the issues and challenges from the security point of view, some of them are discussed below.

Fig. 1 Nonce-lifecycle

3.1 Replay Attack

Replay attack as the name says the adversary here tries to capture the original message and replay the same message in the different contexts of the context intended [12]. Consider an example where Alice is trying to verify his identity to the bob. The bob here asks a password from Alice for authentication, if some person in the middle captures the password or hash of Alice and use it or replay it for further authentication to the bob, this grants the unauthorized access to the person in the name of Alice to the bob.

As shown in Fig. 2, E as eve captures the password and replay's it for further transaction. So, there is a need to associate a uniqueness property with every transaction.

3.2 Authentication

In cryptography, secured authentication is of immense importance to prevent the user from any fraud. Every system has the authentication and authorization policies in one or the other way. If sometimes the authentication password or secret key of the user is leaked then it can be of great loss to the user. Consider a scenario of online shopping, if the user's password is captured by some person in the middle then he can repeat the order again and again which could disrupt the whole functioning of the system.

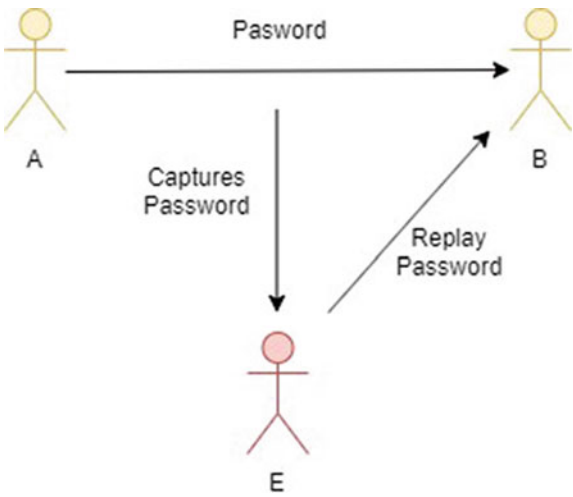

Fig. 2 Replay attack

3.3 Need of Randomness in Cryptographic Algorithms

Why randomness is important in cryptography? The randomness property is helpful against various attacks and malicious activities from the adversary. It provides improved security in many ways since the adversary can't predict the random values. Protocol designers can protect the data and communication with the help of randomness. Replay attacks prevention, authentication, and authorization policies can be made more secure with the randomness [11].

4 Nonce Usage and Solutions

The various issues discussed in the cryptography above are solved by the nonce approach. The nonce is widely used in many such fields that are discussed below.

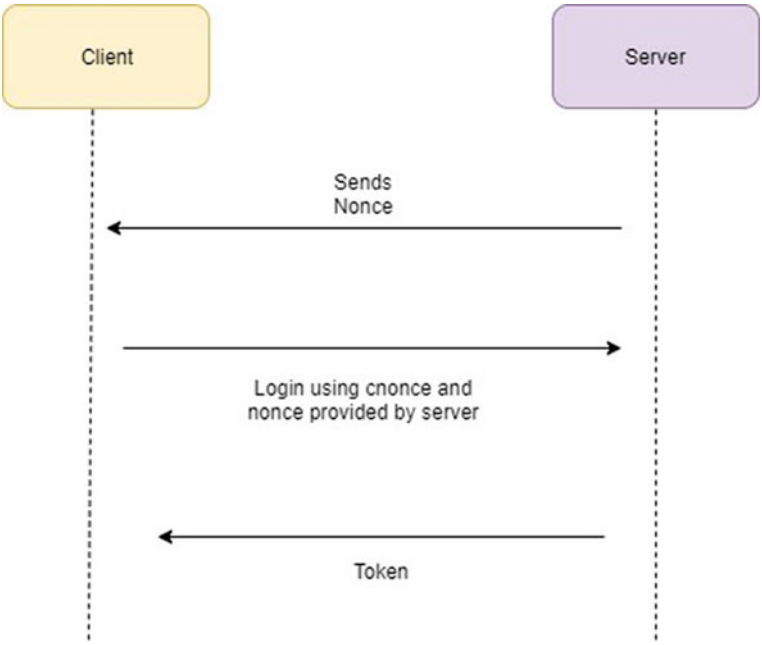

Fig. 3 Client-Server Authentication

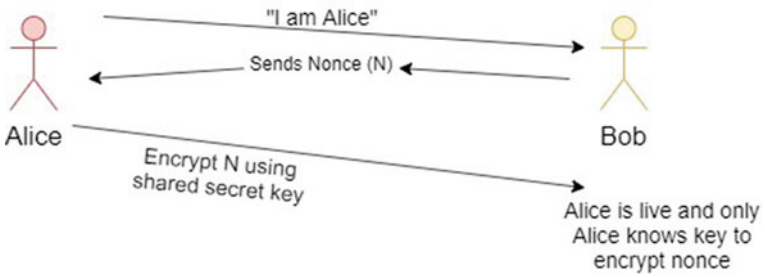

Fig. 4 End-Point Authentication

4.1 Authentication

Authentication protocols make use of nonce to prevent the reuse of old established connections and replaying the same value. Digest access authentication is one of the schemes that make use of the client nonce (cnonce) to enhance the security as shown in Fig. 3. A nonce should be generated with enough random bits to ensure that the probability of replaying is very less. Pseudo-randomness or unpredictability is the requirement of nonce [13].

Figure 4 states the end-point authentication using nonce, where the bob wants to know that none other than alice is live.

4.2 Stream Cipher

The stream cipher encrypts the plain text digits taking the keystream one at a time, the result is the ciphertext stream. A nonce may be used to ensure security in a stream cipher. Since more than one message is encrypted using the same key, so a different nonce value is used with each message [14].

4.3 Lamport Signature

Lamport signature scheme is used to sign the signatures digitally, it uses the cryptographic hash function. Lamport scheme maintains the privacy of signer-side secret with the help of secret nonce values [15].

A cryptographic hash function takes the input as a string of any length and outputs a fixed-size string called “hash value” [16]. The nonce is generated and signature is calculated of the input using nonce as shown in Fig. 5.

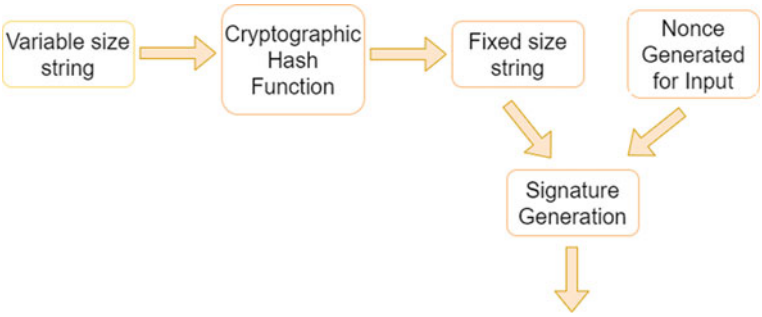

Fig. 5 Generation of signature

4.4 Initialization Vector

The initialization vector is a nonce used in encryption [17]. Encrypted text may contain the repetition of sequences if the initialization vector is not used, thus in the encrypted text repetition of sequences is prevented by using initialization vector. There is a risk that if the attacker identifies the sequence then cipher could be broken.

4.5 Hashing

Proof of work systems that discourage the denial of service attacks makes use of the nonce values to provide and vary the input to a cryptographic hash function [17]. PoW systems help to shift the load of work to one side. This helps fulfill the conditions and obtain a desired level of difficulty.

4.6 Identity Management

Account recovery, two-factor authentication (2FA) or single sign-on (SSO) can make use of the nonce values in their functioning. These all are the procedures to prevent the user's identity with respect to authentication and thus enhancing the security. The account recovery is a procedure where the user tries to get back the old account, which is existing. 2FA and SS0 are some other methods to prevent the user identity in the online world [17].

4.7 Electronic Signatures

Electronic signatures are being verified, compared or created with the help of nonce values. Electronic signature occurs in online documents that are being transferred with some senders signature being signed electronically. This way some digital data is signed concerning to the digital data only. Nonce values may be used in the Electronic signatures. Electronic signature are widely used when generating the online invoice of the users order [17].

4.8 Cryptocurrency

Nonce is being used by crytographic hash in cryptocurrency that connects to a blockchain. In bit coin mining the first "miner" who finds a nonce delivering the desirable hash is awarded with bitcoins.

The "nonce" is a 32-bit field in a bitcoin-block, the value is adjusted as such the hash of the block is equal or less than the current target of the network [18]. All other fields have the defined meaning and they cannot be changed besides nonce.

When the nonce field is changed in the block, the hash of the block will be changed significantly. Many different nonce values are tried by the miners to get the desired hash which is less than or equal to the current target [4]. It is infeasible to predict which combination of bits in nonce will result in the perfect hash satisfying the conditions. When the target set is lower then the difficulty is higher.

Golden Nonce
In bitcoin mining, a golden nonce is some which output the hash lower than the current target.

Fields of the Hash Block in Blockchain
As shown in Fig. 6, a hash block has some constant info, bits, Merkel root, time and a nonce. Out of all these nonce is the field which varies with every block. Here SHA256 is a hash function.

Block Linking and Associated Nonce
As shown in Fig. 7, a block holds the timestamp and a nonce with some other fields like previous hash and hash of the block. Figure 8 illustrates the blocklinking in a blockchain. The hash of the next block in blockchain stores the hash of the previous block [18]. 4294967296 nonces are possible since nonce is a 32-bits integer. The probability of any two blocks having the same nonce is very less compared to the probability of uniqueness.

4.9 Asymmetric Cryptography

In some instances of public-key cryptography, those in SSL/TLS handshake, two nonce values are used for protecting the connection between client and server and keeping it safe. In implementing the handshake during the connection procedure, the client sends the nonce to the server, this is done to avoid the replay and man-in-the-middle attack [17].

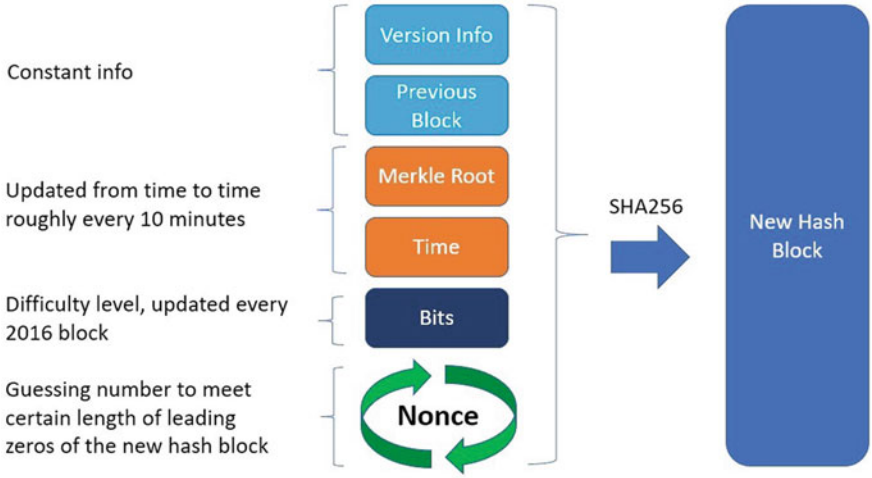

Fig. 6 Fields of hash-block [4]

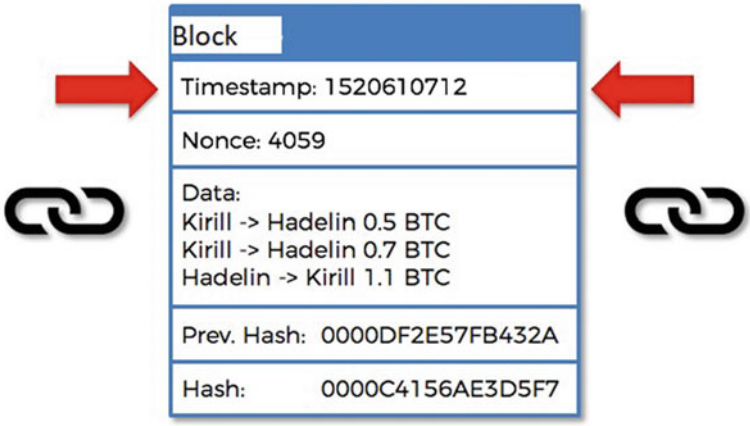

Fig. 7 Single block of block-chain [18]

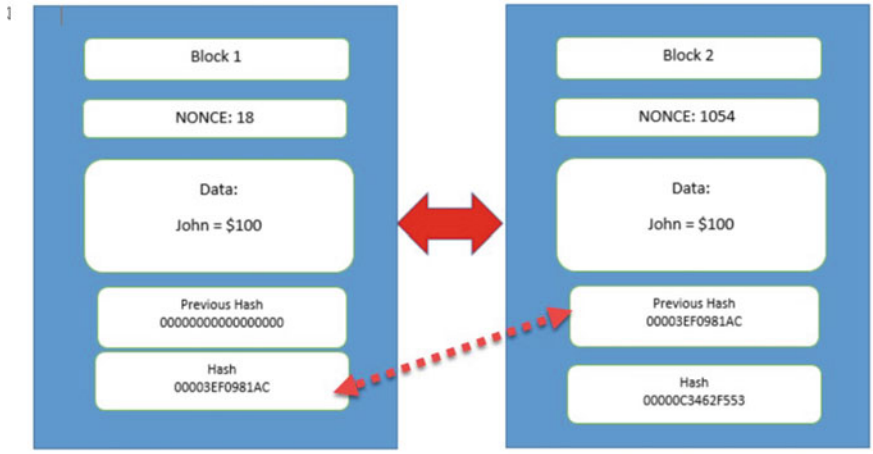

Fig. 8 Linking of blocks in block-chain [18]

5 Conclusion and Future Work

In this paper, we have presented the nonce properties and it's usage in many such places to improve the security. We have also shown the types of nonces and how can we solve the problems by nonce that arise in the cryptography. Although there are many usages of nonces, but various issues in Nonce generators, like one, could generate nonce by the use of random number generator (RNG). To avoid collision nonce length should be large enough, this large length may create problem in a cryptographic system where resources are limited, memory or bandwidth. We also can not use simple counter nonce because they could be predictable. Also, the server needs to maintain the cache of already using nonces in that connection period. A momentarily turn down the system can also lose all the information, if we did not save in ROM memory. This creates the nonce reset problem.

Security researchers should work in the nonce field to make this more secure and less expensive and how can we solve the reset problem of the nonce.

References

1. Margaret Rouse Cryptographic nonce. https://bit.ly/34ZCSHI
2. Kneusel RT (2018) Random numbers and computers. Springer International Publishing
3. Sheth M (2017) Cryptographically secure pseudo-random number generator (CSPRNG). https://bit.ly/32WojDD. Accessed 29 Mar 2017
4. Khatwani S (2019) Bitcoin block hashing. https://bit.ly/2QBNys8. 1 Feb 2019
5. Køien GM (2015) A brief survey of nonces and nonce usage. In: Securware 2015-the ninth international conference on emerging security information, systems and technologies"(SECURWARE 2015)

6. Website. https://cheatsheetseries.owasp.org
7. Elangovan U, Arputharaj K, Ramadoss R (2014) Cambridge CB2 3QG "lowcost dynamic random nonce generator for web services. In: 2nd international conference on emerging trends in engineering and technology (ICETET 2014), 30–31 May 2014, London (UK)
8. Menezes AJ, van Oorschot PC, Vanstone SA (1996) Handbook of applied cryptography
9. Clifford Neuman B, Stubblebine SG (1993) A Note on the Use of Timestamps as Nonces. Information Sciences Institute, University of Southern California
10. Website. https://on.tcs.com/2Qxywnn
11. Gennaro R (2006) Randomness in cryptography. IEEE Secur Priv 4(2):64–67
12. Adams C (2011) Replay Attack. In: van Tilborg HCA, Jajodia S (eds) Encyclopediaof cryptography and security. Springer, Boston
13. The Internet Society (2019) HTTP authentication: basic and digest access authentication. https://bit.ly/2r6J8im,section4.3. 4 May 2019
14. Stream ciphers. https://bit.ly/37knS9q. 18 Mar 2017
15. Green M: The Lamport One-Time Signature. https://bit.ly/346hfFM
16. Cryptographic hash function. https://bit.ly/2OuP8cB
17. Website. https://searchsecurity.techtarget.com/definition/nonce
18. Eremenko K (2019) How does Bitcoin/ Blockchain Mining work?. https://bit.ly/2r6J8im. 4 May2019

An Intelligent Public Grievance Reporting System-iReport

M. Laxmaiah and K. Mahesh

Abstract Public grievance is important in making governance very effective. Generally, the citizens are expected to report their grievances through a grievance reporting system. In the literature, efforts have been made through an interactive web portal, IVR system, mobile applications, etc. However, none of these approaches are providing a feedback mechanism and the status of grievance instantly. In this paper, we address the issues of public grievance reporting using cloud vision. We built an intelligent public grievance reporting system that tracks the grievance of the citizens instantly. The system captures the images and segregates them, and directly drops the information about the issue or a problem to the nearest responsible authority. The system resolves the issue effectively without much human effort and even it can be used by illiterate people. We have conducted the experiments on the real-time system and the results improve the grievance reporting effectively.

Keywords Public grievance · Google cloud vision · Geo-coding · Firebase

1 Introduction

A public grievance reporting system is an automated system for receiving the grievances faced by the general public in their locality. In this system, any citizen of India can raise their problems or grievances directly to the government through this system. As we know, India is a rapidly growing country with a huge population, where we have plenty of public issues to be addressed such as rural development,

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_19

agriculture development, sanitation, tourism, education, poverty, crime, etc. The country needs to work swiftly on these aspects. Hence, contributing to this, we ventured into the livelihoods, asking people to give us a gist of the problems they are facing. These can be anything related to administration, maintenance, safety, sanitation, welfare. We understand that people are unable to report their grievances and express their inconveniences to the right authorities and the concerned departments. Few issues such as Stray dog menace, improper drainage systems, garbage maintenance, mosquito menace, improper roads, etc. Streamlining of the report to the relevant authority of the relevant department is difficult as people don't know which department is responsible for resolving a particular issue. The most common opinion of the people is the need for a centralized, hassle-free application where their issue could be precisely reported to the concerned person or authority. Transparency and accountability of the concerned department should also be provided in the application. There were also instances where people approached certain authorities who simply shrugged their shoulders by saying that their department is not responsible for that particular issue. Even if the issue was brought to the notice, the following things were observed.

- Department wise segregation is performed manually.
- Complaint resolving is slower.
- Progress of the issue resolution cannot be tracked. □ No Centralized System.

To solve the above issues very quickly, we proposed a new system in the form of an android based mobile application. This application has the provision of capturing the issue observed by the common man and can upload an image of the problem into it. The application segregates the data automatically using the image classification technique of image processing with the help of the cloud vision server. The server will process the issue and generates the labels about the issue or a problem. The system also generates automatically location information such as street name, street number by using the forward geo-coding and reverse geo-coding technique. Then the complaints along with location information where an issue has been taken place will be sent to the concern authority or person of concern department. The users can also track the status of the issue very easily.

In this paper, Sect. 2 describes the literature survey and Sect. 3 briefs about the proposed approach. Section 4 describes the working mechanism of the system and in Sect. 5 discussing the results and Sect. 6 concludes the paper.

2 Literature Survey

Nowadays the public service domain has been facing many challenges. These challenges are related to many domains such as agricultural development, poverty, illiteracy, drainage management, traffic management, crime, and sanitation maintenance, etc. To address the problems of the general public, there are some online

reporting solutions available in the market. But none of them are providing a complete solution to the problem. There are some applications such as MyGHMC, where the integrated services to be provided through the mobile app include payment of property tax, trade license fee, view status of layout regularization scheme, downloading of birth and death certificates for records digitally signed on server and submitting of civic-related grievances like manholes, potholes, open dumping points, street lights, etc. The app has been successful in delivering services of resolving the civic issues but there have been several drawbacks, some of which include Automatic and faster streamlining, Real-time complaint tracking, Ease of use [4].

Innovative Citizen Redressal Forum (ICRF) is a web application used as a public administration system, where the public will monitor the administration activity, which is usually done by public servants. Every citizen has to depend on the government for getting their works done and problems to be resolved. In this process, the citizens usually submit petitions to the concerned officials and wait for the result. In most of the cases, the works get abnormally delayed or deliberately kept pending for various reasons. In such a scenario, ICRF will assist the citizens for the speedy redressal of their petitions. All citizens of India can become a member of this organization and can start posting e-petitions, likes, comments, supports, etc., for any works to be done by the government such as roads, drainage, street lights, water supply, corruption, sanitation, education, health, etc. Every epetition posted on ICRF will get support from millions of people to get it resolved at the earliest [5].

To address the public grievances, the government of India is established the public grievance redressal mechanism in various government ministries is regularly reviewed under the chairmanship of a cabinet secretary. The government declared every Wednesday for receiving only public grievances without any other meetings. They suggested to the officials deal with every grievance transparently and also reply to the grievance with proper reasoning if the grievance is rejected. The grievance which is published in newspapers also taken up carefully and must be investigated to find the truth of the grievance and proper action must be taken in a reasonable time [11]. India has various online services that are provided to empower citizens to access online services. In most countries, the major problem is corruption and bureaucracy, and both are related to each other. There are many grievances for people in democratic countries such as India, Japan, and America, etc. The metrics related to the public grievance of the 4 Indian states namely Gujarat, Haryana, Himachal Pradesh, and Karnataka are analyzed. The services offered by these states measured on the scale of 10 by assigning a ranking to the services and they decided the best sate in addressing the public grievances [12].

Public institutions are responsible for the accessibility of public services and maintenance of transparency for all citizens. The public offices of Pekanbaru have two important offices related to the public, namely the office of the population and civil registration. These offices are responsible for issuing identity cards, family cards, and birth and death certificates. This paper address the good principle for good governance [13–15]. To provide a solution to the public grievance, we have

conducted online and a manual survey. In our survey, we found that over 80 percent of people do not know whom to approach to resolve an issue and several authorities were rejecting the fact that the particular issue does not fall under their control. There is no respite from the problems on an immediate basis. Around 10–12% of the people have not faced the issue as they manually approached authorities and reported their grievances and about 3–6% of the people did not approach the department at all and got their work done by private means. The main opinion of people was that it was a tedious procedure of reporting issues as a large number of helpline numbers exist. So it is very difficult to remember. The resolution of problems was taking a long time which was no sooner than a week. There were some instances where officials were denying the fact that they were not responsible for the issue and were just brushing them off their shoulders. Bringing in an automated system that would streamline the grievances would provide a proper solution means.

In this paper, we are exploring a process of citizen grievance reporting system where the reports are passed to the Call Centre and then the intermediate officials manually go through each report and segregate them based on the nature of the complaint. Finally, the complaints are assigned to the in-charge by notifying them of the application used. This process is presently taking a time of around 2–3 days. The resolution of complaints takes around a week, minimum. In our paper, we discussed the idea of maintaining transparency between officials and citizens to keep a track of the complaint resolution and provide a real-time complaint tracking interface for the end-users. It also supports for auto-filling of the fields' like- ward number, zone, circle, etc. by processing the location of the user being fetched. This will reduce the effort put by them trying to find their ward number and all other details. Therefore, we build an application such that it could empower localities by helping them to report their problems. Currently, some solutions are available in the public domain to address public grievances. Some applications related to public grievances are

- Approaching the nearest complaint desks.
- Using helpline numbers.
- Department-specific websites.
- Written applications, letters, and complaint forms.
- Independent municipal corporation apps or forum.
- Email communication.

The above existing solutions are not very reliable and do not address the issue as we expected. So, we proposed a new solution to address these issues effectively.

3 Proposed Approach

The iReport is an intelligent centralized automated system that takes the complaints in the form of images and segregates the data, and directly assigns data to the nearest responsible authority or person to resolve the issue. The features of the system are,

- An intelligent reporting system.
- Reduce the time and human effort in reporting the problem.
- Resolve the problem very quickly.
- Maintains transparency between citizens and authorities

The process flow of the system is explained in the following lines. The first step is User Authentication. This is done by OTP authentication of a phone number to log into that particular users' profile. Once authenticated, the user has options like-Lodge a complaint, finds lodged complaints and resolved complaints available for selection. In the case of the user lodging a complaint, he will be prompted to upload an image of the issue or grievance either through toggle camera or by selecting existing images from a device. The image gets uploaded to the Cloud Vision Server where it is further processed and labels about it are generated. By this, the type/category of the issue is identified (Fig. 1).

The user is then prompted to the toggle location page where the location of the individual is obtained using forward Geocoding and Reverse Geo-coding. Once the location phrase is generated, fields such as zone number, circle number, ward number, pin code, etc. are auto-filled internally hence making it hassle-free for the user. The complaint is then lodged and the concerned authority and/or his hierarchy are notified. A separate interface is provided to the authorities where they can update the status of the report, coordinate among them. This helps the user to keep track of the complaints lodged.

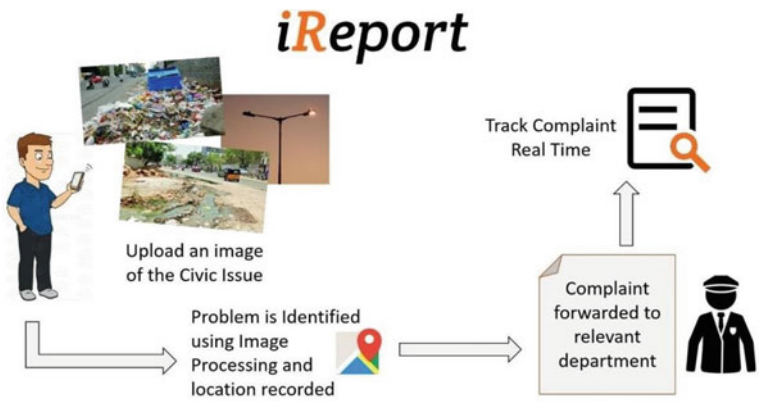

Fig. 1 Process flow of iReport

4 How Does It Works

The working mechanism of the iReport system is specified in Fig. 1 that consists of broadly two phases: front end and back end. The front end carries functions such as user authentication, uploading the image, fetch the location information and lodge the complaints. The back end connects components of the systems such as cloud vision, geo-coding, and firebase.

In the system, the user enters his login credentials for the authentication and validation of user data. After a successful login, the users upload the image of the issue or the problem into the application. The user fetches the location information where the issues take place and lodge the complaint. The backend consists of components such as Firebase, Cloud vision, Geocoding, App Interface (Fig. 2).

Image Classification: In this phase, the user uploads the issue or a problem that has been occurred in their locality. The uploaded image is forwarded to Google's cloud vision tool [1] for analyzing image contents. The tool has a rich set of API's to build image models using auto-machine learning vision. It will take the content of the image and analyses by using machine learning algorithms to classify the

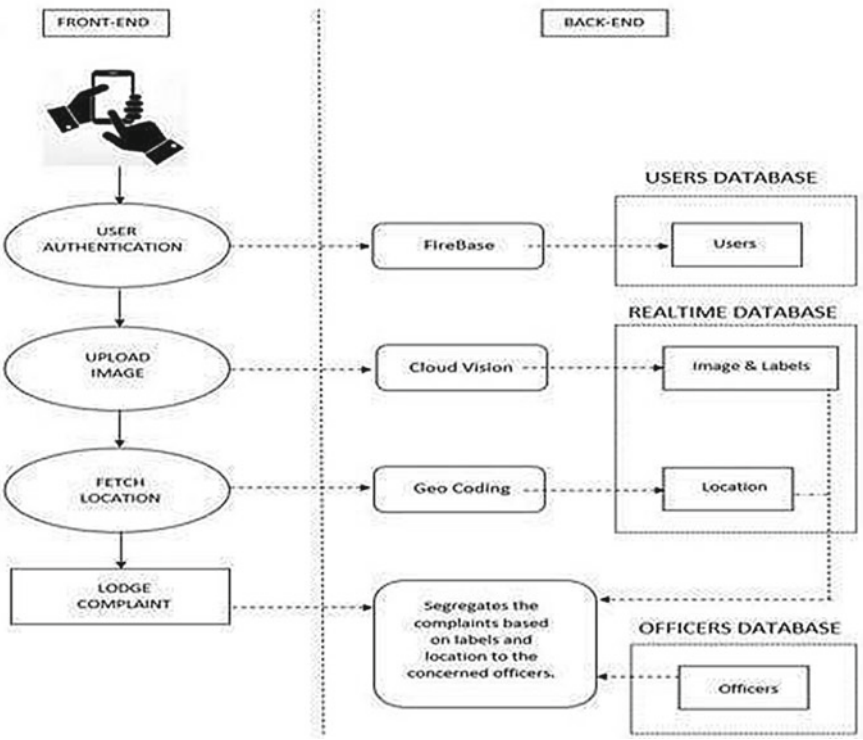

Fig. 2 Block diagram of public grievance reporting system

images into different types of categories. As a part of the Cloud vision, the component AutoML is used to classify images based on characteristics. After uploading the images of the issue or the problem, the autoML vision analyzes the issue or a problem and identifies the labels of the image. Later, the information about the image is forwarded to concern authority or person. The AutoML tool helps to detect the broader set of objects such as animals, trees, mountains, etc., in the given image based on image properties.

Geocoding and Reverse Geocoding: The Geo-coding [2, 9] is the process that takes the pair of longitude and latitudes to calculate the location information on the surface of the earth. When the user observes any issue or problem, he uploads the image where the issue has occurred, then the geo-coding system [6–8] finds the location address such as street name, road number, landmarks very quickly and transfers the information to concern authorities in real-time [10].

User Authentication and Database Management: In this phase, people who have identified the problem will enter user login credentials through the user interface. This interface is connected with the firebase of Google infrastructure [3] for database management, messaging, and generating the crash report. User authentication builds upon Google infrastructure helps to the users for large mobile applications.

Integrating the Module into the Mobile App: This is an android application which provides the connectivity to all the phases with a well-defined user interface to take the complaints quickly from the public and forward the issue to the concern authorities. It also facilitates users to track the status of the complaints.

5 Results

The system has been designed for keeping in view the present and future requirements and made very flexible. The system has been divided into modules so that each module has a separate entity making the modifications easy without affecting its design and functionality. The user enters login details in the login page of the user interface with the user name and password for authenticated login to register his/her complaint (Figs. 3 and 4).

Fig. 3 User login

Fig. 4 Complaints Registration

The citizen captures the image of the problem or issue with his toggle camera or mobile camera and uploads it into the application. The Google cloud vision analyzes the uploaded image content using image classification algorithms and generates labels of the image (Figs. 5, 6 and 7).

Through the system, we will achieve goals such as, ☐ Instant access.

Fig. 5 Cloud vision for data classifications

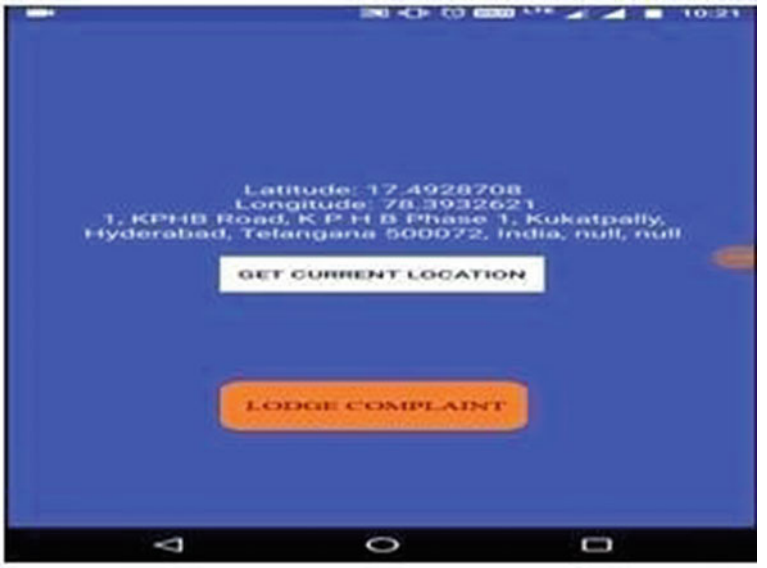

Fig. 6 Geocoding and reverse geo-coding to find the location data

Fig. 7 Complaints lodging

- Improved productivity.
- Optimum utilization of resources.
- Efficient management of records.
- Simplification of the operations
- Less processing time and immediate response.
- Portable and flexible for further enhancement.

6 Conclusions

In recent times, most of the developed countries are using public grievance as their weapon to measure the progress of the country. To address the public related issues, we developed a public grievance reporting system that provides a platform for the people to upload their problem/issue to the government authorities to resolve. Currently, even though there are many numbers of similar applications available in the market on a public grievance, but none of them are giving a complete solution to the problem. Most of the solutions are in imbibing manual operations where the issue or the problem recognition, segregation of the problem and assignment of duties take place manually. In our case, the system is a completely automated system where we have implemented machine learning algorithms using cloud vision. The cloud vision has a rich set of application user interfaces to automate problem identification, segregation and forwarding the problem to the concerned authority without manual process. The present solution can be implemented on a

large scale and be associated with a large number of public grievances related to municipalities, government offices in the urban areas to solve the issues very quickly. The intelligent public grievance reporting system is finally aiming to induce the vision of humans to a computer such that it helps to derive details from a look or picture of the problem efficiently and addresses the problems related public very quickly using cloud vision.

References

1. Xiao HB, Poovendran (2018) Google's cloud vision API is Not Robust to Noise. In: 16th IEEE international conference on machine learning and applications (ICMLA), 18 January 2018
2. Wu F, Wang X (2013) A geocoding algorithm for natural language address with neighborhood properties. In: Proceedings of 2nd international conference on computer science and network technology, 10 June 2013
3. Khedkar S, Thube S (2017) Real-time databases for applications. Int. Res. J. Eng. Tech. (IRJET) 4(06):2078–2082
4. https://www.ghmc.gov.in/KeyContacts.aspx
5. ICRF (Innovative Citizen Redressal Forum). http://www.icrf.org.in
6. Marci DK, Avdan U (2018) Address standardization using the natural language process for improving geocoding results. Comput Environ Urban Syst 70:1–8
7. Geocoding concepts, techniques & secrets from SGSI (2012). http://www.sgsi.com
8. Agatha W, Scott C (2008) Geocoding in ArcGIS tutorial. ESRI Press
9. Wu F, Wang X, Wang N (2012) Neighborhood modeling algorithm of the geographic entity in natural language geocoding. In: 2nd international conference on computer science and network technology
10. Sarnobat A, Rachamadugu R, Talker P (2017) An Interactive Method for Tracking & Geocoding. Int J Recent Innov Trends Comput Commun 4(1):36–39
11. https://darpg.gov.in/sites/default/files/UMCPGRAMS.pdf
12. Chandra S, Kush A (2012) Assessing grievances redressing mechanism in India. Int. J. Comput. Appl. **42**(5):12–19
13. Abrha FW (2016) Assessment of responsiveness and transparency: the case of Mekelle municipality. J Civil Legal Sci 5:191
14. Suhardi NBK, Prayitno D, Sembiring, J, Yustianto P (2017) Public complaint service engineering based on good governance principles. IEEE
15. Dailiati1 S, Hernimawati, Sudaryanto (2018) Principles of good governance in the department of population and civil records Pekanbaru. In: International conference on earth and environmental science

Challenges and Opportunities with ECC and Noncommutative Cryptography: A Survey Perspective

Gautam Kumar, Sheo Kumar, and Hemraj Saini

Abstract Due rapid growth in technological tools and techniques, there are various required considerations to take in the field of information security. The buzzwords of security and privacy are always being important observations in that regards. If consider the overall scenario Elliptic Curve Cryptography (ECC) is releasing one of the most powerful algorithm in relation to better performance and security related concerns than RSA algorithm. It is working as light-weight cryptography due to following reasons such as low computation costs, use of shorter key sizes, and the discrete logarithmic problem is nearly is hard to achieve on computational complexities. With ECC algorithm, to implement the same with noncommutative cryptography assumptions, which is one of the possible generalizations on noncommutative properties, that adds valuable research contributions in perfect secrecy. The prospective thoughts are considered in relation to the same.

Keywords ECC · Noncommutative cryptography · Computational complexity · Security PKC

1 Introduction

Cryptography is one of most important technique used to hide the original information when it hangs in between the medium. It is considered to be a science with respect to the secret information that should to be safe, secure, and state is not observed or disturbed by other(s). As in the real life scenarios cryptography is

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_20

observed as a mixed resultant of the three dimensions such as mathematical concepts formulation, concepts to be programmable in real in the domain of science and at the end, users supports interface is provided on electronically implementable. Using mathematical background it supports the same concepts strongly in co-relation to deploy algorithms those are acting as crucial role responsiveness. In all three concepts, the major attention is to achieve integrity, authenticity, protect information from discloser, secure transmission in unsecured environment, etc. [1].

Diffie and Hellman [2] initially set out the concept for the public key cryptography (PKC) in 1976. After the same a lot of variations with innovative and enlarged thoughts given by authors, but after a lot of observation on security and privacy, Elliptic Curve Cryptography (ECC) has attracted most of the attention and still attracting the most attention from the research community [3]. The deployment of higher length keys, other than ECC algorithm, is one of the major issues in performance, keys computation, and overhead burden that doesn't suite and fit to least memory uses, higher speed in this fast growing world, so ECC is one of the best choice for the same [4]. The strength of the algorithms depends on input key sizes and protection from attack, this statement is most validated according to National Institute of Standard Technology (NIST) released guidelines 2012; interested authors may view its report. Due to following reasons such as to create faster centric approach, speedup, smaller computation costs, and more efficient cryptographic functions, this one is treated to the light-weight cryptography approach. As the cryptographic information processed through the channel is a part of Discrete logarithmic problem (DLP) which is almost difficult to achieve due its exponential growth on keys, where security, privacy, challenges and opportunities are an abstract idea to put forward in manufacturing devices. A inspiration direction for algorithms are covered in relation to performance enhancement, by the support of hardware most of the pre-computation cost are reduced and that are mostly applicable for all techniques in general.

2 Background Knowledge

The research gap in ECC is based on scalar multiplications, where scalar multiplication is depended on point addition and point doubling operation. According to STAR Core 41,000 Processor series, one doubling (DBL) needs 14,000 clock cycles and for one add (ADD) operation needs 13,617 clock cycles, and for each scalar multiplication its algorithms are available [5]. A brief look is presented to understand the algorithms on k bits key size on how it is acting for the various existing approaches, with wherever side channel attacks advantages, in Table 1.

From the research point of perspective the followings are considered in the sense of security (proposed algorithms for the same are referring its security), privacy (attacks, side-channel attacks, safe-error fault attack, and cryptanalysis are representing its privacy), challenges (building or incorporation its services in product-based services or firm-ware services applicability or online as well as

Table 1 Existing algorithms and its complexities

Name of Algorithm	Column B (t)
Most Significant Bit (MSB)	k DBLs & $k/2$ ADDs
Least Significant Bit	$k/2$ DBLs & $k/2$ ADDs
Montgomery Non-Adjacent Form (NAF) Window methods Sliding window method Radix-8 scalar multiplication without Pre-computations [6] Radix-16 scalar multiplication without Pre-computations [7]	k DBLs & k ADDs + Side Channel Attack (SCA) $k/2$ DBLs & $k/2$ ADDs + SCA $k/(w+1)$ ADDs + SCA Escaping series of zero's on key K, $k/(w+1)ADDs + SCA$ $\log_8(k+1)$ + SCA $\log_{16}(k+1)$ + SCA

offline services are challenges applications) and opportunities are in the form of opportunities and infer them for more advanced solution(s).

Where with computer systems to its explosive growth in power, speed, and spread in use related to its threats, security, challenges and opportunities, that's always, opens a research area. Through this manuscript, the major objective is to establish the perfect secrecy on reduced computation costs on developed with innovative ideas. The hardware and software performance reflection gets accelerated. Here the contributions are based on special case of prime order for key-exchange, encryption-decryption and authentication in prospective ECC algorithms and Noncommutative cryptography strengths on extra special group & its consideration on the bigger range of probabilistic theory and it's resistant to attacks. The polynomial function as a secret key used in cryptography doesn't reveal any secrets and its assumptions are unique as well reversible are bigger strengths.

3 Motivation and Objective

Security and privacy challenges are releasing a lot of motivations to preserve data's and its associated tools and techniques [11]. It is observed that using efficient techniques by the support of hardware most of the computation costs have been reduced for secret key computation. In relation to them, precomputations have been reduced, which is one part of research gap. For the same, where Elliptic Curve Cryptography works on reduced computation costs and in correlation to the same Noncommutative Cryptography principles are strengthening in the same [12, 13]. Therefore, one of the possible ways for researchers to step in, and it should to be prospective arena as opportunities.

The challenge of the ECC is in computing on public keys of ECC and its associated parameter. Here adversaries try to completely defeat the designed cryptosystems. From the years ago, most of the cryptosystem have already been

broken and many of them have considered to impractical to defend. The cryptosystem is considered to efficient and secure on the three types of system and these are having the basis to classified mathematical problems like:

- Integer Factorization problem (IFP)
- Discrete Logarithmic Problem (DLP)
- Elliptic Curve Discrete Logarithmic Problem (ECDLP)

The above three problems are assumed to be difficult to solve in an efficient time, but not proven to be intractable on the efforts on intensive study by scientists and mathematicians because have failed to find efficient algorithms to solve at many level problems. For ECC an intensive study has been received from cryptographers, computer scientists and mathematicians in not leading the significant flaws on security compromise. In addition to the same, the following below points releases so many benefits as:

- Higher processing capability
- Consumptions of low power
- Saving Bandwidths
- Less Storage requirements
- Smaller certificates requirements

The advantages are particularly most usefulness in:

- Electronic commerce
- Chip Cards
- Web servers
- Pagers
- Mobile Phones/cellular telephones

4 Challenges and Opportunities to ECC and Solution Based Algorithms

The ECC challenges are having the followings points that are considered from algorithmic design to deployments:

- It needs appreciation, and increased understanding to cryptographic community in difficulty of ECDLP to defend by the cryptographers.
- The theoretical considerations on security levels of comparisons on ECC, RSA, and DSA must be well defined.
- To provide information to users to select appropriate key lengths for desirable security strengths.
- Determine whether any significant difference on the use of binary basis and prime basis for ECDLP.

- To stimulate and encourage on research outcome in computational and algorithmic theory proposal on the study of ECDLP.

The following algorithms are playing important role responsiveness in ECC:

- Naïve exhaustive Search
- Baby-Step giant-step algorithms
- Pollard's rho algorithms
- Distributed version of Pollard's rho algorithms
- Pohlig-Hellman algorithms
- Pollard's Lambda method
- Multiple Logarithms
- A special class of elliptic curves: supersingular curves
- Another special class of elliptic curves: anomalous curves
- Curves defined over a small field
- Curves defined over composite numbers
- Gaudry's subfield-base index-calculus algorithm

Further, a variation in ECC with solution approach has been generalized on Elliptic Curve points of various co-ordinates for a large number of applications. The ECC is playing crucial role responsiveness that making a big impact on the lower computational cost. The ECC is considered being tenable on little higher length keys, but proportionally too reduced length keys than RSA algorithms, but still some of the researchers are working on in the more innovative by keeping in view of future requirements security by not putting in directional approach based on commutative based cryptographic approaches with the possible generalizations on noncommutative properties [8]. In the same the recommended properties follows as $a * b * \neq b * a$. This property, in general, is achieving with combination of mathematics and physics on group, ring, semiring or some algebraic structured elements. The design basis, if the mathematical possible approach, for the same is known as Conjugacy decisional problem (CDP) and Conjugacy search problem (CSP). The definition for CDP is based on assumptions, such as, on given two group elements a and b, to determine for a random x to produce the value of other group elements, such that $b = a^x$ or to produce the same using the Conjugacy multiplicative inverse as: $b = x^{-1}ax$. Whereas CSP, for attacker purposes, the two group elements of a and b in a group G, to find whether there exists x in G such that $b = a^x$ or Conjugacy multiplicative inverse $b = x^{-1}ax$. Due to computational difficulties, the discrete logarithmic problem (DLP) is negligible to get, that's a new direction of research in this area which is truly a fascinating area with a lot of advancement in security and performance specific applications. It establishes on the Hidden subfield or subgroup problems. The initiation is started from braid based methods on noncommutative principles [9], afterwards the structures like Thompsons, Polycyclic, Grigorchuks or matrix groups/ring/semi-ring elements were came to strengthen the logical concepts regarding the same. In all of them, the matrices group is having potential advantages. This approach is solving the similar kind of problems as session key establishments, authentication schemes, and

encryption-decryption in relation to DiffieHellman, RSA and ECC algorithms based number theory. A quantum cryptography approach releases strength on same [10]. An innovative idea is based on random polynomials functions chosen by the entities involved to secure key-exchange, authentication schemes, and encryption-decryption. There are variety of scenarios have been considered to generalize the ideas on hidden group, ring and semi-ring structures on in-between middle equivalents considered elements, known by the monomials cryptographic approach. Typically, the proposed approach is justifying most of the cryptographic requirements, and in addition to same it assails the various attacks like brute-force attacks, length based attacks, and automorphism transpositions [14].

5 Conclusion

In this manuscript, surveys with the prospective thoughts are presented on security strengths on elliptic curve cryptography and noncommutative cryptography. Its privacy underlying assumptions, challenges and an opportunity from research perspective are considered. The proposal is in relation to high performance computations costs and most preferable form the research preferences.

References

1. Jirasek V (2012) Practical application of information security models. Inf Secur Tech Rep 17 (1–2):1–8. https://doi.org/10.1016/j.istr.2011.12.004
2. Diffie W, Hellman ME (1976) New directions in cryptography. IEEE Trans Inf Theory 22 (6):644–654
3. Koblitz N (1987) Elliptic curve cryptosystems. Math Comput 48(177):203209
4. Jarvinen K, Skytta J (2008) Parallelization of high-speed processor for elliptic curve cryptography. IEEE Trans VLSI 16(6):1162–1175
5. Gebotys CH (2010) Security in embedded devices. Elliptic curve protocols. Springer, Cham, pp 75–109. https://doi.org/10.1007/978-1-4419-1530-6
6. Abdulrahman Ebrahim AH, Reyhani-Masoleh A (2015) New regular Radix-8 scheme for elliptic curve scalar multiplication without pre-computation. IEEE Trans Comput 64(2):438–451
7. Kumar G, Saini H (2016) Secure and efficient ECC: Radix-16 scalar multiplication without pre-computation. In: International conference on big data and advanced wireless technologies, ACM digital library, USA. http://dx.doi.org/10.1145/3010089.3010105
8. Cao Z (2013) New directions of modern cryptography. In: Noncommutative cryptography. CRC Press, 233–312
9. Shor PW (1994) Algorithms for quantum computation: discrete logarithms and factorings. In: Proceedings of the 35th annual symposium on foundations of computer science, pp 124–134. https://doi.org/10.1109/sfcs.1994.365700
10. Svozil K (2014) Non-contextual chocolate balls versus value indefinite quantum cryptography. Theoret Comput Sci 560:82–90
11. Myasnikov AD, Ushakov A (2014) Cryptanalysis of matrix conjugation schemes. J Math Cryptol 8:95–114. https://doi.org/10.1515/jmc-2012-0033

12. Moldovyan DN, Moldovyan NA (2010) A new hard problem over noncommutative finite groups for cryptographic protocols. In: Kotenko I., Skorim V. (eds) in MMM-ACNS, Lecture Notes in Computer Science, vol 6258. Springer, Heidelberg, pp 183–194. https://doi.org/10.1007/978-3-642-14706-7_14
13. Kumar G, Saini H (2017) Novel noncommutative cryptography scheme using extra special group. Secur Commun Netw 2017:1–21
14. Kumar G, Saini H (2017) An ECC with probable secure and efficient approach on noncommutative cryptography. In: Jain L, Tsihrintzis G, Balas V, Sharma D (eds) Data Communication and Network, vol 1049. Springer, Singapore, pp 1–11. https://doi.org/10.1007/978-981-15-0132-6_1

Feature and Sample Size Selection for Malware Classification Process

Raghunath Reddy, M. Kumara Swamy, and D. Ajay Kumar

Abstract Android is a popular operating system due to its wide acceptance among people. As a result, several applications have been designed based on Android and a lot many people are using them. It is observed that, due to a large number of users, the malware applications are induced in Android apps. Generally, malicious applications cause serious damage such as password stealing, ransom attacks, viruses, etc. Efforts are made in the literature to address the detection of malware applications. However, the detection of new malware systems is an issue with the existing malware detection systems. In this paper, we proposed an improved malware detection approach using the classification technique. In the proposed approach, we identify the relevant features for characterizing malware. We conducted the experiments on the real-world Derbin and Malegenome datasets and achieve significantly better results.

Keywords Android · Malware · Classification · Mobile devices

1 Introduction

In the modern world, the usage of mobile devices has been increased. Android based mobile devices have been popularized because it is easy to use and cost effective. There are millions of apps in different categories on distribution platforms such as the App Store or Google Play Store. Mobile malware is malicious software that targets mobile phones intending to harm the user data. The most widely

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_21

recognized malware categories are Adwares, Bots, Bugs, Rootkits, Spyware, Trojan ponies, and Worms [1, 4] some of them are listed below.

- *Adware* frequent advertisements in the form of pop-ups shown to a user for unintended redirection of users to different web pages.
- *Banker malware* stealthily attempts to know the bank credentials of an user.
- *Ransomware* capture users files or device functionality and then blackmail users demanding money in exchange to release the captured resources.
- *Rooting malware* secretly gains the device root permission and takes control of the device.
- *Trojan* hidden piece of legitimate software which gets active and takes control of the entire system without the notice of user.
- *Humming bad* gets installed when a person visits certain websites. It gains root access and then sells the user details for earning revenue from malicious advertisements.

Despite several checks and measures taken by App distribution platforms for publishing Apps, malware tend to creep inside the App stores. The security threats posed by malware to mobile users are increasing. There is no full-proof solution for malware threats. A study was done as a part of the ANDRUBIS project in 2014 [5] found that 1.6% of Apps sampled from Google Play-Store were malicious. Characterizing the App's behavior as malware or benign is a challenging task. There are different methods and approaches to identify malware. However, when a new malware enters, it is hard to identify such malware by the existing malware detection software.

The rest of the paper is organized as follows. The next section explains the related work. In Sect. 3, we explain the proposed approach of malware detection. Section 4, presents the experimental results. Finally, the conclusion is given in Sect. 5.

2 Related Work

In this section, we provide related work in the area of machine learning. In [7], malware identification methods are broadly categorized into static analysis, dynamic analysis and hybrid approaches. *Static analysis* is a reverse engineering approach that finds malicious code segments in an app without the actual execution of App. *Dynamic analysis* analyze a suspicious app by executing it in an isolated virtual machine or emulator to monitor its dynamic behavior. *Hybrid* approaches use both static and dynamic analysis. In [8], a static feature-based mechanism has been proposed considering the static information such as permissions, deployed components, messages and API calls used in an app for characterizing the application behavior. The *Droid Mat systems* extracts significant static information from application's manifest file. K-means algorithm is applied on the extracted data to

improve the malware modeling capability. Finally, it uses the k-NN algorithm to classify the applications as benign or malicious. The authors collect Android malware from "Contagio mobile" site which has a total of 238 Android malware from 34 malware families and 1500 benign applications from 30 families. A novel classifier fusion approach is proposed in [9], it is based on a multilevel architecture that combines different learning algorithms. The framework called DroidFusion was designed on a set of ranking-based algorithms on classifiers. They perform experiments on four separate data-sets to demonstrate the DroidFusion method effectively enables the fusion of ensemble algorithms to improve accuracy. The Bayes network and random forest learning algorithms are evaluated on two data-sets, namely publicly available MalGenome and private dataset collected on their own [3]. The classifiers gave an accuracy of 99.97% true-positive rate. The multi-layer perception gave 93.03% on the MalGenome dataset.

This paper is on similar lines of applying machine learning for malware classification. The study differs in performance analysis of machine learning approaches with different features over modified sample sizes. An analysis of the influence of feature selection, class size proportion and data-set size on malware classification is studied. The most relevant features that characterize malware are identified along with the identification accuracy of different classifiers. We conducted experiments on the real-world Derbin and Malegenome datasets.

3 Methodology

The methodology involves the application of different classifiers on two malware data-sets. The steps involve the selection of relevant features, training a classifier model and then evaluating the classifier performance.

3.1 Description of Data-Sets

The experiments to evaluate classifiers make use of two different data sets namely Malgenome and Drebin. The Malgenome dataset consists of feature vectors with 215 features from 3799 app samples. Within it 2539 are benign and 1260 are malware samples. The Drebin dataset consists of vectors of 215 features from 15036 app samples. Within it there are 9476 benign and 5560 malware samples.

3.2 Feature Selection

In the first part of the work, we observe how the change in some features affects the classification process. In a high-dimensional data-set, some features may be

irrelevant or insignificant and the contribution of these features is less in predictive modeling. Feature selection enables the machine learning algorithm to train faster. It reduces the complexity of a model and makes it easier to interpret. It improves the prediction performance and reduces over-fitting. We have used two types of feature selection methods the first is a tree-based feature selection method and the second is a gradient boosting classifier which recursively eliminates features with cross-validation. Tree-based Feature selection computes tree-based estimators to identify relevant feature. Recursive feature elimination recursively eliminates features and builds the model using remaining attributes and checks the accuracy of model [2]. RFE finds a proper combination of attributes that contributes to improved model accuracy. The RFECV curve using the gradient boost classifier in Fig. 1 shows that there are very few important features that are sufficient for getting good accuracy. These features characterize malware effectively and can be used for malware classification. The most frequently occurred features in Drebin data-set is shown in Figs. 2 and 3. There are very few most frequently occurred features that are also most relevant features.

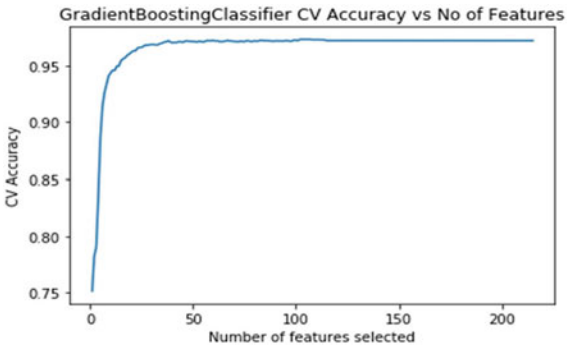

Fig. 1 RFECV feature importance

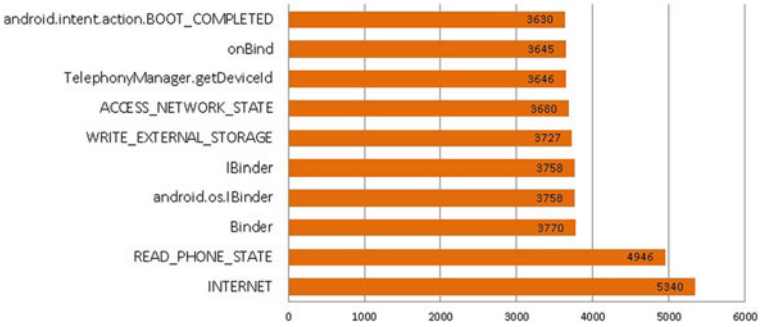

Fig. 2 Top ten occurrence frequency of malware features in Drebin data-set

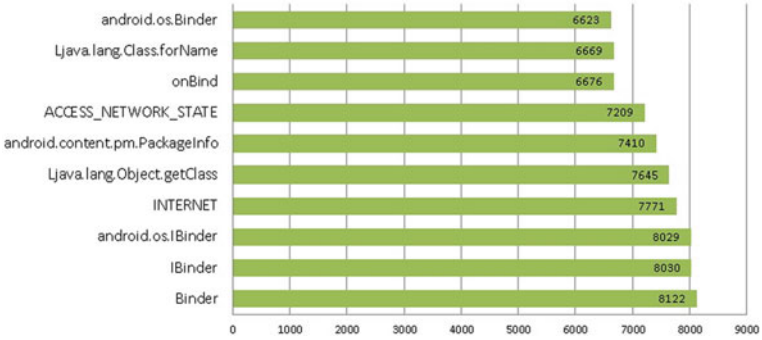

Fig. 3 Top ten occurrence frequency of benign features in Drebin data-set feature and sample size selection for malware classification process 5

4 Results

This section presents the results obtained after performing the experiments.

We use Sklearn machine learning algorithms such as Decisiontree, RandomForest, Gaussian Naive Bayes (GNB), K Nearest Neighbor (KNN), Logistic Regression (LR) and Support Vector Classifier (SVC). Accuracy metric is used to measure performance. It is defined as the sum of correct predictions divided by the total number of predictions [6].

4.1 Influence of Data-Set Size on Classifiers

The data-sets are increased from 20 to 100% and the classifier performance on both data-sets is observed. The Figs. 4 and 5 show the experiment results of changing

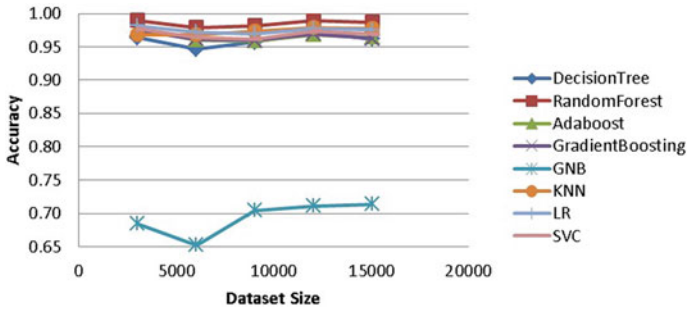

Fig. 4 Data-set size vs accuracy for Derbin data

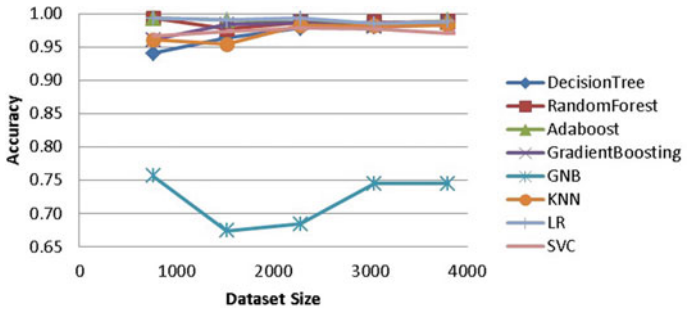

Fig. 5 Data-set size vs accuracy for malgenome data

data-set size and running classifiers for malware identification. It can be seen that there is very little influence on changing data-set sizes.

4.2 Influence of Number of Malware Samples on Classifiers

The influence of the malware sample size on classifiers is studied. Since usually there are fewer malware Apps as compared to benign Apps in the real world. To understand the effect of malware samples on classifiers, the malware sample size is set in a range from 20 to 100% of original size and classifier accuracy on two data-sets is noted. The Figs. 6 and 7 shows there is very little influence of malware sample size on classifiers.

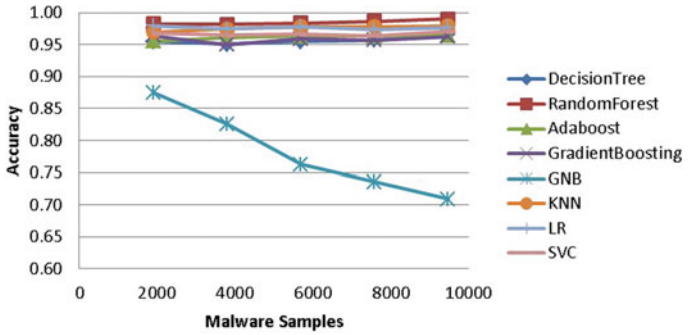

Fig. 6 Malware samples vs accuracy for Derbin data

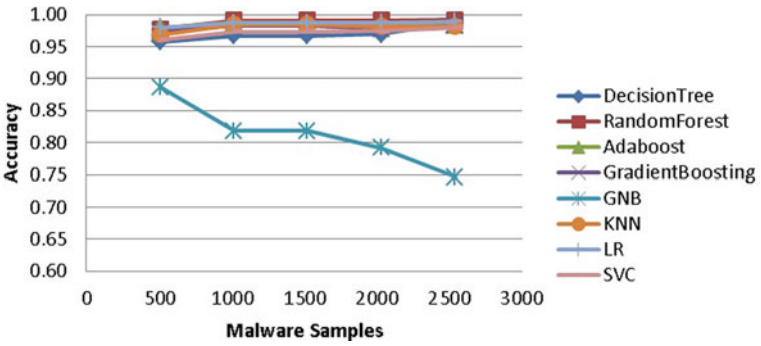

Fig. 7 Malware samples vs accuracy for malgenome data

5 Conclusion

The paper presents a study on how features selection and changes in the proportion of class sample sizes affect classifiers. The machine learning algorithms and the features to be used would improve the understanding of malware detection. There is a need for a holistic approach in the malware identification process. We could see the hackers observe the vulnerabilities of machine learning approaches and anti-malware softwares to create newer malware.

References

1. How hackers are infecting phones with malware. https://www.wandera.com/mobile-security/mobile-malware/malware-on-android/. Accessed 15 Dec 2019
2. Recursive feature elimination. https://www.scikit-yb.org/en/latest/api/model_selection/rfecv.html. Accessed 15 Dec 2019
3. Amalina F, Feizollah A, Anuar N, Gani A (2014) Evaluation of machine learning classifiers for mobile malware detection. Soft Comput 20. https://doi.org/10.1007/s00500-014-1511-6
4. Jerlin MA, Marimuthu K (2018) A new malware detection system using machine learning techniques for API call sequences. J Appl Secur Res 13(1):45–62
5. Lindorfer M, Neugschwandtner M, Weichselbaum L, Fratantonio Y, VanDer Veen V, Platzer C (2014) Andrubis–1,000,000 apps later: a view on current android malware behaviors. In: 2014 third international workshop on building analysis datasets and gathering experience returns for security (BADGERS), pp 3–17. IEEE
6. Raschka S (2014) An overview of general performance metrics of binary classifier systems. arXiv preprint arXiv:1410.5330
7. Souri A, Hosseini R (2018) A state-of-the-art survey of malware detection approaches using data mining techniques. Hum-Centric Comput Inf Sci 8(1):3
8. Wu DJ, Mao CH, Wei TE, Lee HM, Wu KP (2012) Droidmat: Android malware detection through manifest and API calls tracing. In: 2012 seventh Asia joint conference on information security (Asia JCIS), pp 62–69. IEEE
9. Yerima S, Sezer S (2018) Droidfusion: a novel multilevel classifier fusion approach for Android malware detection. IEEE Trans Cybern 1–14. https://doi.org/10.1109/TCYB.2017.2777960

Adithri – (F2) The Farmer's Friend

P. N. V. Sai Sri Gayathri and Sheo Kumar

Abstract In this 21st century of internet world, the adoption of social network and advanced technologies has nurtured a drastic change to automation for communication through messaging applications by using web robots so called chat bots. The stimulation of a real-time conversation between the human and the computer using computer programs are said to be chatbots. For agriculture purposes, it is important to know about the various variables, update rapidly and available easily for the use of farm management by the farmers. In the domain of agriculture using Machine Learning technology chat bot ADITHRI has been prepared. Adithri is developed focusing on the search and query of data by the user deployed on different types of crops by posing query in Facebook which is based on the messenger bot API. The chat bot gives the description of the query posed by the user in the FB messenger bot. Adithri the farmer's friend is designed in such a way by bringing various individual app services that were developed previously to the farmer such as Government schemes, Weather information, Fertilizers etc., in the shade of one umbrella. ADITHRI provides the services applicable for different types of crops and does not stick to one particular crop. It is expected that with logical capacity over the mass data, it is possible to work towards harmful situations by the farmer.

Keywords Adithri · Machine Learning · Chat bot · Facebook · Messenger bot · Farmer's friend

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_22

1 Introduction

The technology that allows communication between users and computers using natural language is known as Human Computer Interaction (HCI), where it is designed to converse humans with machine is used widely in several domains as an automated conversation system called chat bot. Building a smart chat bot is a challenge which requires text entailment and language understanding technology and various forms of Artificial Intelligence (AI) and Natural Language Processing (NLP) are also required. Using the NLP approach the human language complexity and area of research that explores the capability of computers to provide models which focuses on literature review is to survey existing literature and find the challenges related to a Chatbot. Thus, this paper uses the comprehensive survey of the conversation system which is organized as (i) the first section presents an overview of chat bots, (ii) the second section presents a detailed content of proposed chatbots, (iii) the third section details the classification framework for different crops using ADITHRI chatbot, (iv) the fourth section presents the conclusion and future work.

1.1 Background of Chat Bots

Alan Turing (1950) created the Turing test or the "imitation" game to determine whether a computer could imitate human behavior, which became the foundation and raised an idea of chatbot. ELIZA, the first chatbot was developed in 1966 used keywords matching and minimal context identification. The ALICE (Artificial Linguistic Internet Computer Entity) chat bot was created in 1980's was used for Artificial Intelligent Mark-up Language (AIML). Proposed classification for chatbot approaches. With the sudden growth of AI technology, automatic conversation agents that respond to humans in suitable time had been built by the NLP researchers.

2 Literature Survey

Farm chat agriculture chatbot research [1] briefly describes the Kisan Call Centre (KCC) where it acts as the dataset and a helpline to the farmer. If a farmer has a query he can call and register himself to post a query which is answered by KCC Agriexpert. Aham [2] app describes about aromatic and medicinal plants. The AgriBot [3] mention the highlights about the diseases that crops are attacked with and also gives description of the market prices of the seasonal and unseasonal crops which aims to reduce the gap between the farmers and the government by providing the latest market rates, weather forecast, Government policies and scheme for

farmers, technological videos, news related to agriculture etc., [4]. Government launched vernacular Agro advisory app "Meghdoot" [5] for farmers that is available for 150 districts initially and by the next year it may be multiplied to the different parts of India.

3 Existing System

Agronomobot [6] smart chatbot was developed and focused on Wireless Sensors Network [20] data deployed on a vineyard based on telegram bot API [7–9] and was able to access information collected by the field sensors and interacting with the farmers by sending the alert messages and implementing IBM Watson Assistant Engine [16, 20] chatbot using features of Machine Learning and NLP. The main drawback of the existing system was that it was developed only for the vineyard crop prediction.

4 Proposed System

To overcome the drawback in the existing system ADITHRI the farmer's friend, agricultural chatbot is developed on Facebook messenger platform that can be used on Android or IOS with the messenger app. The KCC manual was used as data source in the existing system whereas, in the proposed system the chatbot will be automated by using frequent queries as datasets available through the Government dataset i.e., data.gov [12–14]. The advantages of the proposed system are it saves time of the people and is economically neutral. It is user-friendly and is accessed very easily. The system is robust when compared to the previous system as it provides the information regarding different crops but not only one crop.

5 Methodology

5.1 System Architecture

See Fig. 1.

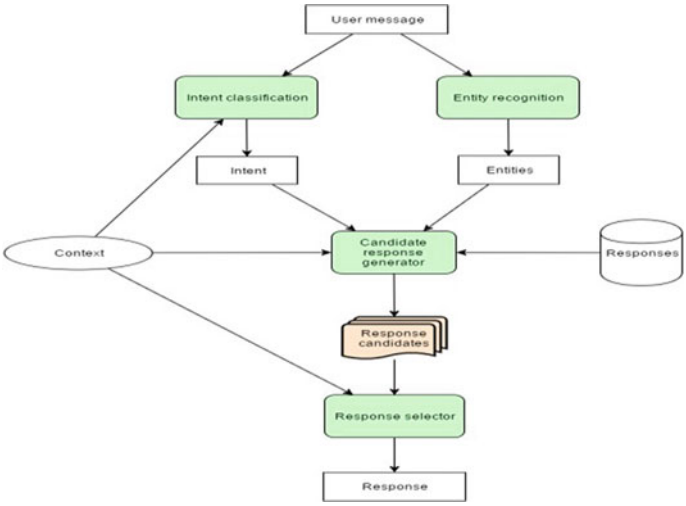

Fig. 1 System architecture

5.2 System Implementation Modules

5.2.1 GAE or Live App Engine

GAE is a Platform as a Service Cloud Computing platform for developing the hosting web applications in Google-managed data centers and applications sandboxed are run across multiple servers. Automatic scaling for web applications were offered by App Engine [12, 13] as number of requests increases for an application and also automatically allocates more sources for the web applications to handle additional demand. [14] Live App Engine is free up to a certain level of consumed resources and only in standard environment but not in flexible environment. Along with node.js [23] App Engine executes the Python application code using pre-loaded Python interpreter in a safe "sandboxed" environment.

5.2.2 Datasets Used

In this system the datasets are sourced from dataset.gov of the Government dataset.

The dataset gives the description of the previous crop yield prediction [11] done through the updated KCC services [10] previously and now the dataset will be automatically automated.

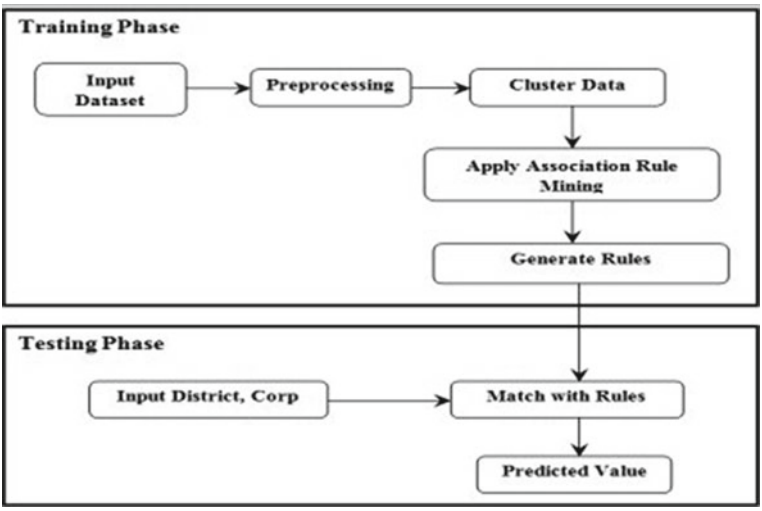

Fig. 2 Workflow of the crop yield prediction

5.2.3 Crop Yield Prediction

Data Mining is widely applied to agricultural issues used to analyze large datasets and establish useful classifications, patterns in the datasets. The overall goal of the Data Mining process is to extract information and transform it into understandable structure for the further use. This paper analyzes crop yield production based on the data available and also used for maximizing the crop productivity Fig. 2.

In this workflow the training phase contains the dataset as input and process the data by checking it in the database of the cluster data and apply the association rule and also use the K-means clustering techniques to provide the accurate output of different types of data of the various crop prediction and rainfall in that particular district or state and the type of crop that is being cultivated in the testing phase and checks the matching patterns and then predict the crop yield value at the end of the production.

5.2.4 Machine Learning and Natural Language Processing

Artificial Intelligence [18, 19, 22] contains various fields, among them Natural Language Processing (NLP) [15, 17, 21] takes care of understanding the human machine conversation [22, 23] and tries to communicate by answering the query. The Machine Learning Algorithms [18] through supervised learning trains the machine to translate input into the desired output which means it assigns an inferred

function to get new outputs. Unsupervised learning means discovering new patterns where the machine itself assigns an inferred function to data through careful analysis for analyzing the data in a hierarchical way.

5.2.5 Rainfall and Crop Production Data

The rainfall datasets of Indian states are collected from data.gov.in. Clustering technique is employed to predict the crop-yield [11] based on the type of crop, total area, rainfall and region workflow is explained in the Live App Engine module in two parts like training phase and the testing phase.

6 Experiments and Expected Results

See Fig. 3.

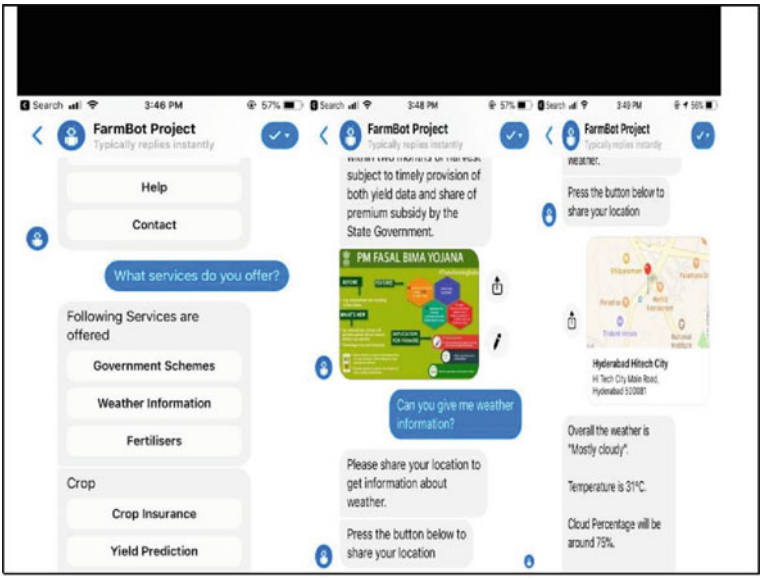

Fig. 3 Services offered by Adithri

7 Conclusion and Future Work

Crop yield prediction is still a challenging issue for farmers. The aim of this research is to propose and implement a rule-based system to predict the crop yield production from the past data. This has been achieved by applying association rule mining on agriculture data. ADITHRI the Indian farmer's friend is here to provide information about Government schemes, Weather forecast using APIs, Fertilizers, Crop Insurance, Crop Yield Prediction and Miscellaneous Information. By taking the government data, I projected and solved some issues of farmer. As future work we can relate the implementation of speech communication like Google Assistant, Alexa etc., and also try for offline chatbot services which make easy for the farmers who are unable to use mobile applications in worst conditions like no internet connectivity.

References

1. https://www.ictworks.org/farmer-chatbot-india/.XVjZS2ZS_IU
2. https://www.firstpost.com/tech/news-analysis/aham-is-an-agriculture-focussed-appthat-is-meant-to-helpfarmers-get-their-queries-addressed-by-a-achatbot-or-a-livescientist-4440369.html
3. https://github.com/dhishku/AgriBot
4. https://yourstory.com/mystory/e374fa4df7-top-5-best-android-app
5. https://inc42.com/buzz/govt-launches-vernacular-agro-advisory-app-meghdoot-forfarmers/
6. https://www.researchgate.net/publication/327212062_AgronomoBot_a_smart_answering_Chatbot_applied_to_agricultural_sensor_networks/ling/5b8052dl14585151fd12f6af4/download
7. https://github.com/yagop/node-telegram-bot-api
8. https://github.com/watsondevelopercloud/nodesdk#conversation
9. https://github.com/icaroramiires/agronomobot
10. https://dackkms.gov.in/account/login.aspx. (For Services)
11. https://data.gov.in/. (For Crop Yield Prediction)
12. https://code.google.com//appengine/docs/python/runtime.html
13. https://archive.org/details/programminggoog10000sand
14. https://cloud.google.com//appengine/docs/quotas
15. Cambria E, White B (2014) Jumping NLP curves: a review of natural language processing research. IEEE Comput Intell Mag 9(2):48–57
16. Campos LB, Cugnasca CE (2014) Applications of RFID and WSNs technologies to Internet of Things. In: 2014 IEEE Brazil RFID, pp 19–21. IEEE
17. Higashinaka R et al (2014) Towards an open-domain conversational system fully based on natural language processing. In: Proceedings of COOLING 2014, the 25th international conference on computational linguistics: technical papers, pp 928–939
18. Hill J, Ford WR, Farreras IG (2015) Real conversations with artificial intelligence: a comparison between human-human online conversations and humanchatbot conversations. Comput Hum Behav 49:245–250
19. Kar R, Haldar R (2016) Applying chatbots to the internet of things: opportunities and architectural elements. Int J Advanced Comput Sci Appl 7(11):147–154

20. Kelly J III, Hamm S (2013) Smart machines: IBM's Watson and the era of cognitive computing. Columbia University Press, New York
21. Lehnert WG, Ringle MH (ed) (2014) Strategies for natural language processing. Psychology Press, New York
22. Poogle D, Mackworth A (2017) Artificial intelligence: foundations of computational agents, 2nd edn. Cambridge University Press, Cambridge
23. Tilkov S, Vinoski S (2010) Node.js: using JavaScript to build high-performance network programs. IEEE Internet Comput 14(6):80–83. https://nodejs.org/en/

Automatic Rice Quality Detection Using Morphological and Edge Detection Techniques

R. Jegadeesan, C. N. Ravi, and A. Nirmal Kumar

Abstract In the industries of farming, the estimation of grain quality is immense challenge. The management of quality is the most significant in the industry of food since post harvesting, on the quality basis constraints food manufactured goods are categorized & ranked into distinct ranks. The evaluation of grain superiority is finished manually yet it is relative, constraint of time, might be differentiating in the results and the cost. The methods of image processing are the substitute clarification which could be utilized for the grain quality analysis for overcoming these restrictions and shortcomings. The rice quality can be accessed by properties like grain size, whiteness, moisture content etc. This paper presents an algorithm of identifying the quality of rice gain using properties of size, shape etc using image processing algorithms.

Keywords Rice characteristics · Rice quality · Grain evaluation

1 Introduction

Agriculture is one of the primary occupations around the word. By tradition, the quality food products are determined from its chemical as well as physical attributes by panel the human sensory [1]. The physical constraint comprises size and shape of grain, content of moisture, whiteness, chalkiness, milling degree as well as bulk

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_23

density. The healthier principle of the storage space moisture content shall be amidst 12—14%. Various procedures are utilized to analyze the analysis such as the standard meter of moisture. This paper has centered the consideration on size and shape of grain analysis by utilizing the methods of processing the picture. Yet all these procedures are time taking processes and few of them are expensive too. The techniques of picture processing are the alternative and best solution [2] to conquer these limitations. The primary aim of the suggested process is to grant a substitute explanation to analyze the quality which lessens the needed time & cost. The processing of image is very crucial and advanced technological areas where the considerable enhancements have been completed. These attempts are being equipped for substituting the human sensory traditional board.

In the farming industry, product analysis of the quality is very imperative. The grain seeds quality is visually assessed by skilled technician. But such amount of result is comparative, fluctuating in outcomes and consumption of time. The eminence also would get influenced by the technician frame of mind; so to conquer the limitations that are happened because of the methods traditionally latest and highly developed method i.e. method of processing the image is recommended.

A. **Rice quality and classification**

The quality of grain is a significant element in the entire world. To import or export the food grains of any category, the quality checking is compulsory. In the purpose of exports, while verifying the grains quality there is certain standard catalog which should to be fulfilled by every grain actuality.

Yet in several situations, quality is verified manually which consists various drawbacks and limitations, to conquer these challenges new and improved methods have to be planned [3]. The established techniques utilized for the size and shape of grain dimension, tester of grain shape and graphical way, however these techniques are the matter of time as they consume lot of time. The result of this study is also relative, time consuming, having different solutions and expensive too. So it would need high degree of exactness to fulfill the purchasers' requirement and also to triumph over the restrictions of manual inspection new and advanced process has been initiated which techniques of picture are processing.

The focused work of quality examination on the basis of the dimension of physical constraint i.e. grain by utilizing the methods of picture processing. Basmati rice is utilized for analyzing the superiority. Basmati grain is categorized as long, extra long, medium & short. The picture processing practice is utilized to count the numerous seeds of rice and categorizes them on the length basis, breadth and ratio of length-breadth.

B. **Image acquisition and processing**

The images are acquired for the processing. the size of the images are generally in the dimensions of 320 $\times$ 240; (Fig. 1).

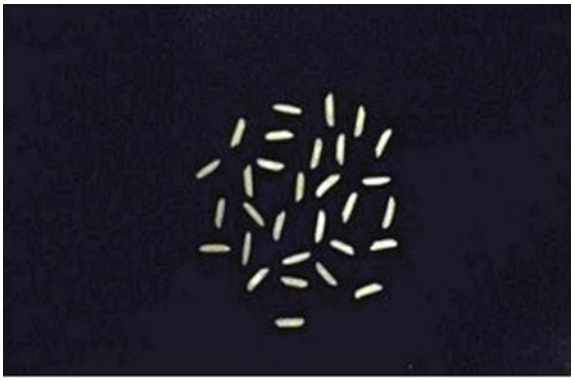


Fig. 1 Original image

2 Literature Survey

The decision making abilities of human-inspectors are subject mattered to the exterior controls like vengeance, fatigue, bias etc. along with the support of processing the image it could be overcome. Through processing the picture, we can also recognize any broken mixed grains. We would discuss here about the several methods utilized to attain the quality percentage of rice grains.

The ever growing population losses in managing and dealing, the raised anticipation of food products of high superiority and security standards there is necessity for the growth of precise fast and quality of objective determination of food grains in India. These days, we are utilizing the chemical practices to identify the varieties of rice grain seed and superiority. The chemical practice utilized would destruct the sample utilized and it consumes a lot of time. It is also very quick and low-priced process when compared to the chemical process. In the past, the application of machine vision to assess the quality of grain, Lai et al. (1986) has recommended few model identification methods o acknowledge and categorize the cereal grains. The similar studies (Zayas et al. 1986) also have applied the digital picture analysis method to differentiate wheat modules and varieties.

The digital camera of high pixel resolution pace could be utilized. The utilized background was black. The surroundings were managed to enhance the collection of data along with background of simple plain. The pictures acquired were 319 $\times$ 300 pixels in size. The pictures were taken and saved automatically in JPG format. With the help of data cable, these pictures are transmitted and then saved in disk.

In this, first of all we would set the level for the background and then take away the picture (Fig. 2) from the background. By working this, we would get the more background of uniform. b) Later we would be adjusting the attained picture stretch border from the last step (Fig. 3). By this, we will be getting more contrast amidst the grains and the background, as we set the 0 and 1ratio for the background as well

as kernels of grains. c) We transfer this picture here into the binary picture (Fig. 4) to perform the other operations of morphology.

Here we would be concluding that ranking of rice could be completed effectively by utilizing the picture processing methods. Along with the coding, we can compute how pure our sample is. The setup utilized is also very general and available easily. This is also more precise than the inspection of human visual. All this would be leading to improved quality in food processing by processing of the picture.

The Agriculture industry on the entire is ancient up till now. The grain superiority evaluation is a very huge problem as the immemorial of time. This document would suggest a latest process to count the numerous Oryza sativa L (rice seeds) along with seeds that are long and tiny seeds utilizing picture processing with a great excellence and then quantifies the similar one for the seeds of rice merged dimensions basis.

Probably, the agricultural industry is too eldest and the many extensive industries in the globe. In hi-tech revolution, the industry of agriculture has turned into scholar and mechanical apparatus that has restored the attempts of human [4].

The efforts are equipped to the substitute of established sensory of human's board along with computerized methods, as human operations are conflicting and less competent [5]. Several industries already have joined the hands with the similar but it is very expensive.

Fig. 2 Flow diagram for image processing algorithm

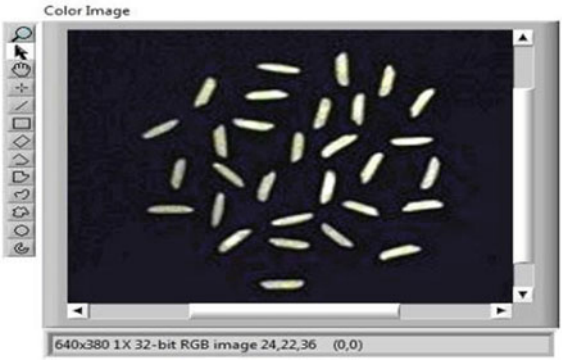


Fig. 3 Color image

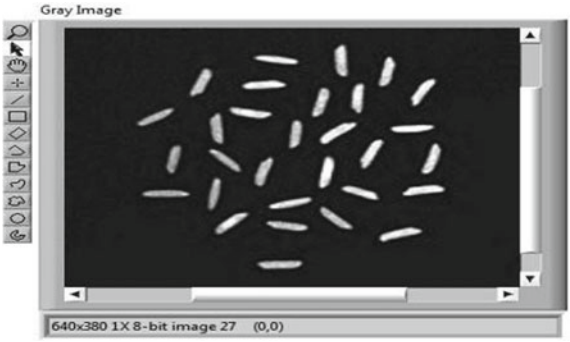


Fig. 4 Gray image

The recommended method & suggested algorithm to calculate seed of rice along with long seed and small seed which is existed in the illustration is also conversed in the similar segment [6].

This paper would present a quality analysis of Gujarat-17 seeds of rice via study of picture. We are computing the area, minor axis length, major axis length and eccentricity to count regular seed & foreign factor in terms of long and small seed for a provided illustration [7]. This paper exemplifies latest procedure which is non-destructive for analyzing the quality. The time taken to attain specific outcomes is also very less which obviously portrays its significance in the automation world. Usually evaluation of quality and estimation is finished by human sensory board which takes a lot of time, might be change in outcomes and expensive too. To analyze the quality more constraints could be computed for making more precise outcomes [8].

Physical Quality of Selected Rice Verities. Experiment was carried out to recognize the physical persona of the rice varieties that are 41. Length, Breadth, Bulk density & 1000 grains heaviness have got verified. The rice varieties were obtained from T Madurai, Virudhunagar and irunelveli district [9].

3 Proposed Method Materials and Methods

NI Labview software is utilized to execute the algorithms of picture processing to analyze the quality of grain. The tool box of vision and motion is utilized for applying and planning the algorithms of picture processing. Color camera is utilized for capturing the picture and utilizing USB cable that is being captured photo could be saved in the desktop. After utilizing labview processing of picture algorithms are intended to assess the rice grains quality. The seeds of rice are randomly placed on black background for acquisition of image. The input image is preprocessed for contrast defects. Then Morphological operation of shrinkage is performed. In the next step, the edge detection algorithm is employed for extracting the shape of the rice grain. Then the object measurement process is carried out followed by object classification.

A. **Image pre-processing**

In the preprocessing stage, the image is converted from RGB to gray and the contrast enhancement algorithms are employed.

B. **Shrinkage morphological operation**

The process of erosion and dilation are applied on the image. Dilation process makes the binary mage parts thick. Erosion process makes the white regions thinner.

C. **Edge detection** various edge detection algorithms like Robert, Prewitt, canny can be used for detection the edges of the rice grains. This helps us analyze the shape of the grain (Fig. 5)

D. **Object measurement**

This step focuses on the extraction of features from the rice gain like numbers, bounding boxes etc. (Fig. 6).

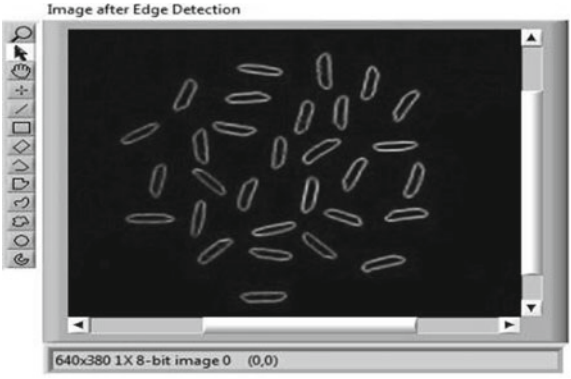


Fig. 5 Edge detection operation on rice grains

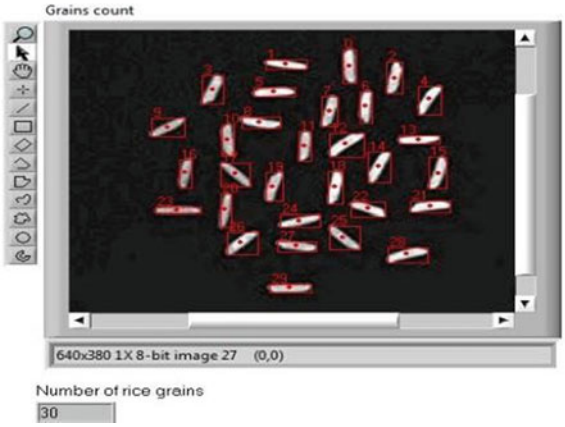


Fig. 6 Number of rice grains

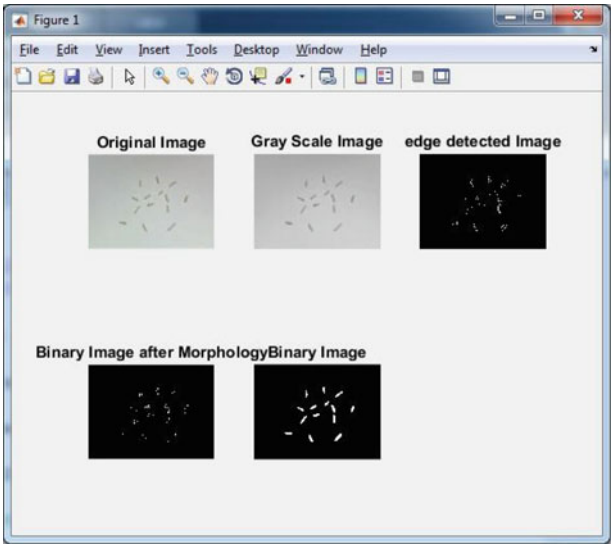
E. **Object classification**

Based on the extracted features, the rice gains are classified as good or defected.

4 Results

4.1 Result and Discussion

The solutions which happened by performing algorithms of picture processing are displayed in Fig. 6. The solutions would be indicating length-breadth ratio of every grain.




```
total_rice_grains =
    14stats = 14x1 struct array with fields:
MajorAxisLength MinorAxisLength stats =
MajorAxisLengthMinorAxisLength
_____________   _____________
          37.8773108489759    10.9971808858253
         40.8416777778177    11.4961620815603
    50.5769746131946    11.1848030297915
    37.4512803207583     11.312872631238
    45.6546316303521     12.747717373013
     36.249116310571     12.504844898772
    32.9781589084845    12.3509806110583
    39.6877990372274    11.0483507516756
    33.2582801368029     11.989429885581
          45.4276731195893    14.3824069010019
         41.8969287257561    11.9889658882612
         57.7431744225651    14.1911303690681
    46.5905606271234    11.3124821556389
     40.248131199208     11.971225919999
L_B_Ratio =
   3.444274604757777
```

3.552635869959341 4.521936995982794
3.310501367914719 3.581396597872747
2.898805751211720 2.670084258650530
3.592192167795558 2.773966773582844
3.158558468848812 3.494624066515926
4.068962296930620 4.118509093417624
3.362072645540007
Rice Grain Number 1 is of type slender .
Rice Grain Number 2 is of type slender .
Rice Grain Number 3 is of type slender .
Rice Grain Number 4 is of type slender .
Rice Grain Number 5 is of type slender .
Rice Grain Number 6 is of type medium .
Rice Grain Number 7 is of type medium .
Rice Grain Number 8 is of type slender .
Rice Grain Number 9 is of type medium .
Rice Grain Number 10 is of type slender .
Rice Grain Number 11 is of type slender .
Rice Grain Number 12 is of type slender .
Rice Grain Number 13 is of type slender .
Rice Grain Number 14 is of type slender .

The analysis of picture algorithms is executed on picture in which grains of rice are placed on a random basis and extend in every layer.

The error happens such as operation of touching kernels shrinkage would efficiently work to separate the associating element from touching point kernels. The revealing of edge is executed to locate the area of boundaries & endpoints of every grain. Later utilizing caliper length and breadth could be evaluated. After getting the values for length and breadth, ratio of length-breadth is to be computed.

5 Conclusion

In this research, the algorithms of picture developing have enhanced to fragment and recognize the grains of rice. It could be finished that the utilization of picture processing algorithm is a competent scheme to examine the quality of grains by its size from the attained effects. The main advantage of initiated process is it needs minimum time; cost is economical and also would give improved outcomes compared along with physical outcomes or traditional procedures.

5.1 Future Work

The utmost numbers of constraints are to be computed by picture processing methods to analyze the quality. This job expansion could aim to intend that a system which could categorize grains of the rice on every constraint basis which could be utilized to develop the rice quality. That particular system cost has to be less and decrease the time obligation to analyze the quality.

References

1. Maheshwari CV, Jain KR, Modi CK (2012) Non-destructive quality analysis of Indian Gujarat-17 Oryza Sativa SSP Indica (Rice) using image processing. Int J Comput Eng Sci (IJCES) 2(3)
2. Kanchana S, Lakshmi Bharati S, Ilamran M, Singaravadivel K (2012) Physical quality of selected rice verities. World J Agric Sci. 468–472
3. Prajapati BB, Patel S (2013) Classification of Indian basmati rice using digital image processing as per indian export rules. Int Res J Comput Sci Eng Appl 2(1)
4. Aulakh JS, Banga VK (2012) Grading of rice grains by image processing. Int J Eng Res Technol (IJERT) 1(4)
5. Bhonsle Shilpa J (2010) Grain quality evaluation and organoleptic analysis of aromatic rice varieties of Goa, India. J Agric Sci 2(3):99–107
6. Verma B (2012) Image processing techniques for grading & classification of rice. In: International conference on computer and communication technology (ICCCT), pp 220–223
7. Ajay G, Suneel M, Kiran Kumar K, Siva Prasad P (2013) Quality evaluation of rice grains using morphological methods. Int J Soft Comput Eng (IJSCE) 2(6):35–37
8. Kaur H, Singh B (2013) Classification & grading rice using multi-class SVM. Int J Sci Res Publ (IJSRP) 3(4)
9. Laboratory Manual on Rice Grain Quality (2013) Directorate of Rice Research, Rajendranagar, Hyderabad, September 2013

Analysis of Machine and Deep Learning Approaches for Credit Card Fraud Detection

P. Divya, D. Palanivel Rajan, and N. Selva Kumar

Abstract In modern days, digitalization increased more demand because of faultless, ease, and convenient use of payment online. More people are choosing to pay the money through online mode through a safe gateway in e-commerce or e-trade. Today's reality seems we are on the fast-growing to a cashless society. As indicated by the World Bank Report in the year of 2018 most of transactions are non-cash and also increased to 25%. Because of so many banking and financial companies spending more money to develop a application based on current demand. False transactions can happen in different manners and can be placed into various classifications. Learning approaches to classification play an essential role in detecting credit card fraud detection through online mode. There will be two significant reasons for the challenges of credit card detection. In the first challenge as the usage of the card has normal behavior or any fraudulent and second as most of the datasets are misrepresented for challenging to classify. In this paper, we investigate the machine and deep learning approaches usage of credit card fraud detection and other related papers and that merits and demerits and, of course, discussed challenges and opportunities.

Keywords Pay online · Credit card · Machine learning · Deep learning · Fraud detection

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_24

1 Introduction

Financial Fraudulent has created significant influences in day to day life and financial sectors. Fraudulent activities are lead to reduce the impact of financial sectors and also digitalization. Many financial institutions are worked to protect the people's money in various ways to address the issues. However, Intruders has conceived new technology against the protective models. Credit card fraud has increased gradually in many ways and its leads to financial loss and trust in all banking sectors. People are using to consuming the financial products for the benefits like as

1. Ease of use
2. Keep Customer credit history
3. Protection of Purchases

Detection for fraud involves finding scarce fraud activities as early as possible among different legitimate transactions. Techniques of fraud detection are rapidly developing to conform throughout the world with different emerging fraudulent techniques [1].

Nevertheless, the emergence of new techniques for fraud detection becomes much more complicated due to the current extreme limitation of the exchange of opinions in fraud prevention [2, 3]. The Fig. 1 represents the overall Financial Fraud Categorization.

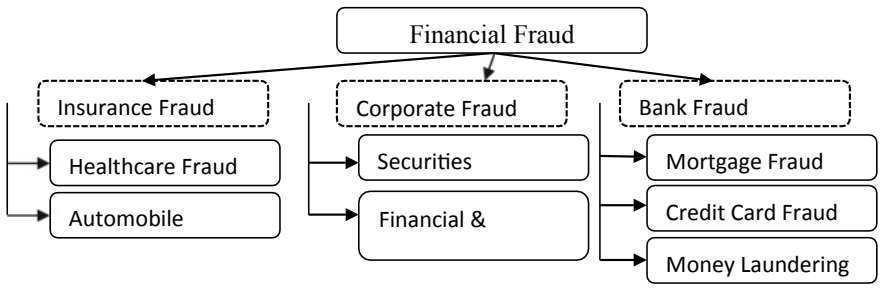

Fig. 1 Financial fraud categorization

1.1 Credit Fraud Detection Using Machine Learning Work Process

1.1.1 Collecting Data

First, the information gathering is very important because its strengthen the model. The precision of the model relies upon the measure of information on which it is

prepared because accurate information has gives better performs. For distinguishing cheats explicit to a specific business, you have to enter an ever-increasing number of measures of information into your model. This will prepare your model so that it distinguishes extortion exercises explicit to your business flawless.

1.1.2 Extricating Features

Feature extraction is basic operation to removing the data of every single string related to an unrelated or unnecessary data for efficient computation. These can be the area from where the exchange is made, the personality of the client, the method of installments, and the system utilized for exchange.

1.1.3 Character

This parameter is utilized to browse a client's email address, versatile number, and so forth, and it can check the FICO assessment of the financial balance if the client applies for an advance.

1.1.4 Area

It checks the IP address of the client and the misrepresentation rates at the client's IP address and dispatching address.

1.1.5 Method of Payment

It checks the cards utilized for the exchange, the name of the cardholder, cards from various nations, and the paces of misrepresentation of the ledger utilized.

1.1.6 System

It checks for the quantity of versatile numbers and messages utilized inside a system for the exchange (Fig. 2).

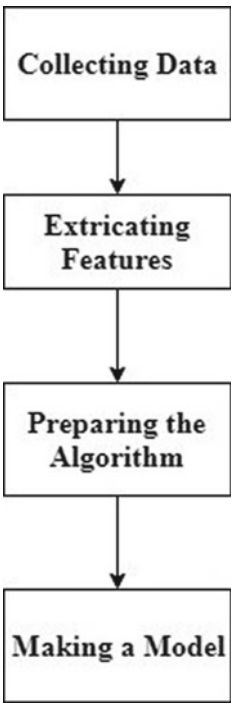

Fig. 2 Credit fraud detection using machine learning work process

1.1.7 Preparing the Algorithm

Once you have made an extortion location calculation, you have to prepare it by giving clients information with the goal that the misrepresentation discovery calculation figures out how to recognize fraud and authenticate exchanges.

1.1.8 Making a Model

Once you have prepared your misrepresentation discovery calculation on a particular dataset, you are prepared with a model that works for distinguishing 'deceitful' and 'non-false' exchanges in your business. The benefit of Machine Learning in extortion recognition calculations is that it continues improving as it is presented to more information. There are numerous strategies in Machine Learning utilized for extortion recognition. Here, with the assistance of some utilization cases, we will see how Machine Learning.

2 Challenges of Credit Fraud Detection

Fraud detection mechanisms are trim to several difficulties and problems listed here. In terms of achieving the best results, an active fraud detection strategy must be able to tackle these challenges.

2.1 Importance of Misclassification

Different misclassifying failures have various meanings in the function of fraud prevention. This is not a harmful to mislabel a fraudulent activity as cheating as usual to detect a fraudulent payment. Even though the classification failure will be identified in more inquiries over the first instance.

2.2 Cost-Efficient of Fraud Detection

The system should take into account both the cost of fraudulent behavior that is detected and the cost of preventing it.

2.3 Imbalanced Data

Credit card fraud detection data has imbalanced nature. It means that minimal percentages of all credit card transactions are fraudulent. This causes the detection of fraud transactions very difficult and imprecise.

2.4 Lack of Flexibility

Classification algorithms are usually faced with the problem of detecting new types of standard or fraudulent patterns. The supervised and unsupervised fraud detection systems are inefficient in detecting new patterns of healthy and fraud behaviors, respectively.

2.5 Overlapping Data

Many transactions may be considered fraudulent, while they are Normal (false positive) and reversely, a fraudulent transaction may also seem to be legitimate (False negative). Hence obtaining a low rate of a false positive and false negative is a crucial challenge of fraud detection systems [4–6].

3 Methods of Machine Learning for Credit Fraud Detection Algorithms

3.1 Logistic Regression

It is a directed learning system that is utilized when the choice is unmitigated. It implies that the outcome will be either 'misrepresentation' or 'non-extortion' if exchange happens. Let us consider a situation where exchange happens, and we have to check whether it is a 'fake' or 'non-fake' exchange [7]. There will be given arrangement of parameters that are checked, and, based on the likelihood determined, we will get the yield as 'misrepresentation' or 'non-extortion.'

3.2 Decision Tree

It is utilized where there is a requirement for the grouping of strange exercises in exchange for an approved client. These calculations comprise of imperatives that are prepared on the dataset for arranging misrepresentation exchanges. For example, consider the situation where a user creates transactions. The system will create a decision tree to predict the probability of fraud based on the transaction made [8].

3.3 Random Forest

It multiple decision tree trees to improve the outcomes. Every choice of tree checks for various conditions. They are prepared on arbitrary datasets, and, because of the preparation of the choice trees, each tree gives the likelihood of the exchange being false and non-extortion [9].

3.4 Neural Networks

Neural Networks is an idea enlivened by the working of a human brain. Neural systems in Deep Learning uses various layers for calculation. It utilizes psychological registering hat aides in building machines equipped for utilizing self-learning calculations that include the utilization of information mining, design acknowledgment, and standard language preparation. It is prepared on a dataset going through various layers a few times. It gives more precise outcomes than different models as it utilizes psychological registering, and it gains from the examples of approved conduct and along these lines recognizes false and trustful exchanges [10].

3.5 Artificial Immune System

Artificial Immune System (AIS) is an ongoing subfield dependent on the organic analogy of the insusceptible framework. Artificial Immune System expanded the accuracy, decline the expense, and framework preparing time. Liking between antigens was determined to utilize a novel technique in the AIS-based Fraud Detection Model [11].

3.6 Support Vector Machines

SVM is a regulated learning model with related learning calculations that can examine and perceive designs for grouping and relapse tasks. SVM is a double classifier. The fundamental thought of SVM was to locate an ideal hyper-plane that can isolate occurrences of two given classes, straight. This hyper plane was thought to be situated in the hole between some minor cases called bolster vectors. Presenting the piece capacities, the thought was stretched out for straight in divisible information. A portion of work speaks to the spot result of projections of two information focuses on a high dimensional space [12].

3.7 Bayesian Network

Bayesian Network is built to display the conduct of dishonest clients, and the next model is developed, accepting the client as real. At that point, exchanges are named fake on-false by these systems. Bayes rule creates the likelihood of misrepresentation for any approaching transaction. Bayesian Network needs preparing of

information to work and require high handling speed. BN is more precise and a lot quicker than neural organize [13].

3.8 Hidden Markov Model

The Hidden Markov Model is a limited arrangement of states, every one of which is related to a likelihood circulation. Many probabilities represent advances among the states called progress probabilities. In a specific express, a result or perception can be produced, as indicated by the related likelihood dispersion. It is just the result, not the state unmistakable to an outer on looker, and like these states are "covered up" to the outside; subsequently, the name Hidden Markov Model. HMM uses cardholder's expenditure behavior to detect fraud. Dissimilar cardholders have their different expenditure behavior [14].

3.9 Autoencoders

Autoencoders is an unsupervised Neural Network. It is an information pressure calculation which takes the information and experiencing a compacted portray a land gives the recreated output [15]. Autoencoders, it gives a decent precision. Be that as it may, on the off chance that we investigate Precision and Recall of the dataset, it is not performing enough (Tables 1 and 2).

3.10 Advantage of Using Machine Learning in Credit Fraud Detection

3.10.1 Speed

Machine Learning is broadly utilized on account of its quick calculation. It examines and forms information and concentrates new examples from it inside no time. For individuals to assess the information, it will take a ton of time, and assessment time will increment with the measure of information [16].

3.10.2 Adaptability

As an ever-increasing number of information is nourished into the Machine Learning-based model, the model turns out to be progressively exact and influential in the forecast.

Table 1 Different machine learning method used in credit fraud detection

References no.	Methods	Learning approaches	Advantages	Disadvantages
7	Logistic regression	Supervised	Velocity variables to discover more characteristics of the algorithm	Cost of retraining the classifier
8	Decision Tree	Supervised	High agility Easily build a system	Accuracy is low compared to neural network
9	Random Forest	Supervised	Very fast in detection training time is less	Accuracy is low compared to the neural network
10	Neural Network	Supervised	High accuracy High speed in detection	It takes a considerable amount of training time
11	Artificial Immune System	Unsupervised	High accuracy in pattern predications and easy to integrate with another system	Memory generation phase & calculation of affinity is time-consuming
12	Support Vector Machines	Unsupervised	SVM is resilient Gives a distinctive solution	Reduced speed in detection process Accuracy is medium
13	Bayesian Network	Unsupervised	High accuracy High speed in detection	It takes a tremendous amount of training time
14	Hidden Markov Model	Unsupervised	High speed in detection process	Accuracy is low
15	Autoencoders	Unsupervised	It gives a decent precision	Precision and recall was not good
16	Machine Learning Hybrid BGWO	Supervised	The huge amount of data sets Less predictive	Precision and recall was not good
17	Hybridization of swarm intelligence	Supervised	Imbalance data sets	Precision and recall was not good

Table 2 Different types of evaluation criteria for credit card fraud detection

Evaluation criteria	Formula	Description
Accuracy	$\frac{TP+TN}{TP+TN+FP+FN}$	Accuracy is the percentage of correctly categorized credit card fraud detection
Precision	$\frac{TN}{FP+TN}$	The ability of a classification model to return only related
Recall	$\frac{TP}{TP+FN}$	The ability of a classification model to identify all related occurrences
F1 measure	$2 * \frac{Sensitivity * Specificity}{Sensitivity + Specificity}$	The distinct metric that pools recall and precision using the harmonic mean
Receiver operating characteristic	True positive rate plotted against false positive rate	Plots the true positive rate versus the false positive rate as a function of the model's threshold for classifying a positive

3.10.3 Effectiveness

Machine Learning calculations play out the excess assignment of information examination and attempt to discover concealed examples redundantly. Their productivity is better in giving outcomes in examination with manual endeavors. It dodges the event of bogus positives, which means its effectiveness.

3.10.4 Open Issues

While charge card extortion recognition has increased wide-scale consideration in writing, there are yet a few issues (various noteworthy open issues) that face specialists and have not been tended to before adequately.

3.11 Nonexistence of Standard and Complete Charge Card Benchmark or Dataset

Master Card is intrinsically private property because making an appropriate benchmark for this design is very troublesome. Small datasets can cause a misrepresentation recognition framework to learn extortion stunts or ordinary conduct in part. Then again, the absence of a standard dataset makes the correlation of different systems risky or inconceivable. Numerous scientists utilized datasets that are just allowed to creators and cannot be distributed to protection contemplations [17].

3.11.1 Nonexistence of Standard Calculation

There is not any fantastic calculation known in Visa extortion writing that beats all others. Each technique has its possess focal points and burdens, as expressed in past areas. Joining these calculations to help each other's advantages and spread their shortcomings would be of incredible intrigue.

3.11.2 Nonexistence of Appropriate Measurements

The impediment of the right measurements to assess the after effect so extortion location framework is yet an open issue. The nonexistence of such measurements causes in eptitude of specialists and professionals in looking at changed methodologies and deciding the need for most effective extortion discovery frameworks.

3.12 Lack of Versatile Visa Misrepresentation Location Frameworks

Albeit heaps of explores have been researched MasterCard extortion recognition field, there are none or constrained versatile methods that can learn in formation stream of exchanges as they are directed. Such a framework can refresh its inner model and systems over a period without should be relearned disconnected. Subsequently, it can include different cheats (or standard practices) promptly to display learning misrepresentation deceives and recognize them after that as quickly as time permits.

4 Conclusion

Credit fraud detection is one of major problem in the banking process. False exercises are uncommon occasions that are difficult to display and in steady advancement. The massive volume of exchanges happening in day to day activity, and it is necessary to use machine learning-based automated tools to use and predict the fraudulent activities in the banking transaction. In this paper, we present a comparative study of different machine learning techniques such as logistic regression, decision tree, random forest, neural network, artificial immune system, support vector machines, Bayesian network, hidden Markov model, autoencoders are presented with advantage and disadvantage.

References

1. Roy A, Sun J, Mahoney R, Alonzi L, Adams S, Beling P (2018) Deep learning detecting fraud in credit card transactions. In: 2018 systems and information engineering design symposium SIEDS 2018, pp 129–134
2. Thennakoon A, Bhagyani C, Premadasa S, Mihiranga S, Kuruwitaarachchi N (2019) Real-time credit card fraud detection using machine learning. In: Proceedings of the 9th international conference on cloud computing, data science & engineering (confluence), pp 488–493
3. Sinayobye JO, Kiwanuka F, Kaawaase Kyanda S (2018) A state-of-the-art review of machine learning techniques for fraud detection research. In: Proceedings - international conference on software engineering, pp 11–19
4. Pillai TR, Hashem IAT, Brohi SN, Kaur S, Marjani M (2018) Credit card fraud detection using deep learning technique. In: Proceedings - 2018 4th international conference on advances in computing, communication & automation ICACCA 2018, pp 1–6
5. Popat RR, Chaudhary J (2018) A survey on credit card fraud detection using machine learning. In: Proceedings of the 2nd international conference on trends in electronics and informatics, ICOEI 2018, no ICOEI, pp 1120–1125
6. Rajora S et al (2019) A comparative study of machine learning techniques for credit card fraud detection based on time variance. In: Proceedings of the 2018 IEEE symposium series on computational intelligence SSCI 2018, pp 1958–1963
7. Rushin G, Stancil C, Sun M, Adams S, Beling P (2017) Horse race analysis in credit card fraud- deep learning, logistic regression, and gradient boosted tree, pp 117–121. IEEE
8. Zeager M, Sridhar A, Fogal N, Adams S, Brown D, Beling P (2017) Adversarial learning in credit card fraud detection, pp 112–116. IEEE
9. Mahmoudi N, Duman E (2015) Detecting credit card fraud by Modified Fisher Discriminant Analysis. Expert Syst Appl 42:2510–2516
10. Halvaiee N, Akbari M (2014) A novel model for credit card fraud detection using Artificial Immune System. Appl Soft Comput 24:40–49
11. Vlasselaer V, Bravo C, Caelen O, Eliassi-Rad T, Akoglu L, Snoeck M, Baesens B (2015) APATE: a novel approach for automated credit card transaction fraud detection using network based extensions. Decis Support Syst 75:38–48
12. Zareapoor M, Shamsolmoali P (2015) Application of credit card fraud detection: based on bagging ensemble classifier. In: International conference on intelligent computing, communication & convergence, pp 679–685
13. Bahnsen AC, Aouada D, Stojanovic A, Ottersten B (2016) Feature engineering strategies for credit card fraud detection. Expert Syst Appl 51:134–142
14. Harkous H, Bardawil C, Artailand H, Daher N (2018) Application of hidden Markov model on car sensors for detecting drunk drivers. In: 2018 IEEE international multidisciplinary conference on engineering technology (IMCET), Beirut, pp 1–6. https://doi.org/10.1109/imcet.2018.8603030
15. Luoand T, Nagarajan SG (2018) Distributed anomaly detection using autoencoder neural networks in WSN for IoT. In: 2018 IEEE international conference on communications (ICC), Kansas City, MO, pp 1–6. https://doi.org/10.1109/icc.2018.8422402
16. Velliangiri S (2019) A hybrid BGWO with KPCA for intrusion detection. J Exp Theor Artif Intell. https://doi.org/10.1080/0952813X.2019.1647558
17. Velliangiri S, Karthikeyan P (2019) Hybrid optimization scheme for intrusion detection using considerable feature selection. Neural Comput Appl. https://doi.org/10.1007/s00521-019-04477-2

Behavioural Analysis Based Risk Assessment in Online Social Networks

N. Teja Sree and G. Sumalatha

Abstract Even though a spectacular enhancement in the utilization of OSN, there are still many security concerns. In that situation, it will be very helpful to have a system that has ability for assigning a score of risk to every user of OSN. Here, we recommend an estimation of risk based upon the initiative that additionally the behaviour of user deviates from which it could be believed as a 'regular behaviour', further it has to be regarded as unsafe. We took it into consideration that the population of OSN actually varied at particular behaviours. It is difficult to explain the behavioural model of an exceptional standard which would fit all the users' of OSN behaviours. Whereas, we do anticipate the same people who tend to chase the same rules along with the outcomes of same behavioural forms. We suggest a risk measurement systematized into 2 stages for this reason: The related users are grouped first simultaneously, later, for every recognized group; we would like to construct more than one forms for casual behaviour.

Keywords Behaviour · OSNs · Risk assessment

1 Introduction

OSNs (ONLINE Social Networks) will be allowing the users for creating a private or public profile. Individuals keep in touch with each other with OSN's, and share personal details, and also for commercial functions. The users of an OSN construct links with each other with in over time. These associations outline a social graph which manages how the details would get spread in the social network. Though there are spectacular raise in OSN utilization—Example, face book has 1.55 billion

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698,
https://doi.org/10.1007/978-981-15-7961-5_25

active users every month, 1.31 billion users through mobile, and the daily users are 1.01 billion [1]. Unfortunately, regular users are unaware of this coverage and this might have severe effects. Even, few users are less alarmed regarding the privacy of information; hence, they would share more insightful without stating suitable settings of privacy and this could direct to the safety hazards [2]. As the outcome, present day's social networks to several kinds of confidentiality and safety assaults. These have exploited the infrastructures OSN for collecting and exposing the personal information about the users, by, as an illustration, convincing them successfully to click on particular mean connections along with a goal of propagating these connections in the system [3]. This kind of attacks could aim users' personal information and their friends' personal information. Another broadly utilized attack is the fake profiles generation that are created with the single reason of extending mean content. There is an increasing underground market in addition on OSNs for wicked actions in that, for just hardly any cents, you could purchase face book likes, followers, share, of Twitter, and any other bogus accounts. Though several results target one particular type of attacks, which have lately recommended, that have a common resolution which could handle along with the central security/privacy assaults that could perpetrate utilizing the social network graph is misplaced. We have made a move in the direction of the definition of an exceptional device that supports the sources of OSN and the users to spot various kinds of attacks and, hence, its easy to recognise risky users on the global platforms.

This risk assessment kind a service would be allowing a user for making the decisions more consciously related to her/his privacy-risk actions within the OSN platforms (e.g., answer a friend request). Besides, risk estimation conducting in OSN would be allowing the providers of service for minimizing the risk and support users for creating and maintaining an improved friendship atmosphere. We suppose that a threat score could be helpful for those who would like to examine their contacts, as well as for the service providers who wish to recognize which users are hazardous.

2 Existing System

The graph-based Sybil recognition systems would make certain suppositions about the graph of OSN growth and structure. Based on this guess, examiners would utilize several techniques of graph analysis for developing the algorithms for detection of Sybil's [4]. The latest investigations have taken a point that these statements always might not hold. In fact, it was noticed that Sybil's would be mixing good. It is evaluated to graph-based techniques of Sybil defence; we suggested threat assessment form which is stretcher as it would never rely on the same statements, as we would be considering the Sybil's activity patterns after joining the OSN. The very latest methods of behaviour-based for an anomalous users' detection in OSNs exploit supervised techniques of the learning. As an instance, for

detecting Sybil's in [5], the suggested system would train a classifier by extracting 4 features, such as:

- requests of accepted incoming
- requests of accepted outgoing
- invitation frequency

The writers have recommended a supervised approach for detecting the attack of compromised account by utilizing a little manually legitimate labelled dataset and anomalous users. Researchers have utilized classifiers for detecting the spam and malware correspondingly. However, we should note down that the primary problem of organized learning is that they are not able to recognize the behaviours of new attacker, as the classifier has been instructed based on the patterns of identified behaviours. The literature would offer methods to notice uncharacteristic users in OSNs that use unorganized methods of learning [6–10].

Disadvantages
The system has been implemented based on approaches of unsupervised learning which is very complex. The recent behaviour-based methods for the anomalous users' recognition in OSNs exploit.

3 Proposed System

The system in the suggested system would make a step towards a unique definition device that supports the providers of OSN and the user to recognize various kinds of attacks and, hence, for having a worldwide consideration of hazardous users in OSN platforms. We believed that the core of particular resolution is a method that has ability to assign a score of risk to every OSN account.

This service of risk assessment will allow the user for making decisions consciously about her/his security in the network. Likewise, leading an valuation of menace in OSN would be allowing the providers of service for minimizing the risk and support the users to build and continue an improved environment.

Advantages
Risk Assessment is done based on User Behaviour

System is implemented based on 2 Phases Clustering (Figs. 1, 2 and 3).

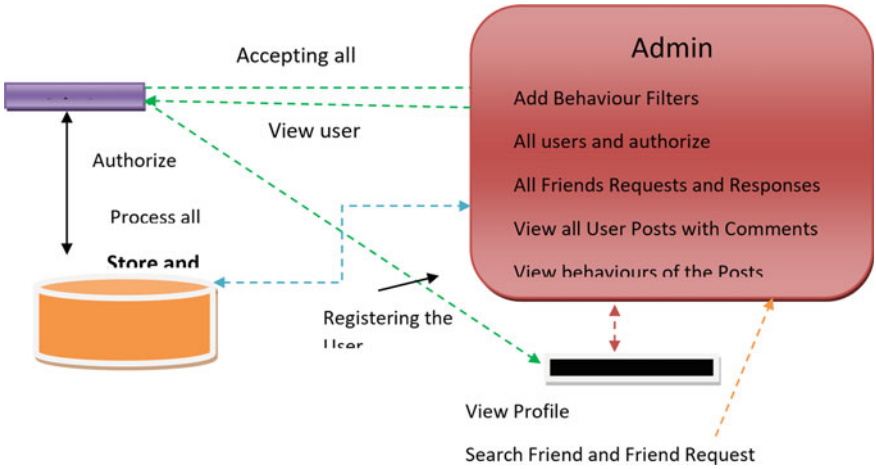

Fig. 1 Architecture diagram

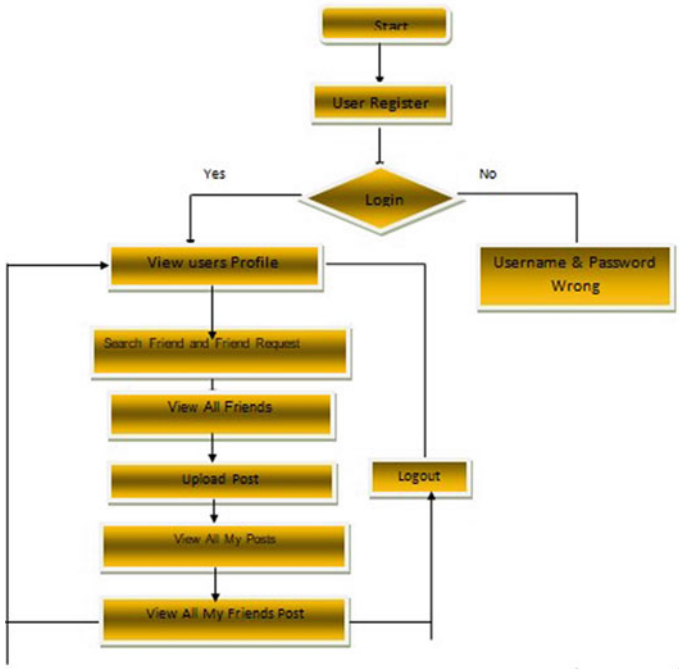

Fig. 2 User flow chart

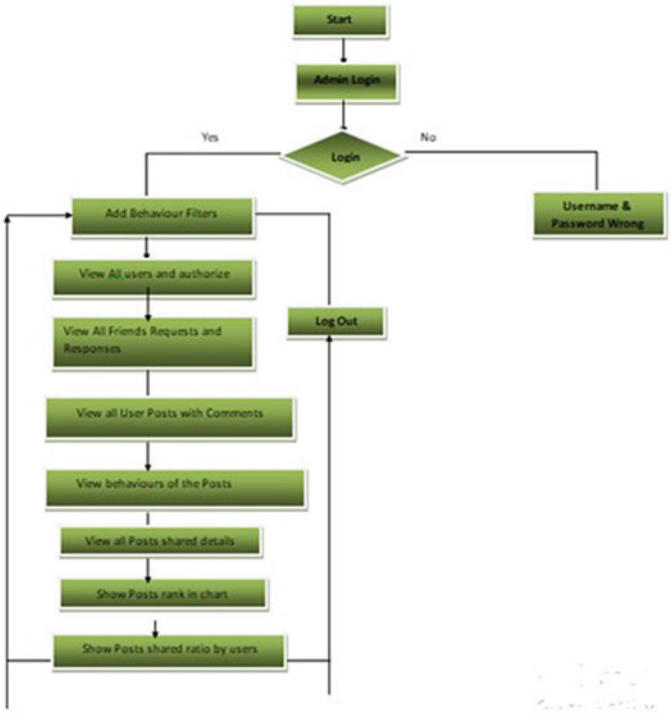

Fig. 3 Admin flow chart

4 Implementation

4.1 Admin

Admin sign's into the account. He could perform few operations after login successful like add behaviour filters, all the users and authorize, all the friend requests and responses, view all user posts with comments, view the behaviours of the posts, view all the posts with shared details, show the post ranks in the chart, show the posts shared ratio by the users.

4.2 Friend Request and Response

The admin in this element can see all the friend requests and the responses. All the requests and responses here would be shown with tags. status changes occurs as per the users request.

4.3 User

The user has to register before executing any processes. after that, the information will get stored in the database. After successful registration, the person has to sign in using the credentials. Also verify the finger print and login. Once login has got successful, user can execute few can view all the friends, upload the post, view all my posts, and view all my friends post.

4.4 Searching Users to Make Friends

The user in this module would search for the users in same network and in the networks and would send the friend requests to them. The user could search for the users in other networks to make friends only if they have permission.

5 Results

See Figs. 4, 5, 6, 7, 8, 9, 10, 11 and 12.

Fig. 4 Risk assessment in social networks based on user anomalous behaviours

Fig. 5 Admin login page

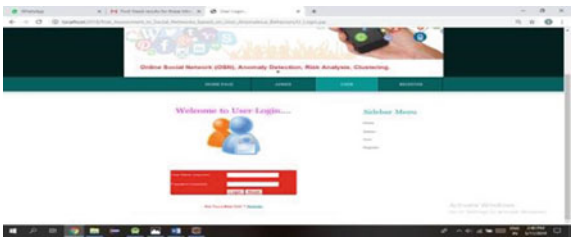

Fig. 6 User login page

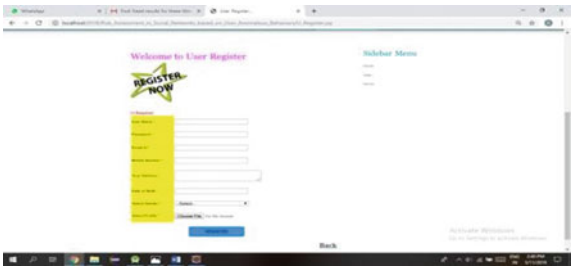

Fig. 7 User registration page

Fig. 8 Admin menu

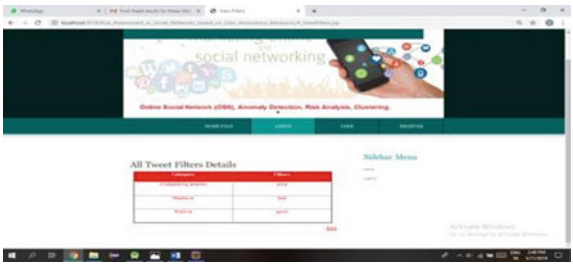

Fig. 9 Different types of filter details

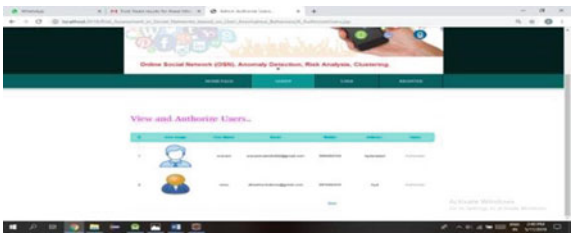

Fig. 10 Authorise user details

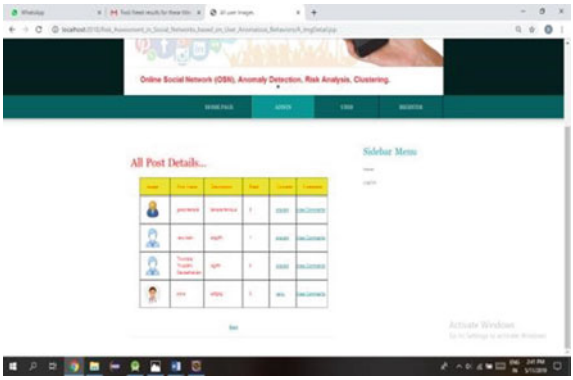

Fig. 11 Posts details

Fig. 12 Rank chart results

6 Conclusion

We have initiated a 2 phase hazard assessment approach in this paper that has an ability to give a score of risk to every user of OSN platform. This evaluation of risk is depends on the user's behaviour in an idea that the more this deviates from what it could consider as a 'regular behaviour', the more the user has to be considered dangerous. The researches that are carried out on a real face book data would place

show our proposal's effectiveness. We would be planning for extending this work according to various ways. A motivating prospect work is the suggested 2 phase addition estimation of risk so as to make it an ability to execute a constant examining and the scores of risk estimation.

References

1. Akcora CG, Carminati B, Ferrari E (2012) Privacy in social networks how risky is your social graph? In: 2012 IEEE 28th international conference on data engineering (ICDE). IEEE, pp 9–19
2. Asterhan CSC, Eisenmann T (2009) Online and face-to-face discussions in the classroom: a study on the experiences of 'active' and 'silent' students. In: Proceedings of the 9th international conference on computer supported collaborative learning, vol 1. International Society of the Learning Sciences, pp 132–136
3. Bilge L, Strufe T, Balzarotti D, Kirda E (2009) All your contacts are belong to us automated identity theft attacks on social networks. In: Proceedings of the 18th international conference on world wide web. ACM, pp 551–560
4. Boshmaf Y, Beznosov K, Ripeanu M (2013) Graph-based sybil detection in social and information systems. In: 2013 IEEE/ACM international conference on advances in social networks analysis and mining (ASONAM). IEEE, pp 466–473
5. Boshmaf Y, Logothetis D, Siganos G, Lería J, Lorenzo J, Ripeanu M, Beznosov K (2015) Integro: leveraging victim prediction for robust fake account detection in OSNs. In: Proceedings of NDSS
6. Boshmaf Y, Muslukhov I, Beznosov K, Ripeanu M (2011) The socialbot network- when bots socialize for fame and money. In: Proceedings of the 27th annual computer security applications conference. ACM, pp 93–102
7. Bradley PS, Fayyad U, Reina C (1998) Scaling em (expectation-maximization) clustering to large databases. Technical report, Technical Report MSR-TR-98-35, Microsoft Research Redmond
8. Cao Q, Sirivianos M, Yang X, Pregueiro T (2012) Aiding the detection of fake accounts in large scale social online services. In: NSDI, pp 197–210
9. Danezis G, Mittal P (2009) Sybilinfer- detecting sybil nodes using social networks. In: NDSS
10. Dave V, Guha S, Zhang Y (2012) Measuring and fingerprinting click-spam in ad networks. In: Proceedings of the ACM SIGCOMM 2012 conference on applications, technologies, architectures, and protocols for computer communication. ACM, pp 175–186

Robust Multimodal Biometric Recognition Based on Joint Sparse Representation

V. Sathiya Suntharam, Ravikumar Chandu, and D. Palanivel Rajan

Abstract In this paper, we concurrently consider the correlations and the information of coupling among the modalities of biometric. A computation of multimodal quality is also suggested for weighing every procedure as bonded. Moreover, we generalize the algorithm for handling the data by non-linearity. Also we have task i.e., optimizing is resolved by utilizing a method of proficient alternative direction. Several researches explain that the suggested method will compare favorably along with competing fusion-based schemes. The customary methods of the biometric recognition depend on a solitary biometric sign for confirmation. Although the benefit of utilizing the numerous resources of data to establish the uniqueness which has been broadly identified, the models that are computational for the multimodal biometric identification have only the attention of obtained recently. We recommend a representation of multimodal sparse technique, which will represent the figures of test by a scattered linear mixture of training records, whilst restraining the studies from dissimilar test subject's modalities to allocate the sparse illustrations.

Keywords Correlations · Coupling · Non-linearity · Proficient · Biometric · Scattered linear · Modalities

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_26

1 Introduction

In latest times, biometric identification is a general & trustworthy technique for authenticating any human based on the biometrics of behavioral or physiological. The physiological biometric feature is a constant in the biometric such as the iris outline, fingerprint, hand geometry, facial trait, pattern of gait etc. while the behavioral attributes of biometric is transmitted to the person's behavior like pattern of the speech, signature, pattern of keystroke [3]. The facial identification process is a system application to classify robotically or verify an individual from a digital photo or a video frame from the respective resource [1]. The face acknowledgment has never got a latest plan yet it has been obtained considerable observation over the last 3 decades because of its worth in comprehending how FR process would work in individuals and in directing numerous demanding real time applications, which include de-duplication of unique files (e.g. driver license, passport), organize over the access and surveillance of the video. While face detection in managed situations (frontal face of cooperative users and managed in illumination of door) that has been obtained by extraordinary enactment over the galleries of huge-scale [2], still they exist in many disputes for the face identification in abandoned surroundings, like huge pose variations, partial procedures and severe ambient illumination [4]. The local facial elements have got a significant job in the forensic applications for meeting face pictures [3]. Biometric has referred to mechanical recognition of individual depending on his or her bodily or interactive features. This recognition system is desired over established techniques that involve passwords and PINs for various causes, include the individual to get known is needed to be actually available At the recognition position and detection based on biometric methods would avoid the remembrance to carry a token or password, along with enlargement utilization of computers as the resources of transport of IT sector in recent times, by this it will limit to connect with the sensitive or personal data is necessary [5]. Advancement of Biometric validation is accuracy and reliability, along with few of the traits offering good enactment.

Enrollment is the method where a user's primary biometric samples are gathered, evaluated, practiced, and saved for the enduring utilization in biometric method as given in Fig. 1. Fundamentally, user's enrollment is a practice i.e., accountable to schedule persons in the storage of the biometric method. The biometric attributes of an individual during the enrollment process are captured first by a scanner of the biometric to generate a sample [6]. Few methods gather numerous illustrations of a user and later either choose the most excellent picture or fuse various pictures or make a pattern of the composite. If the users are facing issues along with a biometric method later they have to re-register to collect the high value facts.

Biometric system will provide 2 chief functionaries viz. confirmation and recognition. Figure 2 show the information flow in the systems of confirmation and recognition. Identification-One-to-Many Correspondence: Biometrics may want to make use of for determining an person's identity without his cognizance or authorization.

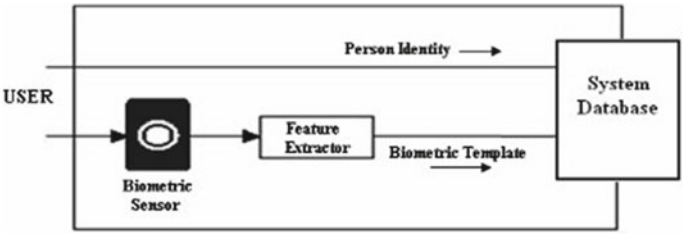

Fig. 1 Enrollment process in biometrics system

Fig. 2 Train the data

A consumer's enter would be evaluated together with the templates of all of the folks that are registered in the statistics and the character's individuality whose templates have the maximum diploma of resemblance when entering of consumer's is productiveness by means of the biometric gadget. As an instance, scanning a crowd along the side of a camera and making use of the system of biometric recognition, one could be determining fits aligned with a regarded report. Popularity is the primary section for figuring out the person inside the route of his trait of biometric. The consumer's statistics might be stored permanently for enduring utilization in a biometric technique [7].

Verification-One-to-One correspondence: Biometrics ought to get applied for verifying an man or woman's identity and the technique would verify whether or not allege is real. The person's entry and then claimed outline of characteristics have an multiplied degree of resemblance, then the announcement has been identified as "proper". Else, the claim receives refuses and the consumer is seemed as "fraud" [8]. For example, one can also supply giant connect to a blanketed location in a shape through utilizing the finger scan or to go into the bank account at an ATM via retinal experiment utilization. Discern 1.2 might show the waft of details in authentication and recognition system.

2 Literature Survey

A biometric system is generally a pattern identifier that would operate by obtaining biometric data from individually, extracting a characteristic set of data which is acquired, and equating this attribute. During the verification mode, the system would be validating an individual's identities are compared from database taking the biometric data along with her own biometric template(s) which are already saved in the system database. Identity will also be utilized in fine popularity for comfort, and the user is not required to assert an identity [8]. While traditional strategies of personal reputation including PINs, keys, tokens, and passwords may match for nice recognition, negative reputation is set up through biometrics [7]. Biometrics is measurable biological (anatomical and behavioral) characteristics that might be used for automated identity. Basically, a biometric machine is a pattern acknowledgement approach which might understand a consumer with the aid of defining the authenticity of a selected behavioural or anatomical feature controlled with the aid of the user. Various leader problems have to be taken into consideration in planning a sensible biometric method [9]. Initially, a person must be enrolled within the system in order that his biometric template or reference ought to get captured. This template is stored securely in a relevant database or a clever card that get issued to the consumer. The template is utilized to healthy when a person requires to be identified. By way of depending on the framework, a biometric system can perform either in the mode of identification or verification (authentication). Biometric identification is a procedure in which a biometric system that compares incoming information which data in its system for determining whether or not it could find a match [10]. Biometric reputation, or biometrics, would seek advice from the automated identification of an man or woman based totally on his/her anatomical or behavioral features or developments. This manner of recognition would provide diverse benefits over conventional tactics that PIN involve numbers or passwords or id cards for various reasons:

(i) An man or woman to be recognized, here we want the available bodily on the factor-of-identity.
(ii) An identity based on biometric practices will remove the need for remembering to hold a token or a password. With an expansion of mixing of computers and internet into the normal lives of people, it's miles are important to defend private and sensitive facts. Several biometric attributes are being applied for real-time popularity, the most well-known being fingerprint, face and iris.
(iii) However, there are biometric structures that are primarily based on speech, hand geometry, signature, retinal test and voice. In few packages, more than one biometric function is used securely to obtain higher circumstances for users [11]. Such kind of security and to handle failure for enrolling of to obtain higher enrolling of structures is referred to as multimodal biometric systems.

The technology of biometric also consist of keystroke reputation, facial popularity, hand geometry popularity, retinal recognition, fingerprint popularity, iris recognition, Signature reputation, and voice popularity. It does not appear like someone system biometric facts assembling and studying that does the first class activity of making sure at ease of authentication. Each other unique methods of biometric identity may have something to indicate them. Few are less invasive, few might be completed without the knowledge of the challenge, and few are too tough to fake.

3 Proposed Method

Unimodal biometric systems depend on a sole records source like a single fingerprint or face for authentication or iris. Alas, these structures must address a number of the subsequent predictable problems: Multi-modal biometrics are systems that are capable of using more than one physiological or behavioral characteristic for enrollment, verification, and identification [12]. Human identification based on multi-modal biometrics is becoming an emerging trend, and one of the most important reasons to combine different modalities is to improve recognition accuracy [19]. There are additional reasons to combine two or more biometrics such as the fact that different biometric modalities might be more appropriate for unique deployment scenarios or when security is of vital importance to protect sensitive data.

How Does a Multi-modal Biometric System Work?
Multi-modal biometric systems take input from single or multiple biometric devices for measurement of two or more different biometric characteristics. For example, a multi-modal system combining fingerprint and finger vein characteristics for biometric recognition would be considered a "multi-modal" system regardless of whether fingerprint and finger vein images were captured by different or the same biometric devices. It is not a requirement that the various measures be mathematically combined in any way because biometric traits remains independent from each other, which results in higher accuracy when identifying a person [20].

Why Do We Need Multi-modal Biometric Systems for Human Identification?
Every biometric system identifies a person by who the person is rather than what the person carries, unlike most traditional authorization systems such as personal identification numbers (PINs), passwords, or ID cards. Unlike these solutions that rely on "what you have," biometric credentials cannot be lost, forgotten, guessed, or easily cloned. Despite these advantages, the technology has some limitations too:

1. **Environment:** The environment in which biometric data is captured may have an effect on the ability of the system to identify an individual. For example, the accuracy of facial recognition is affected by illumination, pose, and facial expression.
2. **Noise in sensed data:** A fingerprint with a scar and voice altered by a cold are examples of noisy inputs. Noisy data could also result from defective or improperly maintained sensors [13].
3. **Intra-class variations:** Fingerprint data acquired from an individual during authentication may be very different from data used to generate the template during enrollment due to a misplacement of the finger on a capture device, thereby affecting the matching process.
4. **Non-universality:** Some people cannot physically provide a standalone biometric credential due to illness or disabilities.
5. **Spoof attacks:** An impostor may attempt to spoof the biometric trait of a legitimately enrolled user in order to circumvent the system [23].

A Fisher-discriminant-analysis-primarily dependent method has recommended to combine more than one perspectives in [12], but it is also alike to MKL with kernel Fisher discriminant analysis because the base learner Fig. 2. Overview of Our algorithm. The proposed algorithm represents the data by a sparse linear combination of training data while constraining the observation from different modalities of the test subject to share their sparse represents. Finally, classification is done by assigning [14].

Joint Sparsity-Based Multimodal Biometrics Recognition. It is about considering a multimodal C-class categorization issue along with D dissimilar biometric features. Assume that there are pi guidance illustrations in every biometric attribute. For all the biometric traits i = 1, …, D, we would be denoting

$$\mathrm{Xi} = [\mathrm{Xi1}, \mathrm{Xi2}, \ldots, \mathrm{XiC}]$$

as an n × pi dictionary of guidance illustrations which consists of C sub-dictionaries Xik's that are corresponding to C dissimilar segments. Every sub-dictionary

$$\mathrm{Xij} = [\mathrm{xij}, 1, \mathrm{xij}, 2, \ldots, \mathrm{xij}, \mathrm{pj}\,]\, 2\,\mathrm{Rn} \times \mathrm{pj}$$

4 Results and Analysis

Further the combined features are compared to get efficient and robust features which will be compared with available features from trained data (Figures 3, 4, 5, 6, 7, 8, 9).

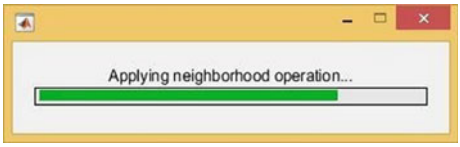

Fig. 3 From Face data we calculated the features and we trained those features and saved in '.mat' format

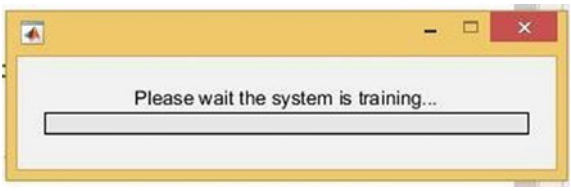

Fig. 4 From Iris data we calculated the features and we trained those features and saved in '.mat' format

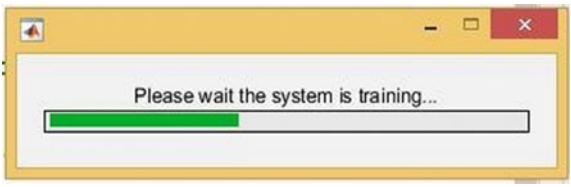

Fig. 5 From Fingerprint data we calculated the features and we trained those features and saved in '.mat' format. Testing the data

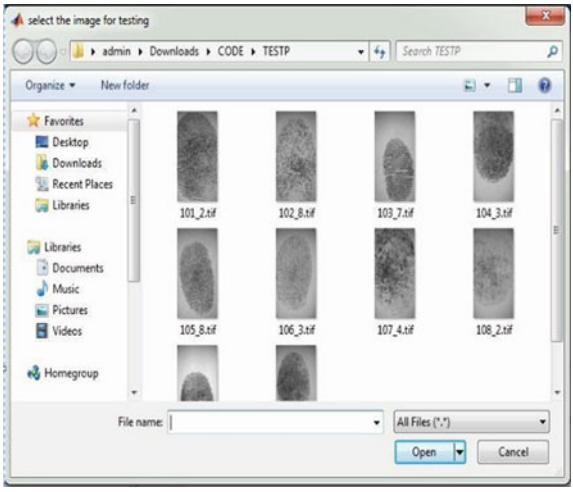

Fig. 6 Given an option to select a face image from user, from the selected face part we calculated the facial features

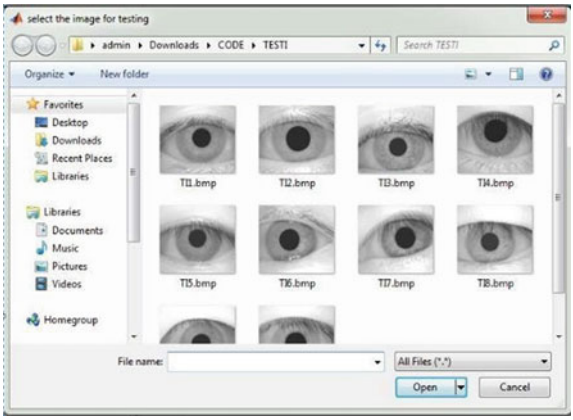

Fig. 7 Given an option to select an iris image from user, from the selected face part we calculated the facial features [15]

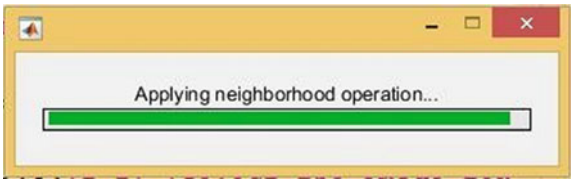

Fig. 8 Given an option to select a iris image from user, from the selected face part we calculated the facial features [17, 18]

Fig. 9 Detected as correct person or an intruder

Finally those features obtained from testing image are matched with trained features which will tell us the features are matched means that is correct person who is available in database otherwise we will say that the person is an intruder (Fig. 10) [21, 22].

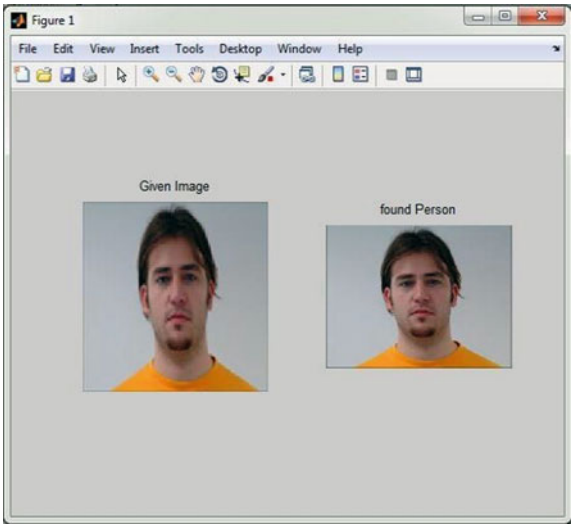

Fig. 10 The matched person face is retrieved from the database if he is correct person and matched to features of database [16]

5 Conclusion

We have initiated a new joint sparsity-based algorithm (set of rules) of characteristic level fusion for the recognition of multimodal biometrics. The algorithm (set of rules) is robust as it clearly comprises both occlusion and noise terms. A competent algorithm based on another direction was recommended to solve the problem of optimization. We also have suggested a multimodal quality measure depends on sparse representation. Moreover, the algorithm has been generalized for handling nonlinear variations.

References

1. Majid S, Maryam P, Mansour, V (2007) Wavelet based retinal recognition
2. Borgen H, Bours P, Wolthusen SD (2008) Visible-spectrum biometric retina recognition
3. Choras RS (2010) Hybrid iris and retina recognition for biometrics. In: 2010 3rd international congress on image and signal processing (CISP 2010)
4. Akram MU, Tariq A, Khan SA (2011) Retinal recognition: personal identification using blood vessels. In: 6th international conference on internet technology and secured transactions, 11–14 December 2011, Abu Dhabi, United Arab Emirates
5. Cemal K, Cevat İ (2011) Expert Syst Appl
6. Wayman JL (2001) Fundamentals of biometric authentication technologies. Int J Image Graphics 1(1):93–113
7. Doğan İ (2004) A' dan Z' ye MatlabileÇalışmak, Şubat
8. Gonzalez RC, Woods RE (2001) Digital image processing
9. Duane H, Bruce L (2005) Mastering Matlab 7

10. Barron UG, Corkery G, Barry B, Butler F, McDonnell K (2007) Assessment of retinal recognition technology as a biometric method for sheep identification
11. Farzin H, Abrishami-Moghaddam H, Moin MS (2008) A novel retinal identification system
12. Ravi D (2007) Retinal recognition, biometric technology in practice
13. Natalia S (2004) Retina identification biometric systems
14. Jain A, Hong L, Pankanti S (2000) Biometric identification. Commun ACM 43(2):90–98
15. Jain A, Bolle R, Pankanti S (1999) Biometrics: personal identification in a networked society. Kluwer Academic Publishers, Dordrecht
16. Zhang D (2000) Automated biometrics: technologies and systems. Kluwer Academic Publishers, Dordrecht
17. Hill RB (1983) Rotating beam ocular identification apparatus and method
18. Hill RB (1986) Fovea-centered eye fundus scanner. US Patent 4620318
19. Inman DJ, Farrar CR, Junior VL, Junior VS (2005) Damage prognosis for aerospace, civil and mechanical systems
20. Johnson JC, Hill RB (1990) Eye fundus optical scanner system and method
21. Hill RB (1999) Biometrics: personal identification in networked society. Springer, Berlin, p. 126 (edited by Jain A, Bolle R, Pankati S)
22. Simon C, Goldstein I (1935) A new scientific method of identification. N Y J Med
23. Tabatabaee H, Milani Fard A, Jafariani H (2006) A novel human identifier system using retina image and fuzzy clustering approach. In: Proceedings of the 2nd IEEE international conference on information and communication technologies (ICTTA 2006), Damascus, Syria
24. Xu ZW, Guo XX, Hu XY, Cheng X (2005) The blood vessel recognition of ocular fundus. In: Proceedings of the 4th international conference on machine learning and cybernetics (ICMLC 2005), Guangzhou, China, pp. 4493–4498
25. Ortega M, Marino C, Penedo MG, Blanco M, Gonzalez F (2006) Biometric authentication using digital retinal images. In: Proceedings of the 5th WSEAS international conference on applied computer science (ACOS 2006), Hangzhou, China, pp. 422–427

Wavelet Based Feature Extraction and T-Set Evaluation for Automatic Brain Tumor Detection and Classification

S. Ravi, V. SathiyaSuntharam, and Ravikumar Chandu

Abstract Brain image classification in order to detect various diseases like Tumor, stroke, Intracranial bleeding (ICB), etc., is being done manually from the Magnetic Resonance Imaging (MRI) results. However, the manual approaches are not accurate, tedious, and time consuming. The proposed work is to classify images using K-Nearest neighbor (KNN), Support vector machines (SVM), random forest, and Decision tree (DT) approaches, and the results obtained through these four approaches are compared. The input to the system is the MRI image, and it is preprocessed to remove various noise sources, then decomposed into structure and texture components. The Discrete wavelet transform (DWT) is applied to perform the noise removal, and decomposition of MRI images. Then classification techniques are applied on the decomposed images in order to detect the condition of the brain as normal, tumor, Alzheimer's, and ICB. The classification techniques are implemented using R programming. The performance of the four approaches are measured in terms of precision, recall, and F-measure.

Keywords Decision tree · K-Nearest neighbor · MRI · Random forest · Support vector machine · Wavelet transform

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_27

1 Introduction

Magnetic resonance imaging (MRI) is a test that uses a Magnetic field and beats of radio wave imperativeness to make pictures of organs and structures inside the body. All things considered, MRI gives different data about structures in the body than can be seen with a X-ray (30 Pete Hz to 30 exa Hz), ultrasound (2–15 MHz), or Computerized tomography (CT) (High frequency sound waves) analyze. The MRI test is performed by exposing the particular area of the body to a strong magnetic field in a machine. Figure 1 demonstrates the MRI of the human cerebrum [1]. Identifying the tumors from MRI is a critical task for a medical practitioner. X-ray is a noninvasive technique for creating three dimensional (3D) tomography pictures of the human body [2]. X-ray is most regularly utilized for the arrangement of Normal, tumors, Alzheimer's, Intracranial Bleed and different variations from the norm in delicate tissues, for example, the mind. Clinically, radiologists subjectively assess films delivered by MRI scanners. The proposed methods comprise of three phases, preprocessing, Discrete Wavelet Transform based component extraction, and arrangement.

When compared with all other imaging methods, MRI is progressively effective in cerebrum tumor recognition and distinguishing proof, principally because of the high differentiation of delicate tissues, high spatial goals and since it doesn't create any hurtful radiation [3], and is a non intrusive system. Figure 2(a), (b) and (c) demonstrates the Magnetic Resonance Image (MRI) from BRATS database is sorted into three particular classes as typical, Astrocytomas and Meaningiomas mind and it is considered for the execution of DWT include extraction and arrangement.

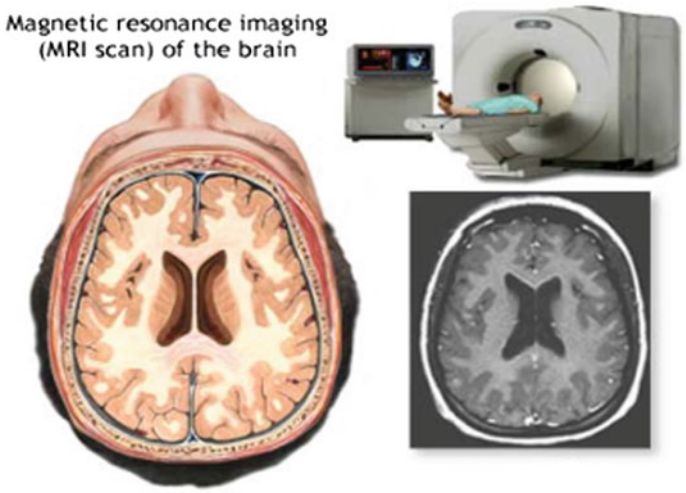

Fig. 1 A magnetic resonance imaging (MRI) of the brain

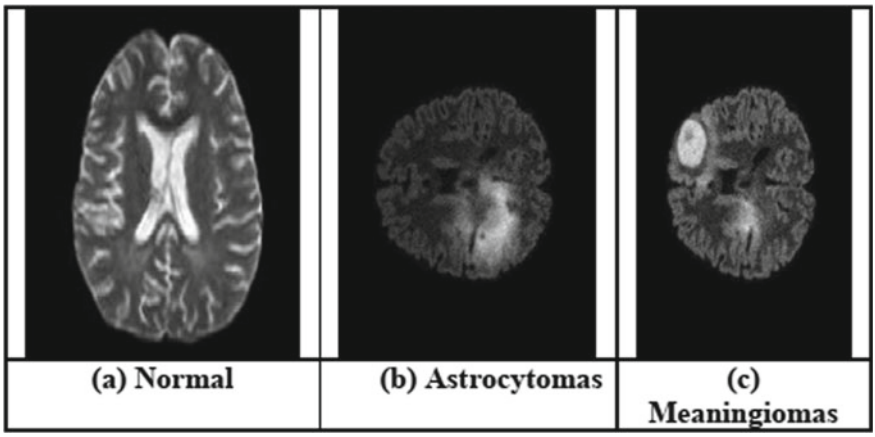

Fig. 2 MRI of the normal and abnormal images of the brain

2 Literature Review

Gromski et al. [3], presented a review on metabolomics and various analysis methods and its comparison for medical data analysis. The analysis techniques considered include Random forest (RF), Principal components – discriminant function analysis (PC-DFA), and support vector machines (SVMs). Diagnosis problems in the brain using threshold method is presented in [4]. This paper classifies the tumor in the image into three categories namely, Benign, Premalignant, and Malignant. The colour image is converted to gray scale image then high pass filter is applied followed by a median filter. Then the edge detection is performed using Sobel edge detection operator. A method based on cerebrum tumor identification calculations that have been proposed so far to distinguish the area of the tumor [5]. Another approach is proposed for programmed grouping of therapeutic pictures in two classes Normal and Abnormal dependent on picture highlights and programmed variation from the norm location. KNN classifier is utilized for ordering picture. K-Nearest Neighbor (K-NN) arrangement method is the least difficult strategy adroitly and computationally that gives great characterization exactness.

Yet another method for analysis of brain images using Support Vector Machines (SVM) are proposed and used to diagnose the problems in brain cells is presented. Some other approach based on Artificial Neural Network (ANN) in MRI images is done. The extraction of surface highlights in the distinguished tumor has been accomplished by utilizing Gray Level Co-event Matrix (GLCM) [5]. Factual surface examination strategies are continually being refined by analysts and the scope of utilizations is expanding. Dark dimension co-event lattice strategy is viewed as one of the significant surface investigation strategies utilized for getting measurable properties for further characterization [6], which is utilized in this exploration work.

3 Proposed Work

The general review of the proposed methodology is outlined in Fig. 3. This methodology utilizes the standard benchmark Brain Research and Analysis in Tissues (BRATS) tumor dataset for the trials [6]. The BRATS dataset is partitioned into three classes (typical, Astrocytomas and Meaningiomas) for highlight extraction process. The extricated highlights are displayed utilizing SVM, k-NN, random forest, and Decision tree for classification. The primary strides of a run of the mill picture handling framework comprise of three stages: Preprocessing, include extraction and characterization [7]. The MRI images of different sicknesses were gotten from Moulana Hospital, Perinthalmanna. After the preprocessing stage, wavelet-based highlights were extricated from these MRI pictures. These separated component esteems were then given to the classifier and the outcomes were examined. The picture characterization issue is tended to as two cases: two class arrangement and four class grouping [8]. In two class arrangement, typical and unusual MRI pictures were utilized while in four class characterization, ordinary, tumor, intracranial drain and Alzheimer's pictures were utilized [9]. The technique utilized in this work is portrayed in Figs. 3 and 4.

Image Acquisition
The proposed strategy was connected to break down the MRI pictures taken from Moulana Hospital. The informational index comprises of two arrangements of information. First set having 50 ordinary pictures and 50 anomalous pictures. The second set comprises of 100 cerebrum MRI images in which 30 pictures with typical cases, 30 Tumor Images, 20 Intracranial Bleed Images, and 10 Alzheimer's Images (Fig. 5).

Pre-processing
Middle separating is a nonlinear technique used to expel commotion from pictures. It is generally utilized as it is viable at evacuating clamor while safeguarding edges. It is especially powerful at evacuating 'salt and pepper' type commotion [10]. The middle channel works by traveling through the picture pixel by pixel, supplanting each an incentive with the middle benefit of neighboring pixels. The example of

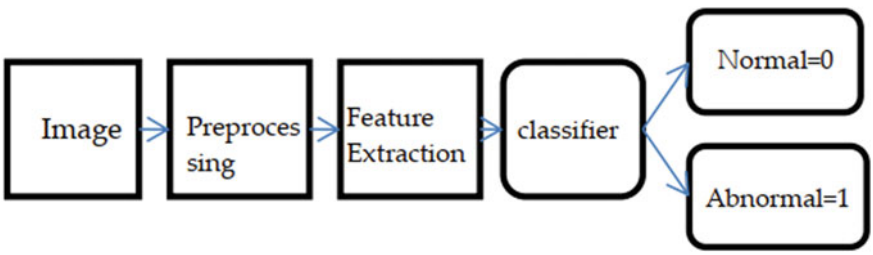

Fig. 3 Image processing system for normal and abnormal

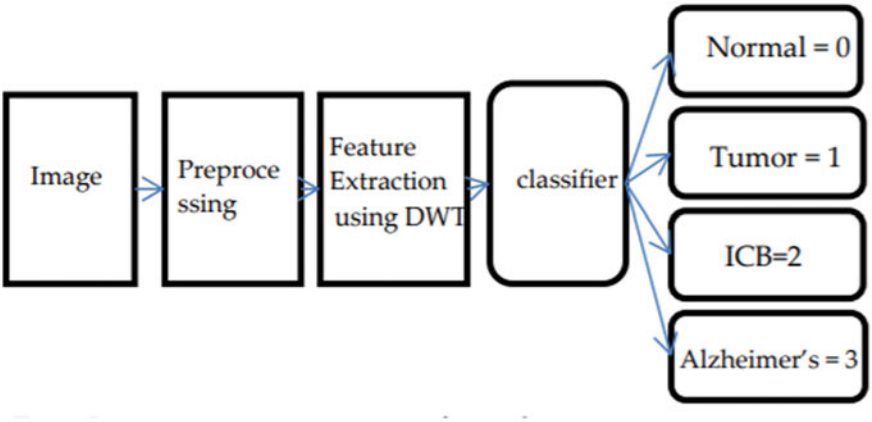

Fig. 4 Image processing system for 4 classes

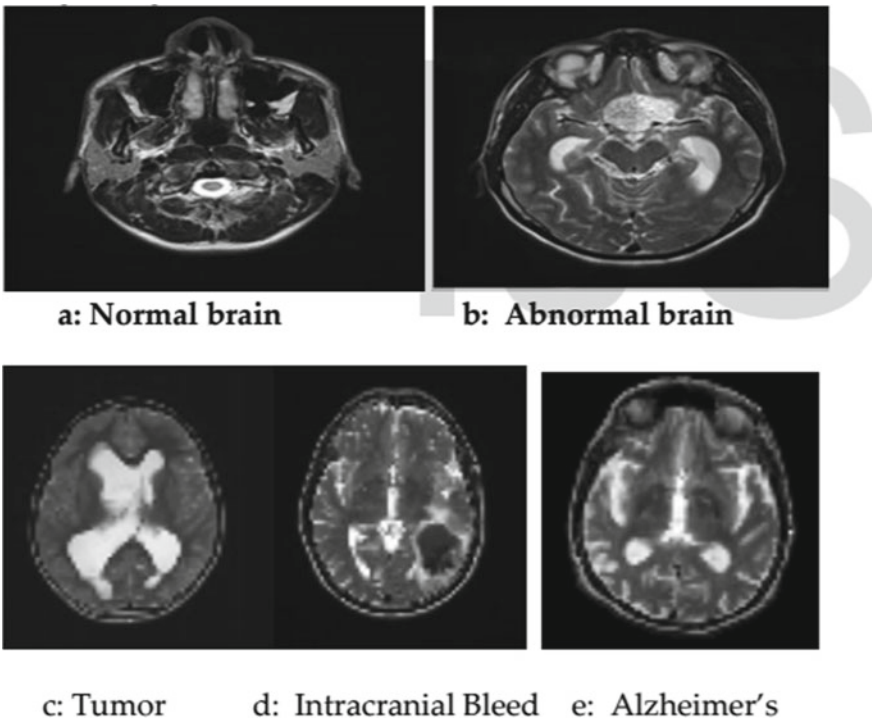

Fig. 5 Images of normal, abnormal, tumor, intracranial bleed and Alzheimer's

neighbors is known as the "window", which slides, pixel by pixel over the whole picture to pixels, over the whole picture [11].

Feature Extraction Using DWT

Highlights are separated for typical, Tumor, Intracranial Bleed, Alzheimer's and irregular MRI pictures. Highlights are Mean, STD, kurtosis, MAD, Variance, RMS esteem, Entropy and Median. A wavelet change have properties like Sub-band coding, Multi goals examination, Time recurrence restriction [12]. The wavelet is a ground-breaking numerical device for highlight extraction and has been utilized to remove the wavelet coefficient from MR pictures. Wavelets are confined premise capacities, which are scaled and moved forms of some fixed mother wavelets. Fourier Transformation (FT) provides portrayal of an image dependent on its recurrence content. The FT decays a sign into a range of frequencies though the wavelet investigation breaks down a sign into a chain of command of scales going from the coarsest scale [13].

The continuous wavelet transforms of the signal f(t) relative to a real valued wavelet $\varphi(t)$ is defined as,

$$\mathbf{W}(\mathbf{a},\boldsymbol{\tau}) = \int_{-\infty}^{\infty} \mathrm{f}(\mathrm{t})1/\sqrt{\mathrm{a}}\,\boldsymbol{\varphi} * (\mathbf{t}-\boldsymbol{\tau}/\mathbf{a})\mathbf{dt} \tag{1}$$

W(a, τ) is the wavelet transform, **τ** acts to translate the function across 'f (t)' and the variable 'a' acts to vary the time scale of the probing function **φ**. Equation can be discretized by restraining 'a' and '**τ**' to a discrete lattice (a = 2 & τ = 2 k) to give the discrete wavelet transform and expressed as,

$$\mathrm{cA}_{\mathrm{j,k}}(\mathrm{n}) = \left[\sum\nolimits_{n} \mathrm{f}(\mathrm{n})\mathrm{l}_{\mathrm{j}}^{*}\left(\mathrm{n}-2^{\mathrm{j}}\mathrm{k}\right)\right] \tag{2}$$

$$\mathrm{cD}_{\mathrm{j,k}}(\mathrm{n}) = \left[\sum\nolimits_{\mathrm{n}} \mathrm{f}(\mathrm{n})\mathrm{h}_{\mathrm{j}}^{*}\left(\mathrm{n}-2^{\mathrm{j}}\mathrm{k}\right)\right] \tag{3}$$

Here, (n) indicate for the low pass and high pass channels separately. j and k speak to the wavelet scale and interpretation factors individually. The estimation segment contains low recurrence segments of the picture while the point by point parts contain high recurrence segments.

Figure 6 shows the MRI images obtained for normal and abnormal brains. The first picture is prepared along the x and y headings by low pass and high pass channels which is the line portrayal of the picture. In this examination, a one-level 2D DWT with Daubechies-4 channels is utilized to separate proficient highlights from MRI [14]. Sub groups got amid highlight extraction are appeared in Fig. 4 for a run of the mill picture.

Ranking of Features Using T-test

Ranking features give the most significant features in sequential order. T-test is the absolute value of 2-sample test with pooled variance estimate.

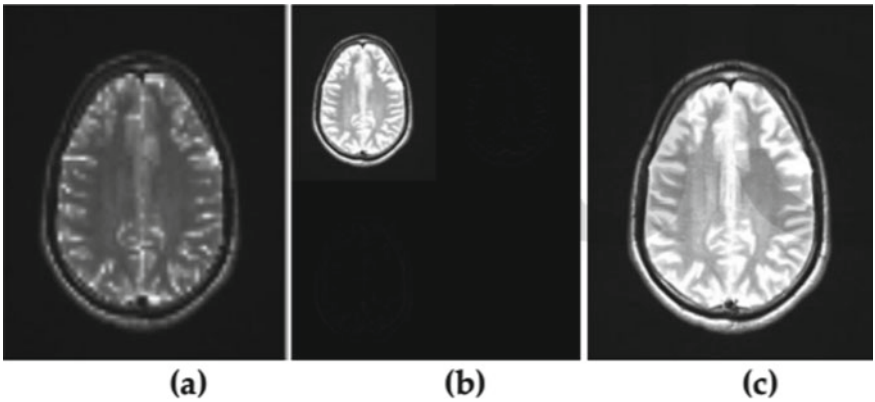

Fig. 6 (**a**) Normal brain image, (**b**, **c**) obtained sub band in one level 2D DWT

$$\text{T-test Value} = \frac{\text{Difference between means}}{\text{Variance}/\text{Sample Size}} \tag{4}$$

In the wake of positioning the eight highlights utilizing t-test class detachability standard, the most huge highlights were chosen [15]. These highlights were submitted to various classifiers. The outcomes were contrasted and changing the quantity of highlights.

Classification

A. **Artificial Neural Network classifier**

ANN depends on a vast accumulation of neural units (counterfeit neurons). In an ANN, handling component, weight, include work, enactment capacity and leave gestures are available separately to neuron, neurotransmitter, dendrite, cell body, and axon in a natural neural system (Fig. 7).

An Artificial neuron is a computational model, enlivened by the characteristic neurons. Normal neurons get flag through neurotransmitters situated on the dendrites or film of the neuron. At the point when the sign got are sufficient, the neuron is initiated and discharges a sign however the axon. These loads are duplicated by the qualities which experience every bolt, to give pretty much solidarity to the sign which they transmit [15]. The neurons of this system simply entirety their data sources.

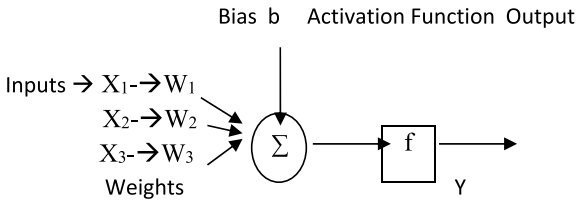

Fig. 7 Artificial neural network classifier

$$v = w_1x_1 + w_2x_2 + \ldots + w_mx_m = \sum_{i=1}^{m} w_ix_i \quad (5)$$

The output is some function y = f(v) of the weighted sum.

B. **Support vector machine classifier**
Support vector machines (SVMs) are most often used in data classification problems. SVM is solid as a result of its basic structure and it requires less number of highlights. SVM is an auxiliary hazard minimization classifier calculation got from factual learning hypothesis [16].
In the event that the preparation information are straightly detachable, select two parallel hyper planes that different the two classes of information, with the goal that the separation between them is as huge as could be expected under the circumstances. The district limited by these two hyper planes is known as the "edge", and the greatest edge hyperplane is the hyperplane that lies somewhere between them [17]. These hyper planes can be depicted by the condition

$$w \cdot x - b = 1 \quad (6)$$

Algorithm for SVM

Step 1: Import the images containing brain images using read command
Step 2: Preprocess the images to scale the pixel values from 0 to 1.
Step 3: Now use some sample of images from the set to train the model
Step 4: Compare the performance of the model in terms of precision, recall, and f-measure
Step 5: Once the model is trained well, apply test images to identify the defects in brain
Step 6: Measure the performance on the test images.

C. **Random Forest classifier**
It is a type of Machine learning algorithm, which is used for image classification applications [18]. It utilizes the results from multiple decision trees to calculate its response. Hence it is better than the results obtained from the single decision tree. It is a faster classification approach and it is easy to introduce a range of numeric or categorical data.

4 Result

Results Obtained with SVM
The disarray lattices of the SVM classifier on BRATS dataset is appeared Table 1, where askew of the table demonstrates that precise reactions of tumor types.

Table 1 Confusion matrix for SVM

	Normal	Astrocytomas	Meningiomas
Normal	100	0.0	0.0
Astrocytomas	0.0	65.22	34.78
Meningiomas	0.0	32.13	67.87

The normal acknowledgment rate of SVM is 85.52%. In SVM, the ordinary class is grouped well, where as in Astrocytomas class is mistaken for Meaningiomas class and the other way around. Along these lines, it needs further consideration [19].

Results Obtained with k-NN

The perplexity networks of the k-NN classifier on BRATS dataset is appeared Table 2, where inclining of the table demonstrates that precise reactions of tumor types. The normal acknowledgment rate of k-NN is 81.21%. In k-NN, the ordinary and Meningiomas classes are grouped great, where as the Astrocytomas class is mistaken for Meningiomas class as 33.33%.

Results Obtained with Decision Tree

The perplexity lattices of the Decision Tree classifier on BRATS dataset is appeared Table 3, where inclining of the table demonstrates that precise reactions of tumor types. The normal acknowledgment rate of DT is 79.66%. In DT, the ordinary class is arranged well, where as the Astrocytomas and Meningiomas class are confounded individually. Accordingly, it needs further consideration. Further, it is proved that multiple decision tree is better than the results obtained from the single decision tree [19, 20].

The performance comparison in terms of precision, recall and F- measure values are arranged in Table 4. These results demonstrate that the random forest classifier has a higher accuracy, recall and F-measure values for the sample images considered. The precision results of the four classifiers are depicted in Fig. 8.

Table 2 Confusion matrix for K-NN

	Normal	Astrocytomas	Meningiomas
Normal	100	0.0	0.0
Astrocytomas	0.0	64.23	3

Table 3 Confusion matrix for decision tree

	Normal	Astrocytomas	Meningiomas
Normal	100	0.0	0.0
Astrocytomas	0.0	65.33	34.67
Meningiomas	0.0	22.22	77.78

Table 4 Performance comparison of the image classifiers

Classifier	Precision	Recall	F-measure
SVM	87.23	86.55	85.43
K-NN	84.31	83.25	80.91
Decision tree	78.52	76.22	73.88
Random forest	84.61	83.48	81.04

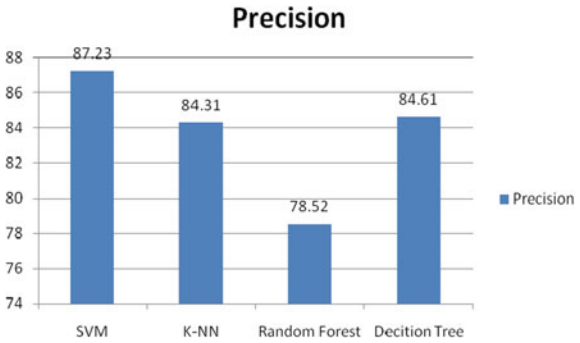

Fig. 8 Precision obtained for BRATS dataset on SVM, k-NN, RF, and DT classifiers

5 Conclusion and Future Work

Identifying the harmful tumors using MRI images is traditionally done using manual approaches. Using Machine learning (ML) algorithms for identifying the problems like brain tumor, Intracranial bleeding, etc., from the MRI images is more effective in order to get accurate and timely results. In this approach four popular Ml algorithms namely SVM, K-NN, Random forest, and DT are considered for image classifications. Experimental results for the BRATS dataset reveals that SVM approach provides better results in terms of precision, recall, and F-measure.

References

1. Aiello M, Salvatore E, Cachia A et al (2015) Relationship between simultaneously acquired resting-state regional cerebral glucose metabolism and functional MRI: a PET/MR hybrid scanner study. NeuroImage 113:111–121
2. Samuel BP, Pinto C, Pietila T, Vettukattil JJ (2014) Ultrasound-derived three-dimensional printing in congenital heart disease. J Digit Imaging 28(4):459–461
3. Van de Wetering R (2016) Modeling alignment as a higher order nomological framework. Paper presented at the international conference on business information systems, Leipzig, Germany
4. Gromski PS, Muhamadali H, Ellis DI, Xu Y, Correa E, Turner ML, Goodacre R (2015) A tutorial review: metabolomics and partial least squares-discriminant analysis—a marriage of convenience or a shotgun wedding. Anal Chim Acta 879:10–23

5. Murugappan V, Sabeenian R (2017) Texture based medical image classification by using multi-scale Gabor rotation-invariant local binary pattern (MGRLBP). Cluster Comput 22:10979–10992
6. Rana J, Galib SM (2017) Cataract detection using smartphone. In: 2017 3rd international conference on electrical information and communication technology (EICT), pp 1–4
7. Gokgoz E, Subasi A (2015) Comparison of decision tree algorithms for EMG signal classification using DWT. Biomed Signal Process Control 18:138–144
8. Xu B, Ye Y, Nie L (2012) An improved random forest classifier for image classification. In: IEEE international conference on information and automation, Shenyang, China, 6–8 June 2012, pp 795–800
9. Thanh Noi P, Kappas M (2017) Comparison of Random forest, k-nearest neighbor, and support vector machine classifiers for land cover classification using Sentinel-2 imagery. Sensors (Basel, Switzerland) 18(1):18
10. Padma Shri TK, Sriraam N (2017) Comparison of t-test ranking with PCA and SEPCOR feature selection for wake and stage 1 sleep pattern recognition in multichannel electroencephalograms. Biomed Signal Process Control 31:499–512
11. Czarnecki WM, Tabor J (2014) Multithreshold entropy linear classifier: theory and applications. Expert Syst Appl 42(13):5591–5606
12. Kavitha AR, Chitra L, Kanaga R (2016) Brain tumor segmentation using genetic algorithm with SVM classifier. Int J Adv Res Electr Electron Instrum Eng 5(3):1468–1471
13. Logeswari T, Karnan M (2010) An improved implementation of brain tumor detection using segmentation based on hierarchical self organizing map. Int J Comput Theory Eng 2(4):591–595
14. Khambhata KG, Panchal SR (2016) Multiclass classification of brain tumor in MR images. Int J Innov Res Comput Commun Eng 4(5):8982–8992
15. Kaur G, Rani J (2016) MRI brain tumor segmentation methods-a review. Int J Comput Eng Technol (IJCET) 6(3):760–764
16. Das V, Rajan J (2016) Techniques for MRI brain tumor detection: a survey. Int J Res Comput Appl Inf Tech 4(3):53–56
17. Zacharaki EI, Wang S, Chawla S, Soo Yoo D, Wolf R, Melhem ER et al (2009) Classification of brain tumor type and grade using MRI texture and shape in a machine learning scheme. Magn Reson Med 62:1609–1618
18. Pan Y, Huang W, Lin Z, Zhu W, Zhou J, Wong J et al (2015) Brain tumor grading based on neural networks and convolutional neural networks. In: 37th annual international conference of the IEEE engineering in medicine and biology society (EMBC), pp 699–702
19. Paradis E (2002) R for beginners. Published by University of Montpellier, E-book
20. Haufe S, Ewald A (2016) A simulation framework for benchmarking EEG-based brain connectivity estimation methodologies. Brain Topogr 32:625–642

An Clue-Based Route Search on Road Networks Using Keywords and Spatial Relations

K. Vijaya Babu, Mrutyunjaya S. Yalawar, and Parameswar Maddela

Abstract It is currently relatively commercial for road systems towards consuming documented substances on the highpoints using the improvements in geo-positioning expertise as well as position-grounded amenities. In latest centuries, preceding effort on recognizing an optimum path which protects a series of interrogation keywords has remained premeditated. On the other hand, an optimum path may not continually remain anticipated in numerous applied situations. Let's say, wherever the product can remain distant commencing the optimum one, a modified path enquiry is delivered in providing certain hints that label the spatial framework amid PoIs alongside the path. Hence, we explore the issue of clue-based route search (CRS) that permits a consumer for providing hints on keywords as well as spatial relations in this broadsheet. Mainly, we recommend a materialistic procedure as well as an energetic encoding procedure by means of standards. We cultivate a division-and-assured procedure which trims excessive highpoints in enquiry dispensation towards improving the effectiveness. We recommend an AB-hierarchy which stocks both the expanse as well as keyword data in hierarchy arrangement in direction towards rapidly locating applicant. We build a PBhierarchy in using the quality of two-party brand directory towards pin down the applicant towards additionally reduces the directory dimension. Wide-ranging experimentations remain accompanied as well as confirm the preeminence of our procedures as well as directory constructions.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_28

1 Introduction

Here is a perfect tendency that a collective sum of geo-documentary substances remains obtainable in numerous submissions using the swift improvement of position-grounded amenities as well as geo-positioning skills. For instance, in connected native exploration amenities (e.g., yellow sheets), the position data along with brief documentary explanations of certain dealings (e.g., restaurants, hotels) could remain simply bring into being. Several keywords correlated spatial enquiry representations as well as procedures have appeared such that the geo-documentary substances can remain proficiently recovered for providing enhanced consumer understanding. In delivering precise discourse or else divergent keyword (i.e., only a small number of PoIs comprise the keyword) in an area that might exclusively identify the position, it remains communal towards searching a Point-of-Interest (PoI). For instance, we enter the address "73 Mary St, Brisbane" or else the term "Kadoya" on Google Maps for finding a Japanese restaurant in the CBD zone.

For instance, recovering a collection of geo-documentary substances (commonly more than 2) or else a course casing numerous keywords and certain prevailing effort [8] encompasses such enquiry [15], towards additional refined backgrounds. Meanwhile, it is common that a consumer objects to discover [1] PoI using a lesser amount of discernible keyword such as "restaurant", however she can merely offer extra or else a smaller amount spatio-documentary framework data about the PoI. Liu et al. [5] validate such.

A CRS enquiry remains definite above a road system G definitely in addition to the contribution of the enquiry comprises of a basis summit vq as well as a series of hints, where every hint comprises an enquiry keyword as well as a consumer predictable system expanse. A summit [2] comprises a hint keyword which remains deliberated as an equal summit. The enquiry proceeds a route P in G beginning at vq, such that (i) P travels over a series of equal summits (PoIs) w.r.t. the hints as well as (ii) the system expanses among twofold transmittable coordinated summits remain adjacent towards the equivalent consumer definite expanse such that the consumer's exploration objective remains fulfilled.

The idea of scheming a mailing empowered stage aimed at a minor stable in which the aforementioned remains informal as well as suitable of sending and getting mails, there exists a exploration appliance, address manuscript then also comprising certain pleasurable playoffs, the leading as well as primary scheme aimed at expansion of a development starts from. Preliminary exploration initiates as soon as the aforementioned stands accepted through the association as well as our mission monitors the leading action. The execution consumes 3 shares:

Request Clarification: The assignment appeal need to be inspected for determining exactly what the scheme needs afterwards the support of the appeal to the group as well as structure director, using a study being deliberated. At this point, our mission is fundamentally intended aimed at consumers in the corporation whose structures can remain interrelated using the Local Area Network (LAN). In current tiring timetable, man want the whole thing would be delivered in a convenient way.

Therefore the equivalent progress of the entrance originated into survival pleasing into attention of the massive usage of the internet in daily routine.

Feasibility Analysis: A significant conclusion of initial exploration remains the resolution that the structure appeal stands practicable. This remains promising on condition that the aforementioned remains possible in restricted source as well as interval.

Request Approval: Not complete appeal schemes remain anticipated or else possible. Certain institute obtains numerous development requirements from customer operators that merely a small number of them remain followed. Nevertheless, those developments that remain mutually practicable as well as required ought to be placed into agenda. When a development appeal is accepted, its price, significance, accomplishment period as well as employees necessity is predictable as well as utilized towards determining where to enhance it to any development list.

2 System Analysis

Li et al. [3–9, 20] investigates the difficulty of track alert spatial keyword exploration that targets at concluding the k adjacent neighbors towards the enquiry that comprise entire feedback keywords as well as fulfill the track restraint. Rocha et al. [17] discourse the difficulty of handling leading-k spatial keyword enquiries on road systems wherever the space amongst the enquiry position as well as the spatial entity remains the distance of direct route. Through totaling shortcuts, ROAD systematizes the road system by means of a pecking order of stand in diagrams as well as joins them. An entity intellectual remains produced aimed at keyword inspection for every substitute diagram. The substitute diagrams lacking anticipated entity remain trimmed out by means of system extension.

Towards forming a pecking order, G-tree [10–13] approves a diagram segregating method. The expanses amongst entire limitations of them remain deposited as well in every single substitute diagram and an expanse matrix is preserved, and aimed at some twofold substitute diagrams. It proficiently calculates the space amid enquiry summit as well as objective summits or else tree nodules grounded on these spaces. Jiang et al. [17, 18] assume 2-hop brand aimed at controlling the space enquiry for kNN difficulty on huge systems as well as enables KT directory for handling the presentation dispute of repeated keywords. Liu et al. [20] validate the spatio-documentary setting data of the enquiring POI by means of hints as well as practice them to recognize the supreme favorable PoIs, which remains diligently connected towards our CRS effect. We purpose to discover a possible path on road systems by means of hints which are dissimilar through their effort. Furthermore, the spatial expanse deliberated in our exertion remains system expanse with the intention of the procedures in [19, 20] cannot be practical.

In the suggested structure, the structure investigated the difficulty of CRS on road systems that purposes towards finding an optimum path such that it refuges a customary of enquiry keywords in an assumed precise command, as well as the identical expanse is lessened. We mainly suggest [14–16] an acquisitive hint-grounded procedure GCS using no directory wherever the system development method remains modified towards covetously selecting the existing top applicants to build possible routes for answering the CRS enquiry.

We advance AB-tree as well as PB-tree arrangements towards speeding active the tree traversal, in addition to a semi vigorous directory informing device with the intention of swiftly trace the applicant summits. Even though the BAB procedure turns really quicker, as well as the directory dimension of PB-tree is far lesser compared to AB-tree, the Outcomes of experimental educations demonstrate that all the anticipated procedures remain accomplished of responding CRS enquiry professionally.

Admin

Management has to login using legal username and PIN in this element. After login successfully, he can ensure certain processes such Opinion entire Operators as well as approve and display their position by means of numerous indicators in Grape-assessment PB-tree on Traveler place and provide relation towards viewing its particulars, Outlook entire Traveler place particulars by way of ranking as well as scores, Outlook Entire automobile particulars as well as reserved facts, Outlook Entire Traveler commercial reserved through the operators as well as demonstrate their position in Numerous indicators by means of GMap, Outlook entire Optional Traveler place particulars using Steering route, Outlook traveler place ranking in graph, and outlook number of interval the identical operator journeyed equal traveler place as well as provide linkage to outlook in graph.

User

There are n numbers of consumers existing in this segment. Operator ought to record afore undertaking certain. Afterwards the effective registering, he can login by means of lawful consumer label as well as PIN. Effective Login will ensure certain procedures alike Outlook Your Profile, Accomplish Your Account, Outlook PB-tree on Traveler place and Order the place, Enhance tourism particulars using your particulars like name, address, email id, contact no, select vehicle type, and from to locality details, Condensed the sum centered on number of kilometers, Outlook all your Reserved site particulars as well as discover direction-finding route by means of GMap in addition to that compute the expanse amid from and to habitation through date and time, Endorse the traveler place to others using the aforementioned relation as well as direction-finding route, Discover all additional consumers direction-finding on identical roaming route and demonstrate in numerous indicators in GMap.

Service Provider

There exists n no. of operators are existent in this segment. Provision Supplier ought to record formerly performing certain. Afterwards the effective registering, he

can login by means of lawful consumer label as well as PIN. After effective login, he would perform certain actions corresponding Enhance Positions from and to Enhance Position's Guidelines using focus spaces as well as dwelling explanation alike if hotel means hname, hdesc (enc), existing articles, cost, address, enhance traveller spot particulars (min 3 places) corresponding place label, place desc (enc), well-known for, enhance appearance Opinion entire place particulars using ranking, assessments as well as direction route.

Advantages

a. Effective Direction-finding route owing to Hint-grounded Path Steering towards finding particular Direction route.
b. The Exploratory method is swift using Avaricious Hint exploration procedure.

3 Results

See Figs. 1, 2, 3, 4, 5, 6, 7, 8 and 9.

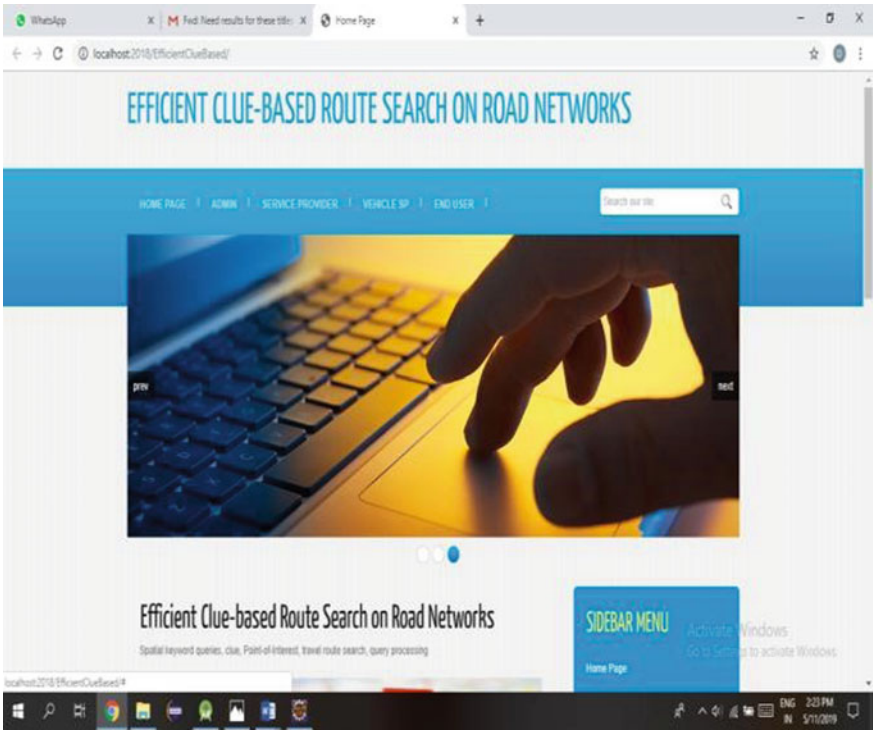

Fig. 1 Home page for the efficient clue based route search on road networks

Fig. 2 Admin login page

Fig. 3 Service provider login page

Fig. 4 Vehicle service provider login page

Fig. 5 User login

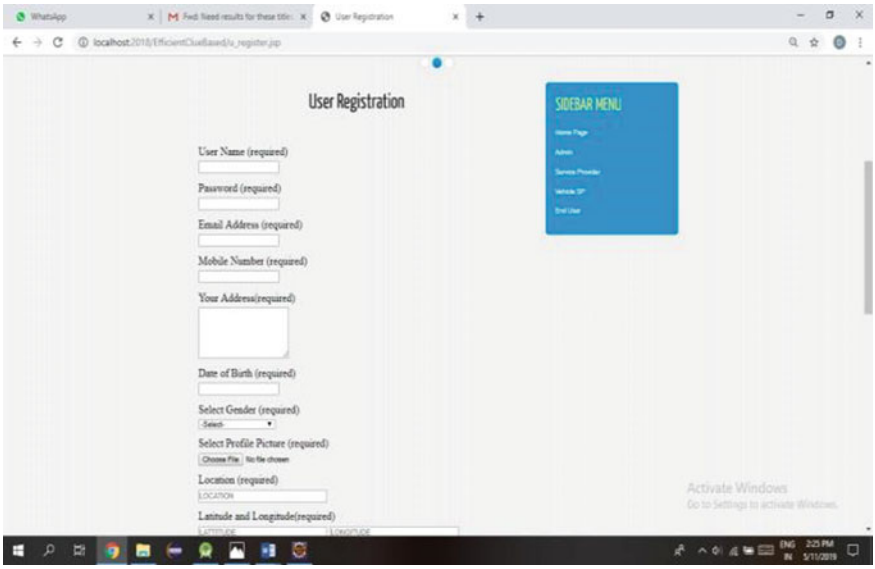

Fig. 6 User registration

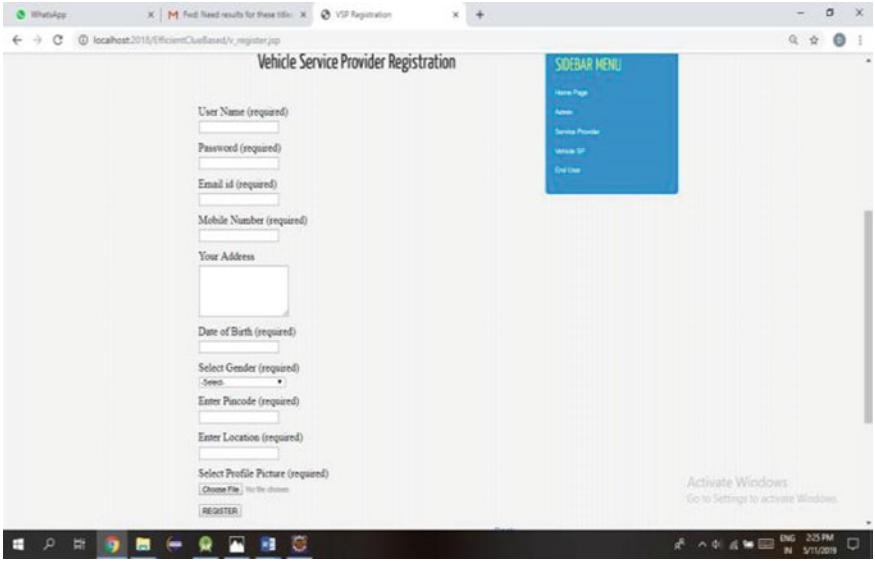

Fig. 7 Vehicle service provider registration

Fig. 8 Main page

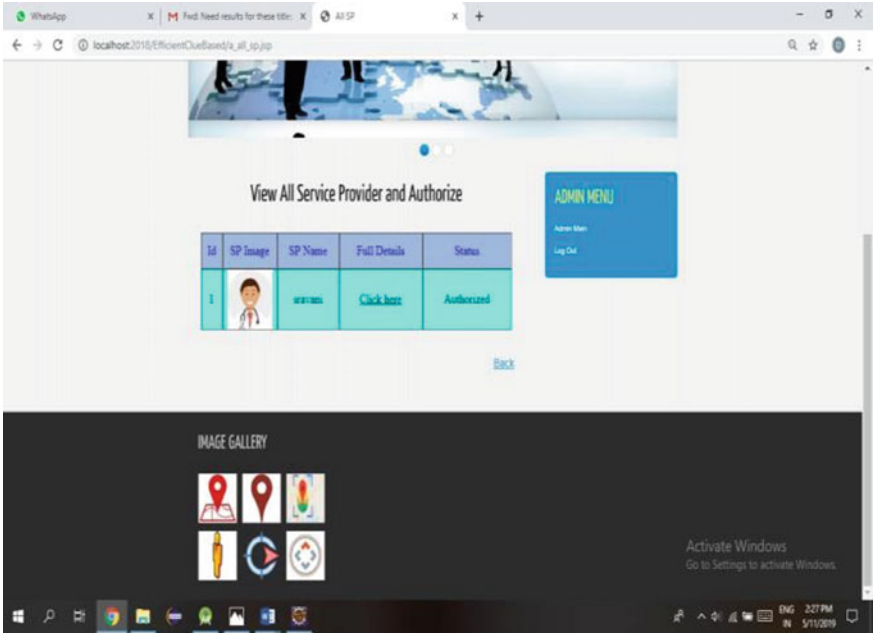

Fig. 9 Details of the providers

4 Conclusion and Future Directions

In this broadsheet, we revise the difficulty of CRS on road systems that targets towards finding an optimum path such that it protects a customary of enquiry keywords in a known precise directive, as well as the identical expanse remains reduced. We majorly suggest an avaricious hint-grounded procedure GCS using nondirectory wherever the system extension method remains adjusted towards insatiably selecting the present unsurpassed applicants for constructing possible routes to reply the CRS enquiry. At that time, we develop a precise procedure, specifically hint-grounded active encoding CDP, to reply the enquiry, which computes entire possible routes as well as lastly yields the optimum outcome. We suggest a division-and-destined procedure BAB through relating strainer-and-enhance example such that merely a minor share of summits remain continued, hence progresses the exploration effectiveness towards additionally reducing the divisional overhead Numerous instructions aimed at upcoming investigation remain encouraging. Firstly, operators might choose an extra general inclination exemplary that chains PoI score, PoI regular menu cost, etc., in the enquiry hint. Secondly, the aforementioned is of concern to yield progressive data into consideration as well as additional extending the CRS enquiry. Thirdly, wanting operators towards providing particular keyword equality remains problematic occasionally as they remain just delivering "hint", this might be imprecise in environment. Therefore, the aforementioned remains of attention towards encompass our exemplary towards supporting the estimated keyword competition.

References

1. Abraham I, Delling D, Goldberg AV, Werneck RF (2012) Hierarchical hub labelings for shortest paths. In: ESA. Springer, pp 24–35
2. Akiba T, Iwata Y, Kawarabayashi K, Kawata Y (2014) Fast shortestpath distance queries on road networks by pruned highway labeling. In: ALENEX. SIAM, pp 147–154
3. Akiba T, Iwata Y, Yoshida Y (2013) Fast exact shortest-path distance queries on large networks by pruned landmark labeling. In: SIGMOD. ACM, pp 349–360
4. Akiba T, Iwata Y, Yoshida Y (2014) Dynamic and historical shortestpath distance queries on large evolving networks by pruned landmark labeling. In: WWW. ACM, pp 237–248
5. Bentley JL, Saxe JB (1980) Decomposable searching problems I. Static-to-dynamic transformation. J Algorithms 1(4):301–358
6. Cao X, Chen L, Cong G, Xiao X (2012) Keyword-aware optimal route search. PVLDB 5 (11):1136–1147
7. Cao X, Cong G, Jensen CS (2010) Retrieving top-k prestige-based relevant spatial web objects. PVLDB 3(1–2):373–384
8. Cao X, Cong G, Jensen CS, Ooi BC (2011) Collective spatial keyword querying. In: SIGMOD. ACM, pp 373–384
9. Chen H, Ku W-S, Sun M-T, Zimmermann R (2008) The multi-rule partial sequenced route query. In: SIGSPATIAL. ACM, p 10

10. Chen L, Cong G, Jensen CS, Wu D (2013) Spatial keyword query processing: an experimental evaluation. PVLDB 6(3):217–228
11. Christofides N (1976) Worst-case analysis of a new heuristic for the travelling salesman problem. Technical report, DTIC Document
12. Cong G, Jensen CS, Wu D (2009) Efficient retrieval of the top-k most relevant spatial web objects. PVLDB 2(1):337–348
13. De Felipe I, Hristidis V, Rishe N (2008) Keyword search on spatial databases. In: ICDE
14. Dijkstra EW (1959) A note on two problems in connexion with graphs. Numer Math 1 (1):269–271
15. Guo T, Cao X, Cong G (2015) Efficient algorithms for answering the m-closest keywords query. In: SIGMOD. ACM, pp 405–418
16. Jensen CS, Kolářvr J, Pedersen TB, Timko I (2003) Nearest neighbor queries in road networks. In: GIS. ACM, pp 1–8
17. Jiang M, Fu AW-C, Wong RC-W (2015) Exact top-k nearest keyword search in large networks. In: SIGMOD. ACM, pp 393–404
18. Jiang M, Fu AW-C, Wong RC-W, Xu Y (2014) Hop doubling label indexing for point-to-point distance querying on scale-free networks. PVLDB 7(12):1203–1214
19. Kanza Y, Levin R, Safra E, Sagiv Y (2010) Interactive route search in the presence of order constraints. PVLDB 3(12):117–128
20. Kanza Y, Safra E, Sagiv Y, Doytsher Y (2008) Heuristic algorithms for route-search queries over geographical data. In: SIGSPATIAL. ACM, p 11

Secure Data Sharing Using Two Fold Cryptography Key Protection, Proxy Re-encryption and Key Separation Techniques

D. Uma Vishweshwar, A. BalaRam, and T. Kishore Babu

Abstract In Data transmissions Expertise, Data sharing in cloud storage is getting considerable responsiveness, as it could offer consumers using well-organized as well as operational storing facilities. The cryptographic methods are generally practiced for protecting the privacy of the collective complex information. On the other hand for information distribution, the information safety remains quiet posturing important encounters in cloud storage. How to defend as well as withdraw the cryptographic basic remains the essential trial amongst them. We recommend a novel information safety device for cloud storage for tackling this that embraces the resulting properties. 1) Using twofold aspects, the cryptographic basic remains safeguarded. The privacy of the cryptographic basic remains detained, on condition that one of the dual features works. 2) In incorporating the substitution re-encoding as well as basic departure methods, the cryptographic basic could remain withdrawn proficiently. 3) Through implementing the characteristic grounded encoding method, the information is endangered in a finegrained approach. Moreover, the safety inquiry as well as presentation assessment demonstrate that our suggestion remains safe as well as well-organized, correspondingly.

Keywords Cryptography · Decryption · Encryption · Fine-grained approach · Key separation technique · Proxy re-encryption

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_29

1 Introduction

Cloud storage remains one of the greatest effective cloud-centred submissions [1–7]. The main thing the information participator wants to ensure is to upload the information towards the cloud as well as accurate to the information. The aforementioned similarly presents various probabilities towards the opponent for accessing the collective information. The safety of cryptographic patterns stanch commencing the safety of essential cryptographic basic. Presently, in maximum of prevailing cryptographic systems, the cryptographic basic remains basically deposited in the PC whereas the aforementioned has been described that the deposited bases could remain exposed using specific diseases [8]. Numerous methods have been anticipated, such as basic-protected communal basic method [9, 10], as well as comparable basic isolated communal basic procedure [11, 12] for dealing through the basic experience challenge. They anticipated a new twofold-influence information safety device in [13]. The privacy of the cryptographic fundamental remains apprehended as long as one of these dual shares is reserved secretly from the opponent. Therefore, the "two-factor" is termed. Moreover, the aforementioned might be invalidated by means of the substitution re-encoding method after the consumer's safety scheme remained either misplaced or taken. The information distribution remains educating an impassioned apprehension in recent times, whereas confidentiality remains quiet, the basic apprehension as well as an similarly outstanding encounter which lessen the evolution of information distribution in cloud [14].

2 Related Work

Here we concisely appraisal the cryptographic structures using comparable utilities required in the information distribution setup as well as describe why they cannot completely attain our objectives in this sector.

1. Cryptographic schemes dealing with the key exposure problem
There exist twofold origins in such a structure. One, which is called leading furtive basic, remains deposited in a substantially safe but divisionally incomplete scheme (security device) and the additional one remains deposited in an uncertain scheme (e.g., computer) however can stay efficient occasionally by means of the leading furtive basic. The leading furtive basic as well as the communal basic stay equal for constantly. Dodis et al. [10] presented the basic isolated method into digital signs soon after. The Additional hazard of leading furtive basic disclosures though extra regularly the isolated basic modernizes. However the safety evidence of [11] remains attained in the indiscriminate revelation exemplary. Libert et al. [12] suggested an equivalent basic isolated communal key encoding safety in the customary exemplary in 2007. For solving the basic revelation difficult in ring sign, Liu

et al. [15] practiced the basic isolated approach in 2008. The safety scheme remains utilized towards updating every single operator's stage in entire the overhead patterns. Though, it remains preferred that the operator's isolated basic doesn't reorganized in each session in addition to the safety scheme must remain tangled in each decoding stage consistent with the necessities in the information allocation situation aimed at cloud calculating.

2. Cryptographic schemes with the fine-grained access control

In 2005, Sahai et al. [16] first presented the concept of attribute based encryption (ABE) and later deliberated in [17]. After that, in 2006, Goyal et al. [18] anticipated twofold harmonizing impressions of ABE i.e., key-policy ABE (KP-ABE) as well as ciphertext-policy ABE (CP-ABE). The isolated basic remains connected using a strategy (a Boolean formulation) as well as the ciphertext remains connected by a group of features in a KP-ABE. The anticipated ABE pattern merely cares monotonic admission configuration, whereas the CP-ABE remains the conflicting incident of KP-ABE in [18]. They concentrated on constructing operator verification by a secrecy-preservative, fine-grained as well as basic revelation-repelling method. Therefore, the approaches utilized cannot be practical in our suggestion, as well as novel approaches comprehending the dual-aspect method remain anticipated.

3. Cryptographic schemes with revocability

We would prefer to appraisal the ABE methods by reversibility, as the anticipated resolution in this broadsheet exists grounded on ABE.

3 Preliminary Investigation

Preliminary investigation can be done with 3 concepts:

- Request Clarification
- Feasibility Study
- Request Approval

3.1 Request Clarification

At this point, our mission is fundamentally intended aimed at consumers in the corporation whose structures can remain interrelated using the Local Area Network (LAN). In current tiring timetable, man want the whole thing would be delivered in a convenient way.

3.2 Feasibility Analysis

The dissimilar possibilities that need to be investigated are as follows:

- Operational Feasibility
- Economic Feasibility
- Technical Feasibility

Operational Feasibility
This type of mechanization would assuredly decrease the period as well as strength that are formerly used up in physical effort. The structure remains verified towards being practically possible grounded on the investigation.

Economic Feasibility
Aimed at a PC grounded scheme, Economic Feasibility remain a valuation of the financial validation. Since non-software remained fitted after the commencement and aimed at loads of determinations.

Technical Feasibility
Technical Feasibility remains the calculation of the procedural possessions of the group according to Roger S. Pressman. The structure remains established aimed at policy liberated atmosphere. Intended for developing the structure, Java Server Pages, JavaScript, The network remains theoretically possible aimed at expansion as well as can remain industrialized using the prevailing capability.

3.3 Proposed System

For solving the limitations of the simple resolution, the structure incorporate the characteristic-grounded encoding procedure, substitution re-encoding method, as well as the fundamental departure method The cipher texts exist in twofold setups in LLS + 15. One is the IBE cipher text and the additional remains the PKE cipher text.

Nevertheless, entirely the cipher texts in our anticipated structure remain ABE cipher texts. We require that the cloud modernizes the past cipher texts afore distributing them to the operator by means of consuming substitution re-encoding method for revoking the former safety scheme.

3.4 Implementation

Owner
The transmitter may transfer the folder through entrance as well as would ensure modernize, remove, confirm as well as retrieval choices aimed at the folder transferred afterwards the agreement.

Cloud Server
Cloud Server will allocate SDI for both owner (Alice) and user (bob) in this unit and outlook the folder transferred as well as the assailants interrelated towards folders in cloud. Observe the folders in decoded setup using the resultant furtive bases and the aforementioned dealings.

User
Through inserting keyword as well as appeal furtive basic and copy the specific folder from the cloud if both furtive basic as well as the decoding approvals remain delivered, the operator has to record and initialize, and explore for the folders in this unit.

Security Device Issuer
Views all the files decrypt permission request form the users and provide permission and view its related metadata and the transactions related to the requests from users.

Central Authority
The central Authority produces the furtive basic in this unit. It differences the basic into dual portions such as pkey1 and pkey2. This produced basic remains distinctive aimed at dissimilar operators intended for identical folder and outlooks entirely produced furtive bases and the dealings connected towards the aforementioned.

3.5 Results

See Figs. 1 and 2.

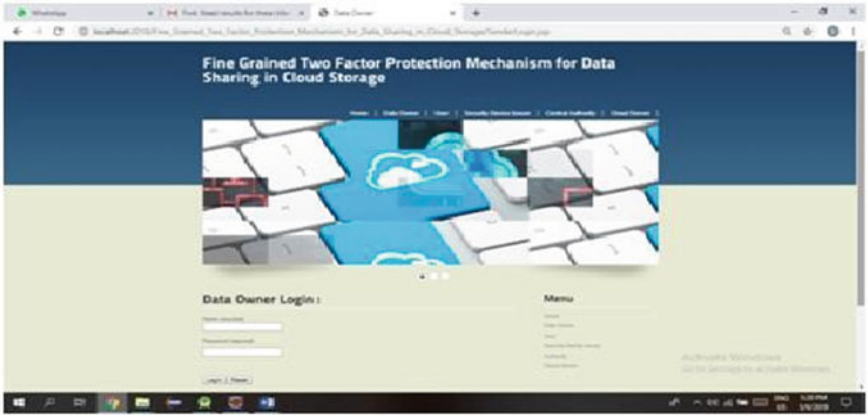

Fig. 1 Owner login page

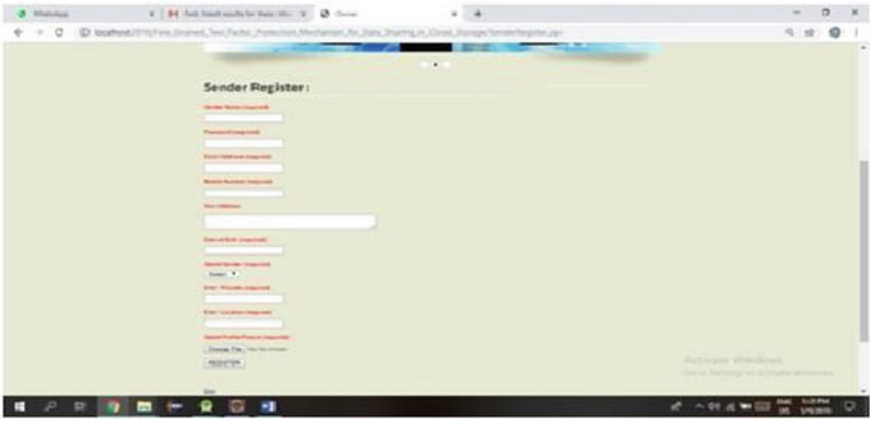

Fig. 2 Sender register page

4 Conclusion

We offered a fine-grained two-factor data protection for cloud storage in this broadsheet. The two-factor stands comprehended through splitting the furtive basic into double portions, one can remain kept in a probable-uncertain region, and the further is kept in interfere resilient scheme. The application is protected as long as one of them is preserved furtively. Additionally, we attained the fine-grained admission mechanism on encoded information and the variability of interfere resilient scheme correspondingly by means of the assistance of CPABE as well as PRE.

References

1. Dropbox. www.dropbox.com
2. Google drive. https://www.google.com/drive/
3. Pcloud. www.pcloud.com/
4. Wang C, Chow SS, Wang Q, Ren K, Lou W (2013) Privacy-preserving public auditing for secure cloud storage. IEEE Trans Comput 62(2):362–375
5. Wang C, Wang Q, Ren K, Cao N, Lou W (2012) Toward secure and dependable storage services in cloud computing. IEEE Trans Serv Comput 5(2):220–232
6. Zhu Y, Ahn G-J, Hu H, Yau SS, An HG, Hu C-J (2013) *Dynamic* audit services for outsourced storages in clouds. IEEE Trans Serv Comput 6(2):227–238
7. Chen HC, Hu Y, Lee PP, Tang Y (2014) NCCloud: a network coding-based storage system in a cloud-of-clouds. IEEE Trans Comput 63(1):31–44
8. Encryption key virus threat. http://searchsecurity.techtarget.com/tip/Encryption-key-virus threat
9. Dodis Y, Katz J, Xu S, Yung M (2002) Key-insulated public key cryptosystems. In: Advances in cryptology–EUROCRYPT 2002. Springer, pp 65–82
10. Dodis Y, Katz J, Xu S, Yung M (2002) Strong key-insulated signature schemes. In: Public key cryptography–PKC 2003. Springer, pp 130–144
11. Hanaoka G, Hanaoka Y, Imai H (2006) Parallel key-insulated public key encryption. In: Public key cryptography-PKC 2006. Springer, pp 105–122
12. Libert B, Quisquater J-J, Yung M (2007) Parallel key-insulated public key encryption without random oracles. In: Public key cryptography–PKC 2007. Springer, pp 298–314
13. Liu J, Liang K, Susilo W, Liu J, Xiang Y (2016) Two-factor data security protection mechanism for cloud storage system. IEEE Trans Comput 65(6):1992–2004
14. Winkler VJ. Cloud computing: Privacy, confidentiality and the cloud. https://technet.microsoft.com/en-us/magazine/dn235775.aspx
15. Liu JK, Wong DS (2008) Solutions to key exposure problem in ring signature. IJ Netw Secur 6(2):170–180
16. Sahai A, Waters B (2005) Fuzzy identity-based encryption. In: Advances in cryptology–EUROCRYPT 2005. Springer, pp 457–473
17. Pirretti M, Traynor P, McDaniel P, Waters B (2006) Secure attribute based systems. In: Proceedings of the 13th ACM conference on computer and communications security. ACM, pp 99–112
18. Goyal V, Pandey O, Sahai A, Waters B (2006) Attribute-based encryption for fine-grained access control of encrypted data. In: Proceedings of the 13th ACM conference on computer and communications security. ACM, pp 89–98

A Fire Alarm Detection System with Speech Output Using Thresholding RGB and YCbCr Colour Space

M. Archana and T. Neha

Abstract Fire branches in Malaysia constantly face the problem of reaching a fire site locality in a short time for rescue operations owing to complications like of lacking data pertaining to crowding on roads leading to the site. In addition to their existing complexities, identification of fake calls from unidentified callers is making it even more difficult. The framework proposed in the current work is based on increasing the visualization grounded fire detection scheme which observes for a substitute result to overcome the complexities. Nevertheless, these revision choice remains restricted for fire detection only. The presentation of the structure is conformed by means of hundred images. To ensure, the scheme remains tough towards dissimilar neighboring illumination, the images are put in use from morning through evening. However, the images shall experience numerous stages of pre-handling for minimizing sounds. "YCbCr" color space illustrates top presentation compared to RGB since the former technique can discriminate luminance from chrominance more efficiently compared to RGB color space.

Keywords Fire recognition · Image processing · RGB · YCbCr color space

1 Introduction

Visualization-grounded fire is a scheme established for taking precaution of any region or places as well as aimed at a location that our naked eyes are inadequate. Rather than consuming a proportion of man's influences towards guarding the region, it could be condensed by means of consuming an investigation scheme. It is economically feasible for installation of cameras too. Nevertheless, owing to the

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698,
https://doi.org/10.1007/978-981-15-7961-5_30

illumination of adjoining, particularly in a daytime situation, visualization-grounded scheme also consumes certain limits in identifying fire. During night-time, fire remains hardly detected since it consumes the brightest image pixels. The untruthful fire alarm recognition could stand condensed in numerous methods, [1] for example, by means of consuming Gaussian Procedures, Blob recognition, besides pixel color resolution. In this scheme, the RGB as well as YCbCr color mechanisms of an image will remain examined towards determining whether there occurs some fire or not. The benefit of YCbCr color space is that it can detach brightness after chrominance more efficiently than RGB color space. Brightness in image is essentially a light concentration or in other words, the quantity of bright arrays from black towards white, although chrominance is only a light wave using color Cyan Red and Cyan Blue.

1.1 Vision System

Commonly, visualization centered scheme by a camera delivers plentiful data consistent than a scheme that consumes additional devices such as temperature sensor, smoke sensor etc. Moreover, image processing process pays a small price as the procedure stands inexpensive in calculation. Image processing comprises of 4 phases. The first phase is image acquirement where as the adjacent is apprehended by a web camera which unswervingly is linked to a computer. At that time, the image experiences pre-handling phase. In second phase the image remains modified plus improved for removing noises by means of image straining, image reinstatement as well as color handling methods. Third phase is image handling that will distinguish contextual from the forefront article, edge recognition, and morphological treating as well as image divider. The fourth phase is feature abstraction, where the pixels of every single preferred feature are assembled in an organized manner.

1.2 Fire Recognition Methods

Fire recognition is proficient in numerous customs, such as temperature sample, element sample, humidity sample, air limpidity analysis and similarly smoke investigation. Nevertheless, these methods are unreliable as they cannot deliver additional data such as fire locality, dimension of fire, increasing amount of fire as well as other useful information that might provide the precise opinion of the fire prospect. Therefore, the methods may affect in false apprehension since the methods can slip evaluator the energy discharge of non-fire or yields of ignition [2]. There exist numerous kinds of color exemplary such as RGB, CMYK, YCbCr, YUV, HSL, and HSV, HIS as well as CIE Lab. Nevertheless, every single color

spaces consume its compensations as well as drawbacks which are discussed further in this paper.

2 Literature Survey

Meng Yafei, Gong Shengrong, Liu Chunping discovered the deserted rubber keypad, the industrial unit consumes towards devoting enormous manpower as well as economic possessions, nevertheless the effectiveness as well as accurateness remains small [12]. In this broadsheet, a visualization-grounded great-speed scheme aimed at the recognition of rubber keypad intended as well as advanced.

Ping-He Huang, Jing-Yong Su, Zhe-Ming Lu, and Jeng-Shyang anticipated a broadsheet that offers a fire-distressing technique grounded on video dispensation. We offer a structure which uses color as well as gesture data removed from video categorizations towards detecting fire. [6, 8] Flame can remain detected conferring towards the aforementioned color which remains a main component of fire imageries T.Chen et al. proposed a customary set of instructions towards separating the fire pixels by R, G and B data. B.U. Totryin et al. employed a combination of Gaussians in RGB color space that are advanced commencing an exercise customary of fire pixels, rather than consuming a regulation grounded color exemplary. B.U. Totryin et al. hired concealed markov replicas towards detecting the gesture features of the fire flame which are fire flickering alongside by the fire pixel cataloging.

Wen-Homg et al. employed HSI color exemplary for separating the fire pixels. They established the guidelines aimed at optimistic as well as gloomier atmospheres. T. Celik et al. designed figure of guidelines by means of standardized (rgb) principles with the intention of avoiding the belongings of altering brightness. Noor A. Ibraheem, Mokhtar M. Hasan, Rafiqul Z. Khan, anticipated a revision of watching out for a substitute resolution towards overcoming the difficulties by increasing visualization centered fire detection scheme [10, 11].

Punam Patel, Shamik Tiwari et al. anticipated a broadsheet of fire recognition procedure grounded on image handling methods that are compatible in investigation strategies alike CCTV, wireless camera to UAVs. Md Saifudaullah Bin Bahrudin et al. deliberates an actual-interval controlling scheme that identifies the occurrence of smoke in the midair owing to fire as well as seizures images through a camera fixed intimate a chamber whenever a fire befalls. Sudhir G. Nikhade deliberates wireless device system structure that is established by means of vulnerable hardware stages, Raspberry pi as well as Zigbee. Pasquale Foggia, Alessia Saggese, and Mario Vento offer a technique which is capable of detecting fires by means of investigating videos [5].

3 Proposed Method

The anticipated technique of image handling can be classified into five phases that are useful for observing an invisible entity [2]. Secondly, image perfecting as well as reinstatement aimed at improved image, third remains image recovery towards finding image of attention. Fourth, quantity of decoration towards measuring numerous entities in image and fifth is image identification towards detecting goal entities in an image. This process remains inexpensive in divisional [3]. Figure 1 displays the procedure course of advanced fire detection system.

3.1 Image Acquisition

This phase tangled camera allocates computers towards receiving the image in therefore mentioned numerical presentation. Image format employed is a JPG

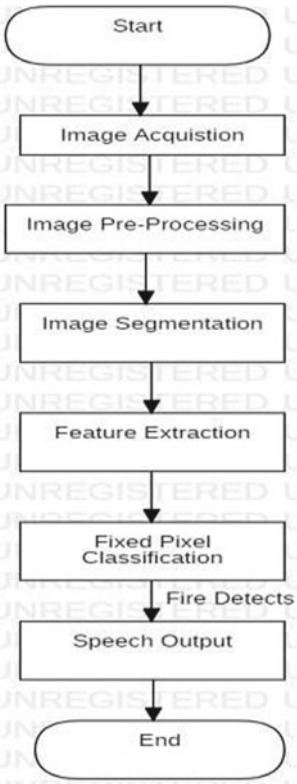

Fig. 1 Stages of fire detection system

image density customary using 8 Mega Pixel resolves. The information would be composed in a daylight that are from morning, through evening. Additional information will composed is aimed at a healthier presentation structure in 100 illustration imageries. A fire may be grouped with the intention of the information being composed.

3.2 Image Pre-processing

Pre-processing of the digital image is a stage for creating enhancement as well as development towards the image, making definite entire sound remains unconcerned previous towards dispensation stage. In pre-handling, image filtering, image refurbishment and/or colour dispensation stay performed. This scheme employed RGB as well as YCbCr color space. With the intention of detecting fire, pixel of fire area in RGB remains discovered. In YCbCr colour space, the image commencing RGB presentation devises transformation into YCbCr setup much earlier as soon as the image is investigated. The formulation aimed at RGB towards YCbCr adaptation is presented in Fig. 2[7]. Image pre-handling may raise the dependability of visual examination as well as identifying the area of attention.

Image dissection is an additional stage for separating the contextual commencing the center entity in the image. Loads of image subdivision procedures such as solidity, morphological handling, and edge recognition in addition to numerous development methods can be utilized now. This is the toughest portion in digital image handling as it comprises subdivision techniques for partitioning the image hooked on the entities anticipated. Then, through choosing the finest onset assessment aimed at the image, the resolution of edging remains extracting the entities from the contextual. With the intention of differentiating among contextual as well as fire, the procedure may comprise subdivision of the fire area as well as edging whose assessment can stay initiated by means of color edging implements in MATLAB [3].

Histogram exhibits a significant character towards finding the finest onset assessment in this procedure. RGB as well as YCbCr together ensure dissimilar onset assessment of fire area. The definite series as well as pixel assessment towards being categorized by means of fire in RGB as well as YCbCr color space is

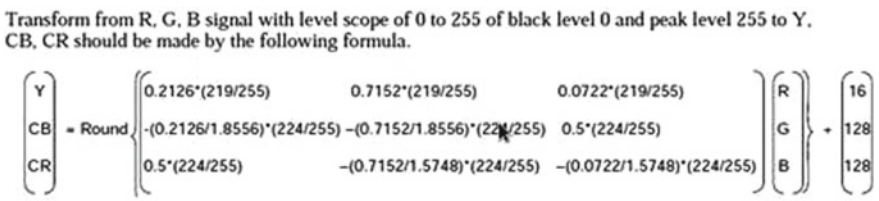

Fig. 2 Image segmentation

emphasized. Next, the utmost significant phase will herald that is feature abstraction. Whereby, entire information as well as onset assessment is utilized for creating guidelines aimed at fire detection [4].

3.3 *Feature Extraction*

Feature extraction information pixel which signifies as well as defines the preferred pixels is remained clustered. The customary of topographies would abstract appropriate data consequently towards the preferred commission. For this scheme, fire pixel is removed by means of consuming two fold colour spaces as well as seven guidelines that are practiced aimed at every single image verified [7]. The guidelines are scheduled in Table 1.

Table 1 Seven rules for fire recognition

Color space	Rules
RGB	1) R > G > B
YCbCr	2) if R > Rmean $\cap$ G > Gmen $\cap$ B < Bmean
	3) Y(x,y) >= Cb(x,y)
	4) Cr(x,y) >= Cb(x,y)
	5) Y(x,y) $\geq$ Ymean $\cap$ Cb(x,y) $\leq$ Cbmean $\cap$ Cr(x,y) $\geq$ Crmean
	6) Cb(x,y)−Cr(x,y) $\geq$ Th
	7) (Cb(x,y) $\leq$ 120) $\cap$ (Cr(x,y) $\geq$ 150)

For instance, for the Instruction 1 as well as Instruction 2, entire fire images display that R remains the foremost module in a fire image. Nevertheless, the R color module suggestively decreases throughout afternoon because of robust sunshine. En route for overcoming this difficult, usual assessment of R, G as well as B is resolute grounded on 100 imageries utilized in this effort. The usual of R module in a fire Image remain registered in Table 2. Henceforth, usually we may categorize that the fire area module R must remain superior than G as well as G should remain superior to B constituent.

Table 2 Range for fire region in different conditions

Daylight	Range R	Range G	Range B
Morning	>230	>160	>50
Afternoon	>180	>70	>100
Evening	>230	>100	>40

3.4 Fire Pixel Classification

In this phase, recognition of fire in RGB as well as YCbCr color space is organized at the outcome to remain precise. That remains predestined that the image ought to fulfill entire seven guidelines to remain deliberated by means of fire. In this period, the productivity thought towards showing the fire area in dual image as if the fire discovered. Otherwise, simply filled black colored image would remain presented.

4 Results

4.1 Analysis on Color Space

The investigation stands for deciding which color space (RGB, Gray scale, and YCbCr) is appropriate towards being utilized in the structure. For this experimentation, together RGB and YCbCr color expanse progressive fire recognition proportion as well as little incorrect apprehension proportion. Nevertheless, YCbCr color space delivers extra benefit than RGB color expanse as YCbCr could distinguish the

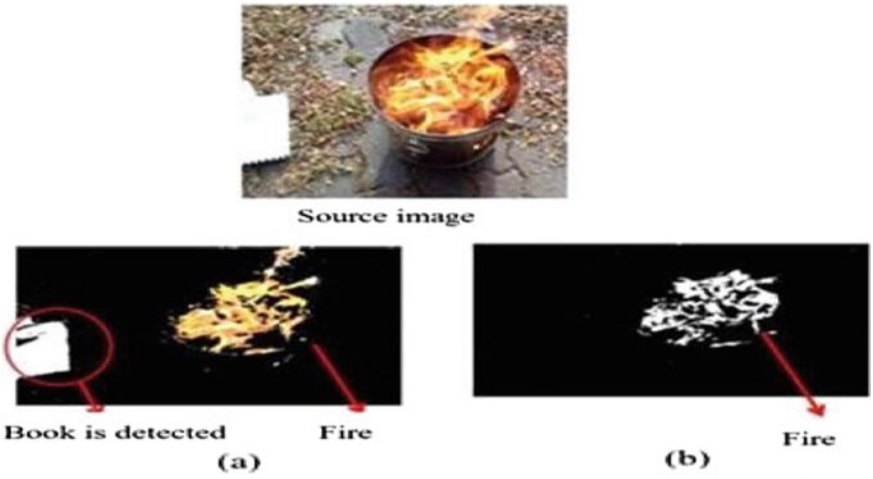

Fig. 3 Comparison of two color spaces in recognizing fire **a** RGB **b** YCbCr

brightness from chrominance more efficiently. However aimed at gray scale, the outcomes of color space RGB as well as gray scale are identical. Gray scale is appropriate in the circumstances of great or little light concentration and illumination. In gray scale, aircraft R, G, as well as B would consume similar value. RGB and gray scale capable toward detecting fire, nonetheless they may not distinguish among fire and non-fire entity. Figure 3 underneath demonstrates the outcomes for fire recognition by means of RGB, gray scale as well as YCbCr color expanse.

YCbCr color space remains the solidity of half RGB pixel standards. The color pixel in YCbCr would lessen from the fore mentioned innovative pixel standards (255 until 127). Lessening of pixel standards in YCbCr enables the aforementioned to discover the fire proficiently due the series of every color in addition to noise is condensed [9]. In this experimentation, investigations have remained performed throughout day light and hence the fire as well as the aforementioned neighboring will remain inclined by means of the brightness and chrominance result [9]. Mutually color spaces can remain utilized towards detecting fire, however YCbCr color space stands additional appropriate towards dealing with atmosphere in daytime. Additional description remains molded in the subsequent investigation.

4.2 *Analysis on Fire Detection Process (Image Processing)*

With the intention of detecting fire, entire color modules of the two fold color expanses must remain resolute, may not only reliant on RGB color expanses. This remains toward preventing from untruthful apprehension the fire detection.

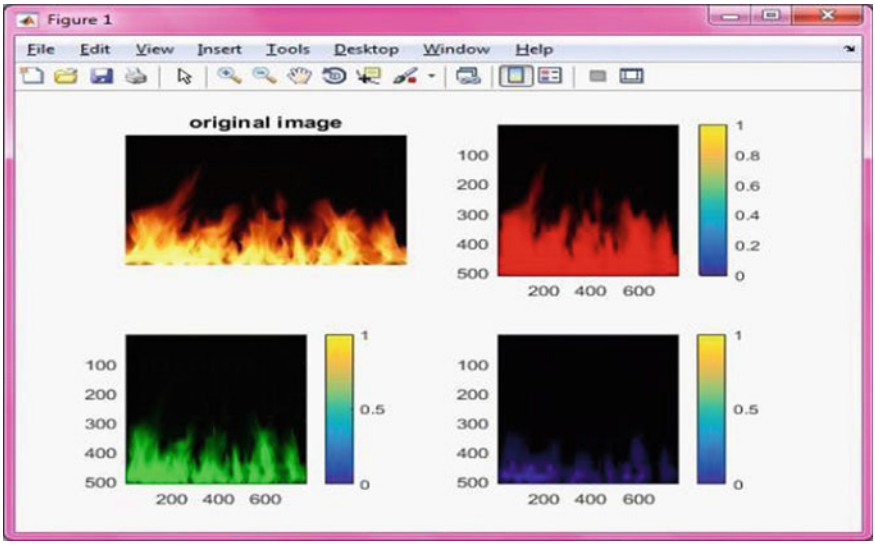

Fig. 4 Original image and its planes

Consequently, a regulation that consists of 7 guidelines had remained fabricated for classification of a pixel categorized as fire. If a pixel pleases these 7 guidelines, the pixels are suitable to fire session. Around 100 images have been utilized for determining fire features (Figs. 4, 5, 6 and 7).

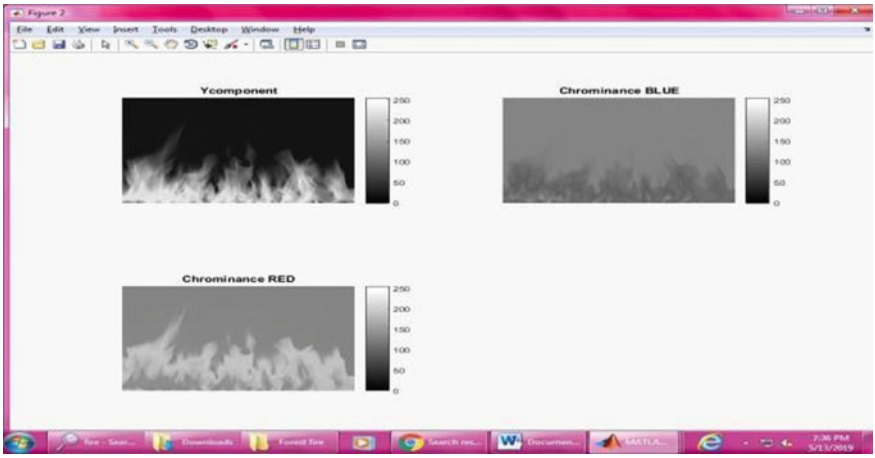

Fig. 5 Y, Cb and Cr component of the image

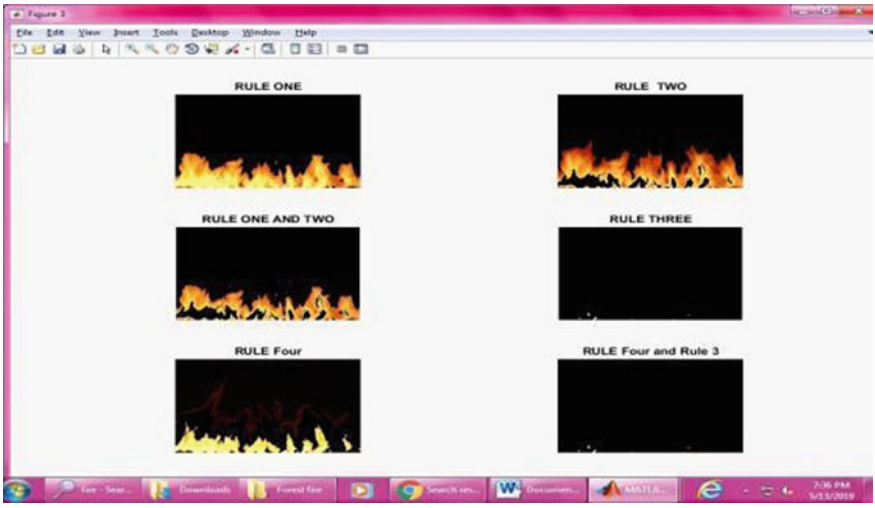

Fig. 6 Applied rules for both rgb and ycbcr planes

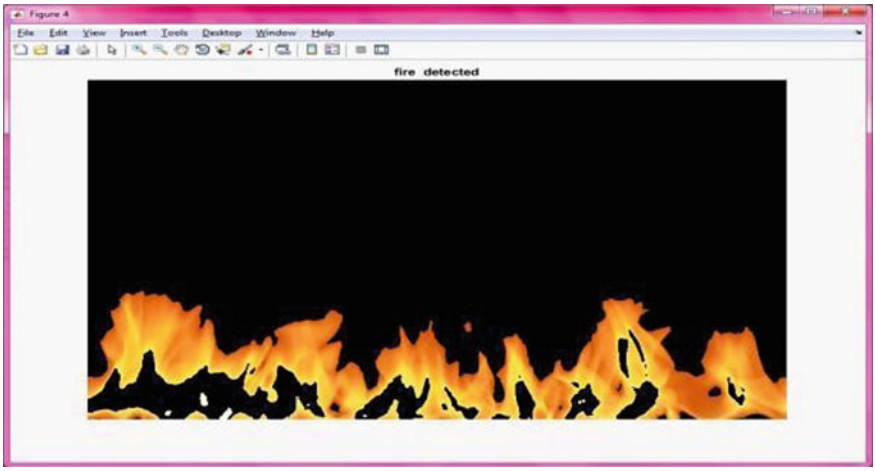

Fig. 7 Detected Fire

5 Conclusion and Futurework

Finally, the structure effectively accepted fire survival in all three circumstances that were verified built on 100 images. Investigation outcomes display that mutual colour expanses ensure advanced fire recognition proportion remains 90% and 100% with RGB and YCbCr respectively. Equal colour expanses can be utilized for detecting fire; nonetheless YCbCr colour expanse promises a superior recognition proportion as compared to RGB since YCbCr can discriminate brightness from chrominance more effectively compared to RGB. The structure is capable of discriminating the possessions in adjoining (non-fire) or else imitated entities that ensure similar assessment as fire pixel assessment; false fire alarm may however cannot be overcome. Therefore, detection of fire by means of colour expanses RGB, as well as YCbCr over seven guidelines aimed at fire pixel arranged would install an extremely reliable structure.

References

1. Tuba V, Capor-Hrosik R, Tuba E (2017) Forest fires detection in digital images based on color features. Int J Environ Sci 2:66–70
2. Chen T-H, Wu P-H, Chiou Y-C (2004) An early fire-detection method based on image processing. In: Proceedings international conference image process (ICIP), October 2004, pp 1707–1710
3. Celik T (2010) Fast and efficient method for fire detection using image processing. ETRI J 32 (6):881–889
4. Rgitha K (2013) Vision based intelligent fire detection system. Int J Eng Sci Invention 2(3)

5. Toreyin BU, Dedeoglu Y, Cetin AE (2005) Flame detection in video using hidden Markov models. In: Proceedings IEEE international conference image processing, pp 669– 672
6. Kim Y-H, Kim A, Jeong H-Y (2014) RGB color model based the fire detection algorithm in video sequences on wireless sensor network. Int J Distrib Sensor Netw 10(4), Article ID 923609
7. Matrix Equation is Referenced https://stackoverflow.com/questions/4032380/ycbcr-to-rgb-from-matrix-table
8. Huang P-H, Su J-Y, Lu Z-M, Pan J-S (2006) A fire-alarming method based on video processing. In: International conference intelligent information hiding and multimedia signal processing. IIH-MSP 2006, pp 359–364
9. Yadav G, Gupta V, Gaur V, Bhattacharya M (2012) Optimized flame detection using image processing based techniques. Indian J Comput Sci Eng 3(2):202–211
10. Liu C-B, Ahuja N (2004) Vision based fire detection. In: CVPR, vol 4, pp 134–137
11. Chen T-H, Wu P-H, Chiou Y-C (2004) An early fire-detection method based on image processing. In: Proceedings of the international conference on image process (ICIP), October 2004, pp 1707–1710
12. Meng Y, Gong S, Liu C (2010) A fast computer vision system for defect detection of rubber keypad. In: International conference on computer application and system modeling (ICCASM), vol 2, pp V2-155, V2-160, 22–24

Secure Cloud Encryption Using File Hierarchy Attribute

P. Prashanthi, M. D. Gulzar, and S. Vikram Sindhu

Abstract Secure Data Sharing enables account-to-account sharing of data through Snowflake database tables, secure views, and secure UDFs. With Secure Data Sharing, ***no*** actual data is copied or transferred between accounts. All sharing is accomplished through Snowflake's unique services layer and metadata store. This is an important concept because it means that shared data does not take up any storage in a consumer account and, therefore, does not contribute to the consumer's monthly data storage charges. The ***only*** charges to consumers are for the compute resources (i.e. virtual warehouses) used to query the shared data. **Attribute-based encryption** is a type of public-key encryption in which the secret key of a user and the cipher text are dependent upon attributes (e.g. the country in which he lives, or the kind of subscription he has). In such a system, the decryption of a cipher text is possible only if the set of attributes of the user key matches the attributes of the cipher text. There are mainly two types of attribute-based encryption schemes: Key-policy attribute-based encryption (KP-ABE) and cipher text-policy attribute-based encryption (CP-ABE). In KPABE, users' secret keys are generated based on an access tree that defines the privileges scope of the concerned user, and data are encrypted over a set of attributes. However, CP-ABE uses access trees to encrypt data and users' secret keys are generated over a set of attributes. Secure data sharing is a challenging problem currently being faced by the cloud computing

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_31

sector. A novel method of Cipher text policy attribute based encryption (CP-ABE) is presented by paper to overcome the issues. The data from various sources like Medical and military sources, stored in the cloud, tend to have a multilevel hierarchy. But this hierarchy was not explored in CP-ABE.

Keywords Encryption · Two factor authentication · Hierarchical Attribute Set Based Encryption

1 Introduction

Cloud computing is a composite of physical and virtual resources used as third-party services on Network (i.e. Internet).it is mainly represented in cloud-shaped symbol in a network as shown in the figure. Cloud computing is used to access complex applications and networks. Which enables user data and computations? (Fig. 1).

It mainly used do huge computations in military and research facilities, mainly used in consumer-related applications in financial organization and to provide data storage for 3D computer games. Using Virtualization technique cloud computing enable processing chores across them which are linked together in IT infrastructure systems to increase the efficiency.

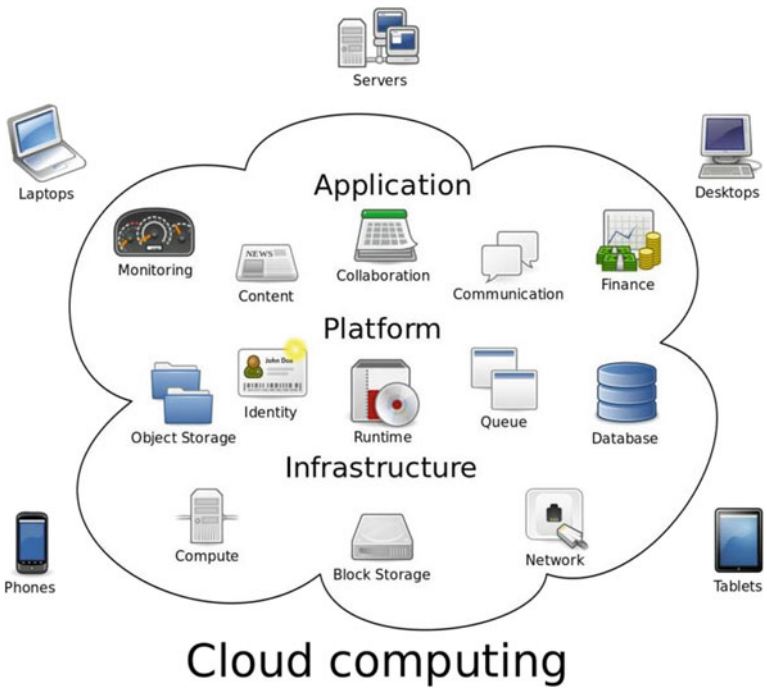

Fig. 1 Structure of cloud computing

Characteristics and Services Models: According to the National Institute of Standards and Terminology (NIST) the mains features of cloud computing are given below:

1. **On-demand self-service**: The entity can use computing capabilities and network storage without human interaction.
2. **Broad network access:** A wide range of devices over the network that enables to use heterogeneous platforms
3. **Resource pooling:** As per consumer demand, the multi-tenant model has Hardware and Virtual resources like storage, bandwidth are assigned based on the geographical location.
4. **Rapid elasticity**: High scalability of hardware and virtual arrangements can brought to consumer very quickly in any quantity at any time. Scale-out and Scale in which mainly depend on proper executing requests from multiple services.
5. **Measured service:** It control and uses storage, bandwidth and user accounts to increase their capacity at some level.

2 Literature Survey

Proxy Re-Encryption (PRE) is an algorithm for encrypting the plain text to cipher text and decrypted if a DFA associated with the string. This encryption is changed to another cipher text String using semi-trusted proxy. This string can increase the flexibility to transfer their decryption rights to others which proved in the standard model.

Two-Factor Authentication (2FA) access control system is an user restriction based Mechanism for web-based computinservices. If users cannot access the system mechanism to increase the security of the system. Then the user shares the same computer for web-based cloud services. By following some restricted access to preserving user privacy. It only follows the similar attributes without knowing exact identity of the user [1].

In other methods, The privacy of user data is unsecure due to compromised storage data. but with this new technique, Encrypted data can be kept safe even at entrusted storage server. Previously, user used restricted access attributes to preserve his data privacy and uses restriction based keys. But in new technique (Role Based Access Control (RBAC)) attributes are used for user credentials and encrypted data determines policy for decrypted data [2].

ABE is encrypted based technology where receiver's valuable data is secured by using secret keys, it ensures that only receiver can access the decrypting the cipher text by using restriction attributes. To maintain privacy the user must renew the keys whenever he log in and log out from the group which was very expensive. First ABE scheme which focuses on Dynamic Membership Management for

attributes which enable more flexibility to the user to join, leave and update their attribute. But not essential for users who are not renewing their attributes.

Most of the schemes fail to implement due to insecurity to their privacy. because customer need security for their valuable data. In order to increase flexibility and scalability researches create Hierarchical Attribute Set Based Encryption (HASBE) which is a extending version of ASBE. This scheme provides scalability and inherits flexibility. HASBE assist multiple assignments and also deal with user revocation more efficiently [3].

3 System Analysis

ABE (CP-ABE) is a variant of ABE. Which was a prototype of Fuzzy Identity-Based Encryption (IBE) proposed by Sahai and Waters in 2005. The first notion of hierarchical encryption CP-ABE scheme has been proposed by Gentry and Silverberg [4]. In order to achieve flexibility and fine-grained access control in cloud computing, a new efficient scheme based layered model are there namely CP-ABE scheme (or FH-CP-ABE) for the Hierarchical structure of access policy. The Characteristic of these schemes are

- Firstly, to eradicate the problems in multiple hierarchical files sharing.
- Secondly, According to FH-CP-ABE successfully resists plain text attacks (CPA)
- Thirdly, experimentally proved that in FH-CP-ABE scheme, encrypting and decrypting the data it uses low storage cost and less time in computation [5].

CP-ABE scheme is more flexible to a user in general applications like decrypting multiple files to reduce time and cost [8].

4 Modules Description

Data Owner Module: Data Owner Module which is a unique way to secure the privacy of the user. In this module, The owner can sign up and sign out by using the approval key from admin.

Owner can upload and share any large quantity of data in the cloud system. This whole process can lead by the unit for executing encrypting operations.

User and Physician Module: User module is used to search medical records based on medical id given by user and the user will receive the encrypted document from admin which decrypted by using admin key, under this scheme first, the unit downloads the required ciphertext and executes decrypt operation.

Cloud Service Provider (CSP): The system performs given task and after finding sensitive contents it gets correct results, In this module admin will log in and he/she check the pending request and accept the request, then they will create main key for encrypting and the private key for decrypting [6].

Authority Module: It is a most reliable unit in which the Researcher will log into the researcher's page and search the medical records of specific diseases they need by using the decrypted key from the admin, Researchers can only process the data without extracting the personal information [7].

File Hierarchy System: The Classes in the Java IO packages is simplified structure to understand that it just needs the correct way of learning [9] (Fig. 2).

5 System Design

DFD Diagram

DFD is a bubble chart which represents input data to the system in a graphical form which processing on this data to generate output data in the model. DFD is a modeling tool used to model the system components. These components models are system process which used to interact and information flow in the system. DFD is a Graphical technique which shows clear information of system movement and series of transformations which applied from input to output data. DFD used to represent abstraction, information flow as well as functional details of the system (Fig. 3).

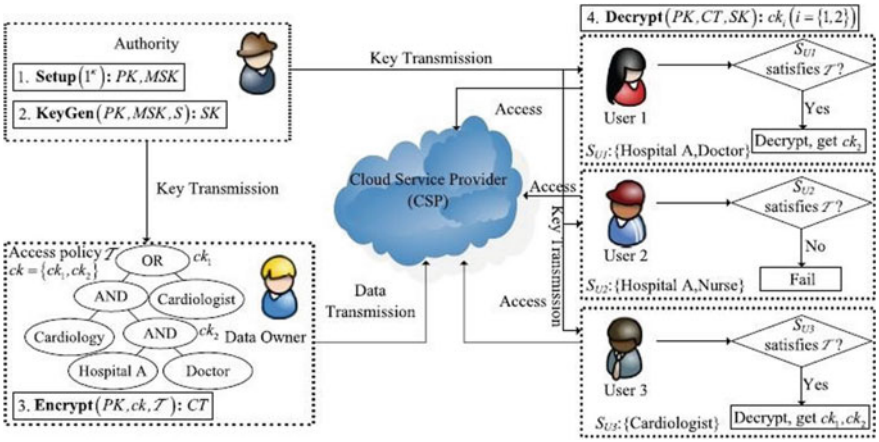

Fig. 2 System architecture

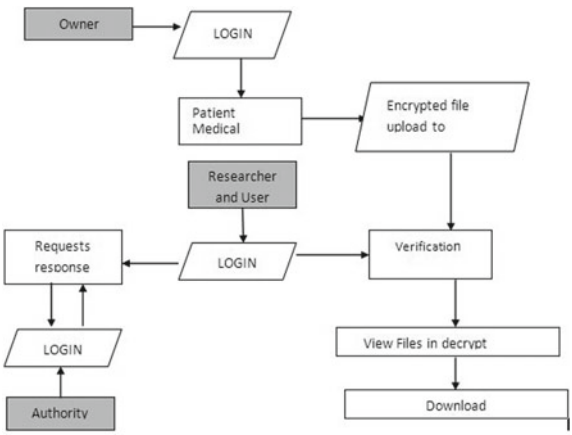

Fig. 3 Dataflow diagram

UML diagrams:

UML is created and directed by Object Oriented Management Group. It has two models:

1. Meta-model
2. Notation

Mainly Focus on Vision, manufacture and report-making the production of a system and engineering practices of complex systems. It mainly uses graphical notations for software project designs.

- Use case diagram
- Class diagram
- Sequence Diagram (Fig. 4)

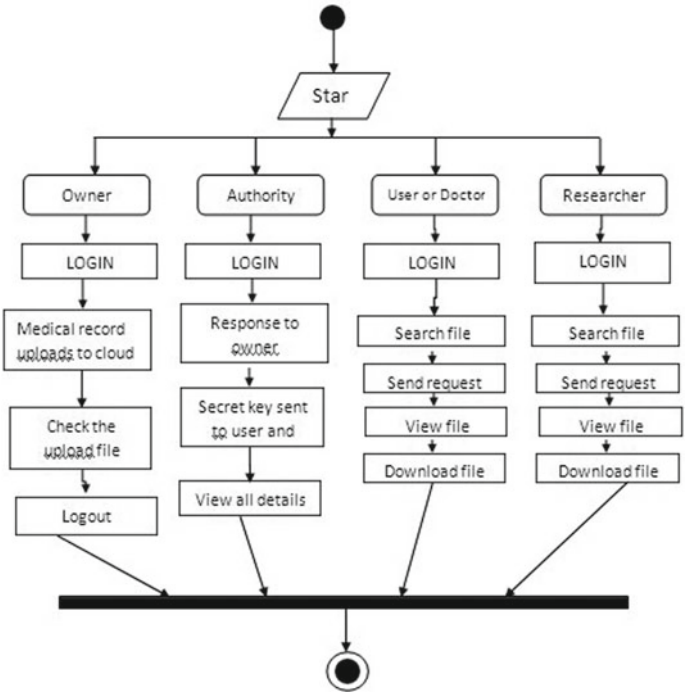

Fig. 4 Sequence diagram

6 Results

(See Figs. 5, 6, 7, 8, 9 and 10).

Fig. 5 Home page

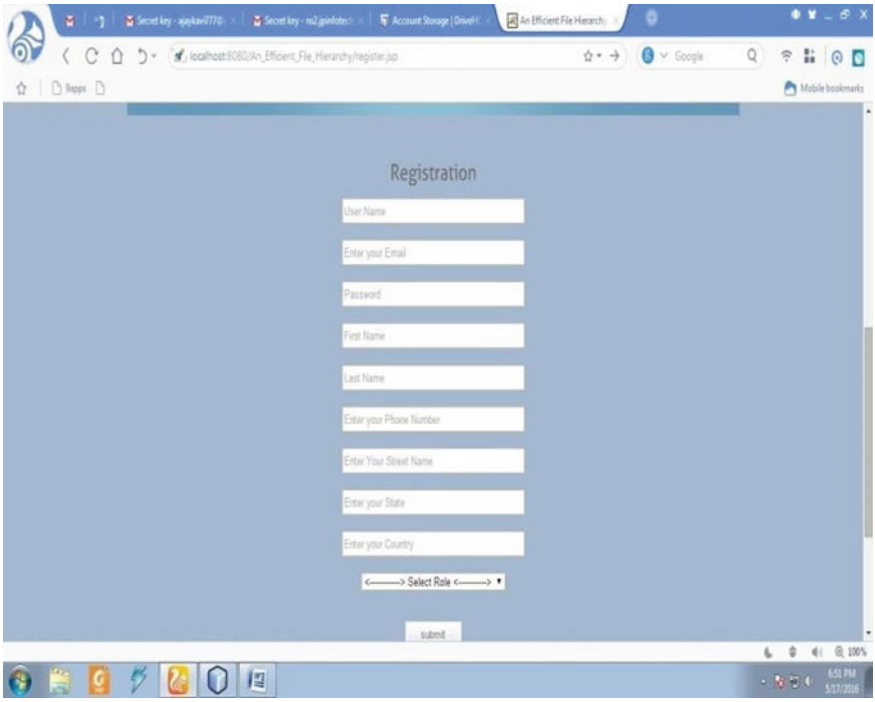

Fig. 6 Registration page

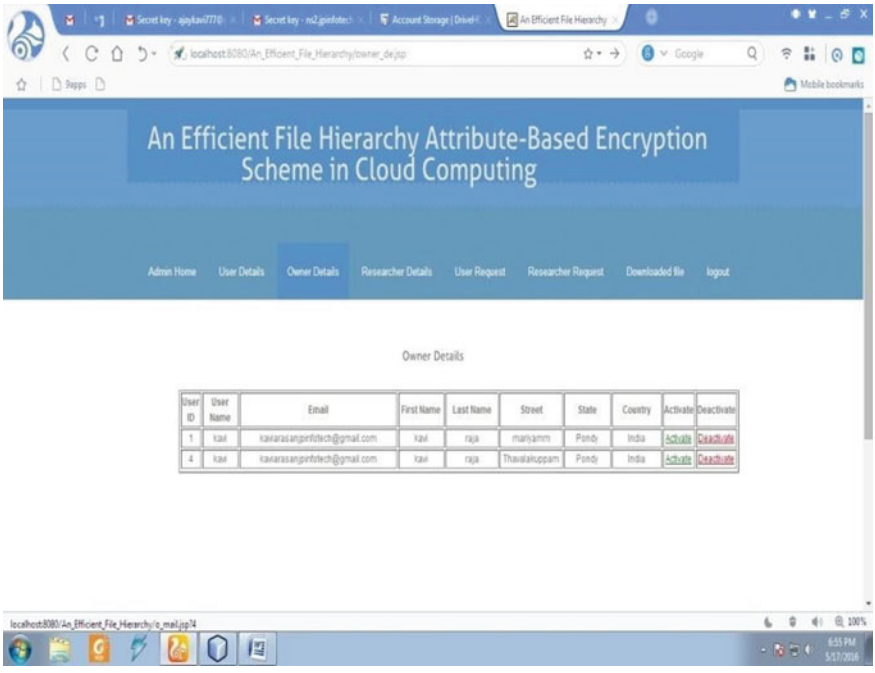

Fig. 7 Owner details

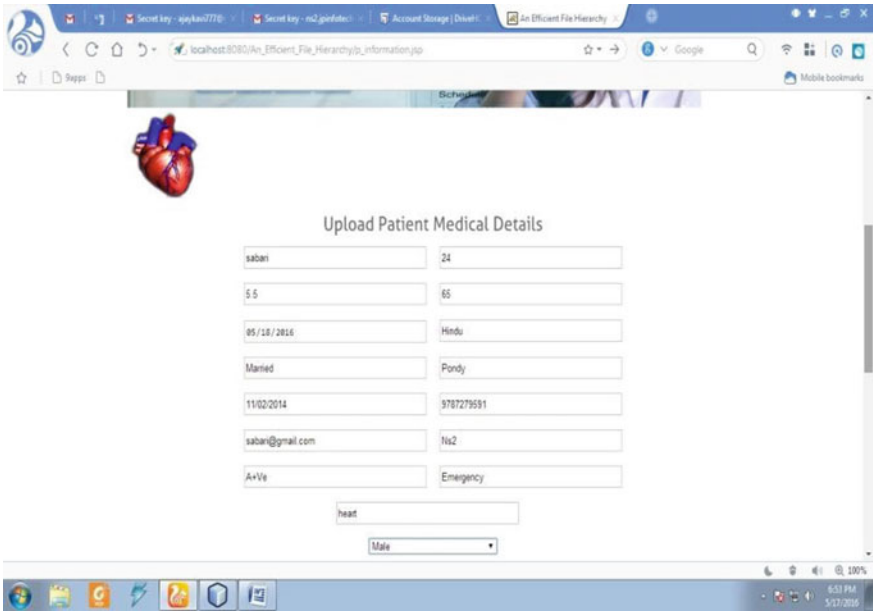

Fig. 8 Patient details

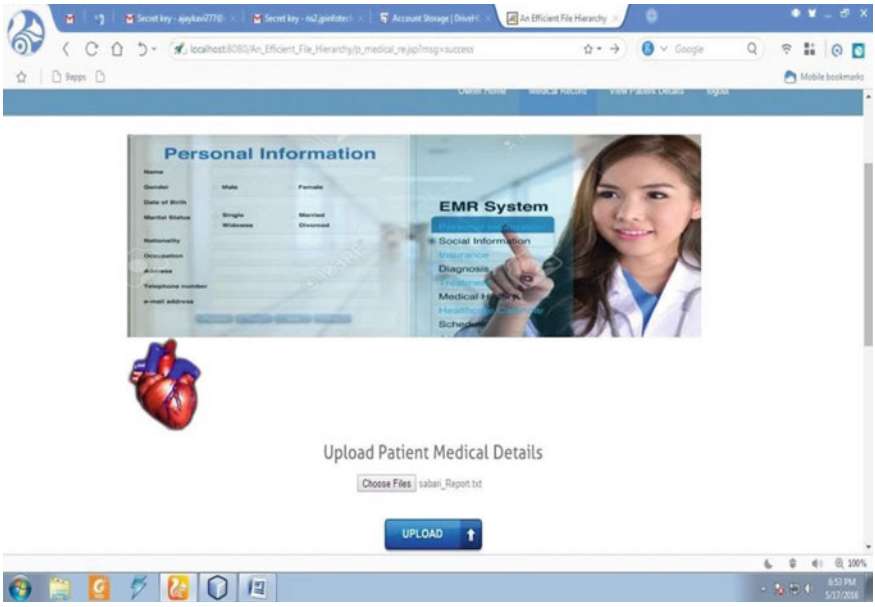

Fig. 9 Patient file upload

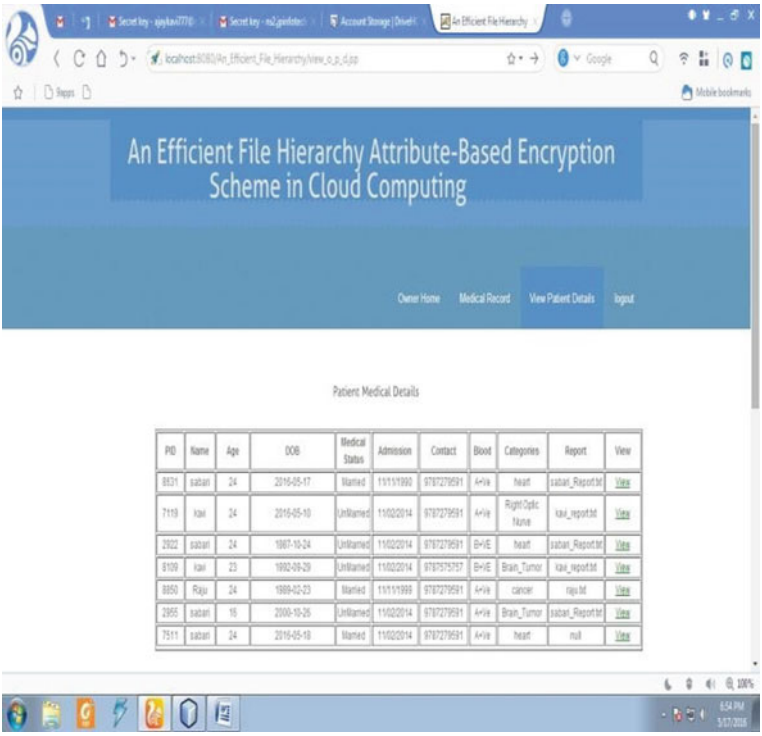

Fig. 10 Patient file encrypted

7 Conclusion

CP-ABE which shared the files in cloud computing very efficiently. This reduces the cost. Under DBDH assumption user can save time by decrypting multiple files by computing a secret key at once. In the future, it would be interesting to consider attribute-based encryption systems with different types of impressibility. While, Key-Policy ABE and Cipher text-Policy ABE capture two interesting and complimentary types of systems there certainly exist other types of systems. The primary challenge in this line of work is to find a new systems with elegant forms of expression that produce more than an arbitrary combination of techniques.

References

1. Chu C-K, Zhu W-T, Han J, Liu J-K, Xu J, Zhou J (2013) Security concerns in popular cloud storage services. IEEE Pervasive Comput 12(4):50–57
2. Jiang T, Chen X, Li J, Wong DS, Ma J, Liu J (May 2014) TIMER: secure and reliable cloud storage against data re-outsourcing. In: Proceedings of the 10th international conference on information security practice and experience, vol 8434, pp 346–358

3. Liang K, Liu JK, Wong DS, Susilo W (September 2014) An efficient cloudbased revocable identity- based proxy reencryption scheme for public clouds data sharing. In: Proceedings of the 19th European Symposium on Research in Computer Security, vol 8712, pp 257–272
4. Yuen TH, Zhang Y, Yiu SM, Liu JK (September 2014) Identity-based encryption with post-challenge auxiliary inputs for secure cloud applications and sensor networks. In: Proceedings of the 19th European Symposium on Research in Computer Security, vol 8712, pp 130–147
5. Liang K et al (2014) A DFA-based functional proxy re-encryption scheme for secure public cloud data sharing. IEEE Trans Inf Forens Secur 9(10):1667–1680
6. Yuen TH, Liu JK, Au MH, Huang X, Susilo W, Zhou J (2015) *k*-times attribute-based anonymous access control for cloud computing. IEEE Trans Comput 64(9):2595–2608
7. Liu JK, Au MH, Huang X, Lu R, Li J (2016) Fine-grained two factor access control for web-based cloud computing services. IEEE Trans Inf Forens Secur 11(3):484–497
8. Sahai A, Waters B (May 2005) Fuzzy identity-based encryption. In: Advances in Cryptology, Berlin, Germany: Springer, pp 457–473
9. Goyal V, Pandey O, Sahai A, Waters B (October 2006) Attribute-based encryption for fine-grained access control of encrypted data. In: Proceedings of the 13th ACM Conference Computing Communication Security, pp 89–98

Detection of Suicidal Tendency in Users by Analysing the Twitter Posts

Mahesh Kumar Challa, Bairy Mahender, and N. Prashanthi

Abstract Suicidal conceptual detection in online social networks is a prominent research area with most challenges. The main challenge of suicide prevention is understanding and detecting the major threat level and warning signs that may trigger the event. In this paper, we present a new way that uses media platforms like Twitter to measure suicide signs for a single person and to identify posts or comments containing suicidal intentions. The main aim is to identify such intentions in user posts to detect that we use a general language-based technique like martingale framework with calculating user online behavior. Practically proved that our text-scoring approach identifies warning signs in the text compared to traditional machine learning. Moreover, the applications of the martingale framework focus on any change in online behavior and eventually detect behavioral changes.

Keywords Trigger · Martingale and suicidal

1 Introduction

As per the World Health Organization (WHO) every year 800,000 people are dying by committing suicide. WHO aims to reduce the suicidal tendency by 2020. To reduce this public should have awareness, for that American Foundation for Suicide Prevention (AFSP) has identified some events that caused this tendency. They are (1) Health issue (2) Stressful life (3) family history of this suicidal tendency. It differs by person to person from time to time. The main warning signs of this

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_32

activity are (1) Talking less (2) Strange behavior like too much sleeping (3) Depress or Rage mood [1–4].

If one can identify such activity prevention is the first step to be taken. Individual more interested to make himself away from resources. Online media is such resources like blogging to express their deepest thoughts indirectly. It results more victims are making Twitter, Facebook and other social networking as their platform to express their final views, but using this prevention of suicidal ideation is possible. Social research community focused on this topic from the past years [5]. By giving awareness speech to this individuals awareness can be created among themselves. Some awareness messages are also published depend on the research analysis over time to time [6–8].

2 System Analysis

Suicidal ideation is commonly referred to as emotional suicidal related emotions which individual posts in social networking sites, these existing system implemented to understand such behavior. This system analyzes by collecting identified user tweets and posts in social networking sites and verifying friends and followers list and make graphical representation network [9, 10]. The existing system proved that common connection between suicidal ideation posts and tweets. It similar and seems like virtually connected group, eventually retweet graphs identifies bridge nodes and connected hub nodes using suicidally related ideas, so taking fall down emotional posts and mental illness effect. This system intensifies by evaluating friendship and retweeting posts mixed graphical representation. It is not related to NLP approach and no method for detecting emotional changes

In this system, martingale framework is used to identify the suicidal ideation posts and tweets in the real world mostly used by data streaming. The frame work contains input which is coded behavioral features which automatically predict individual suicidal emotional changes by comparing with their shared posts. Early detection of suicidal ideation signs and system is more effective in identifying suicidal related com (Figs. 1 and 2).

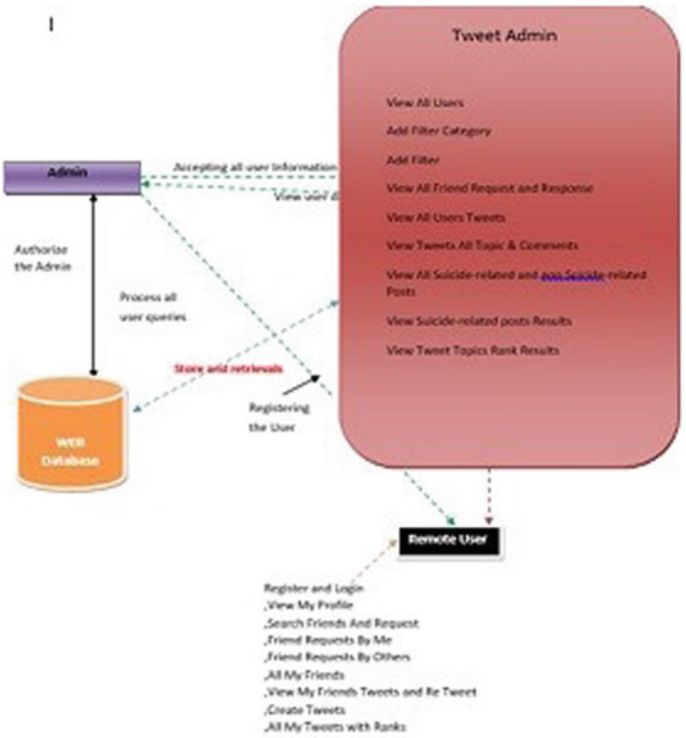

Fig. 1 Proposed system architecture

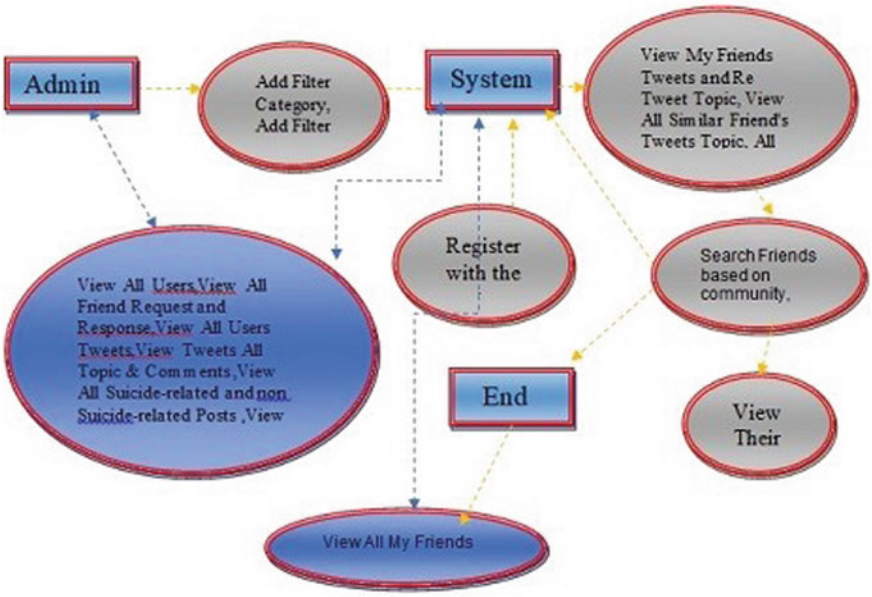

Fig. 2 Data flow diagram

3 Implementation

3.1 Tweet Admin

In this section, Admin can login using authorized credentials and access user personal details like lookup all users details, viewing all friend requests, viewing their tweet, comments, can view All suicidal ideation and non-suicidal related posts and their results based on ranking.

3.2 Friend Request Response

In this unit, the admin can lookup overall friend requests and their reply which are displayed with their tags such as Id, name, and photo with time date. If the user accepts the request then it shows accepted or else it shows waiting.

3.3 User

This model used for multiple users, After completion of registration. User can log in using his credentials and operate Profile details, send a friend request to anyone, creating tweets and arranging them with ranking can be accessed by the user.

3.4 Searching Users to Make Friends

In this model, the user searches for other user in similar Network and sends friend requests. If they have permission the user can search for users in other Networks to make friends only.

4 Results

See Fig. 3.

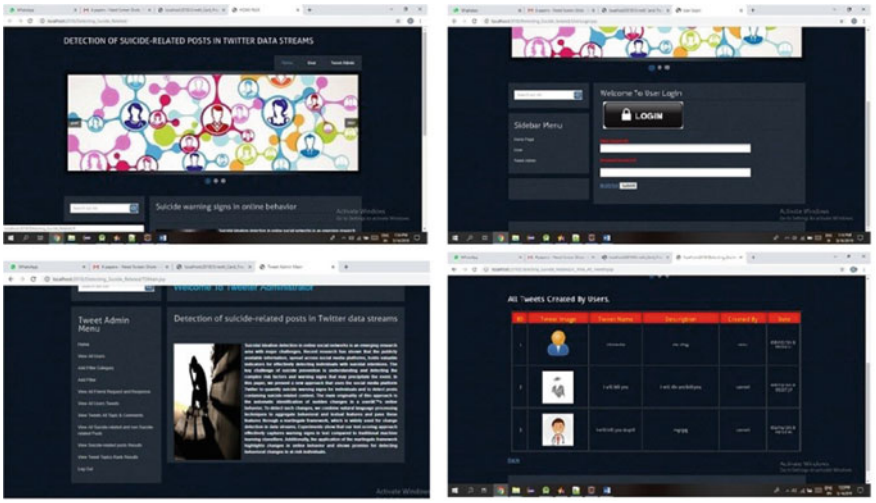

Fig. 3 Home page, login page, suicide post detection, tweets categorized

5 Conclusion

Finally, conclude that using the novel based approach on twitter we can monitor the mentally ill user. To elaborate on the current research. We work to take necessary measures through the online context. We mainly focused on stress related and suicidal ideations relate content to prevent this we have two ways to firstly an NLP-based approach and More Traditional Machine Learning.

Practically proved that our NLP text separates stress related text and make input to martingale framework. And validate that case, and changes the speech parameter in a positive way but that requires more standard.

Further research analysis, martingale fields on change detection effectiveness in image processing and other social networking. Another important concept is emotional classes like anger, agony, Fear, etc. considering every possible approach and believe that we can prevent using textual concept.

References

1. Preventing suicide: A global imperative (2014) World Health Organization, Geneva, Switzerland. http://www.who.int/mentalhealth/suicideprevention/worldreport2014/en
2. American Foundation for Suicide Prevention (AFSP). https://afsp.org
3. Corrigan P (2004) How stigma interferes with mental health care. Am Psychol 59(7):614–525
4. Rickwood D, Deane FP, Wilson CJ et al (2005) Young people's help seeking for mental health problems. Aust e-J Adv Mental Health 4(3):218–251

5. De Choudhury M, Gamon M, Counts S, et al (2013) Predicting depression via socialmedia. In: Proceedings of the 7th international AAAI conference on weblogs social media, Boston, MA, USA, pp 128–137
6. Moreno M, Jelenchick L, Egan K et al (2011) Feeling bad on Facebook: depression disclosures by college students on a social networking site. Depression Anxiety 28(6):447–455
7. Gunn JF, Lester D (2012) Twitter postings and suicide: analysis of the postings of a fatal suicide in the 24 hours prior to death. Suicidologi 17(3):28–30
8. Kailasam V, Samuels E (2015) Can social media help mental health practitioners prevent suicides? Curr Psychiatry 14(2):37–51
9. De Choudhury M, Kiciman E, Dredze M, et al (2016) Discovering shifts to suicidalideation from mental health content in social media. In: Proceedings of 2016 CHI conference human factors computing system, San Jose, CA, USA, pp. 2098–2110
10. De Choudhury M, Counts S, Horvitz E, (2013) Predicting postpartum changes in emotion and behavior via social media. In: Proceedings of SIGCHI conference human factors computing system, New York, NY, USA, pp. 3267–3276

A Secure Pre-existing Routing Technique for Enhanced Protection in MANETs

Ravi Kumar Chandu, Sathiya Suntharam, and Ch. Sirisha

Abstract The mobility & elasticity of MANETs (Mobile Ad hoc Networks) have been made them accepted in different types of usages. The protocols of security to look after these networks were expanded for protection of the routing and particulars of application. The given practices protect only either route or data transfer. The security practices of routing as well as communication have to be executed to grant the entire safety. These security procedures were developed initially for wired lines and wireless networks such as the Wi-Fi and could burden a huge load on the restricted MANET resources. A novel secure system (SUPERMAN) has been initiated to address these challenges. The structure has been planned for allowing the network of existence and routing practices to execute the purposes, at the same time authentication of node providing, controlling the access, & the mechanisms of communication safety measures. This document is going to present a novel safety outline for MANETs, SUPERMAN. The results of simulation that compare SUPERMAN along with IPsec, SAODV & SOLSR have been presented for demonstrating the suitability of structures initiated for safety wireless communication.

1 Introduction

The mobile computing is the regulation to create a platform of information management, which is liberated from temporal and spatial restraints. The liberty from these restraints would allow the access to users and process the needed data that can be taken from wherever it resides. The user's position, mobile or static, would never

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_33

influence mobile platform data management capacity. A user could carry on accessing and operating needed info even when traveling. Hence, the regulation would create an misapprehension that wanted information and adequate calculation control are accessible then and there, but in reality they may are located at a distance more than they seem. If not **Mobile computing** would be a common terminology utilized for referring to a diversity of devices which would be allowing the people for data accessing & the information from wherever users exist.

Various types of devices used for the mobile computing:

1. Personal Digital Assistant/Enterprise Digital Assistant
2. Smartphones
3. Tablet Computers
4. Netbooks
5. Ultra-mobile PCs
6. Wearable Computers

Benefits of Mobile Computing:

- Improve the trade productivity through the interaction of streamlining and take the immediate access advantage
- Diminish the costs of trade operations by rising the visibility of the supply chain, logistics optimizing & accelerating processes
- Build the relationships with the customer through creating more chances to get connected, provide data

into their palms whenever required

- Sum up the benefits by developing a difference of brand & the user experience expanding □ Gaining effective work force and competence by giving on-the-go usage rights.
- Develop the business cycle processes by rewiring the work flow for utilization of the mobile devices that would be interfacing along with the apps that are famous and used everyday.

Advantages:

Mobile computing has transformed the entire human being's life. Given are the benefits of it:

1. **Location Flexibility**
   It enables the user for doing the job irrespective of location as long as there is an established data transfer. User don't have to work in a stable position to accomplish the job. The mobility would be ensuring that they have ability to carry out multiple tasks.
2. **Saves Time**
   The wasted or utilized time by travelling from diverse geographical points has been decreased. Now, anyone could get the accessibility to all the data over a protected session of communication & works like the user is on a computer.

3. **Enhanced Productivity**
   The productiveness of an employee could simply increases drastically and works proficiently and successfully from the location he sees as best fit, comfortable and suitable. The users have the ability to choose the workplaces.
4. **Ease of Research**
   Easier research has become possible, since users would search for details by going to the fields and give them back to methods. This made it quicker for the officers on fields and examiners for gathering and feeding the information from anywhere without making any pointless trips.

2 Literature Survey

This paper would be presenting an extension of novel with CBBA (Consensus-Based Bundle Algorithm), it got named as CFCBBA (Cluster-Formed Consensus-Based Bundle Algorithm) [1]. CF-CBBA has been created for lessening the amount of communication needed to finish the process of allocating a distributed task, by dividing and processing the issue in parallel clusters. CF-CBBA seen in comparison with the base CBBA, to need minute data transfer while task allocation. The 3 important phases of task allocation are, (a) the time that is taken for assignment of tasks, (b) the amount of the communication that is necessary to gratify needs of distributed task allotment algorithms, and (c) the effectiveness through which a task collection (a mission) is completed by a group of robots.

In the popular ad hoc routing protocol, till date, research is done utilizing simulators. The reason to utilize the simulation is the complexity in creation of a real accomplishment. The code in a simulator has been surrounded in a logical component, that is defined and clearly accessible [2]. Implementation would need to use a method with a lot of factors, including those having tiny or no documentation at all. The one who develops the implementation should keep in mind both the protocol of routing and the system modules and their difficult transactions. Additionally, as ad hoc protocols of routing are radically special against the protocols of normal routing, a different group of characteristics should get initiated for helping the routing protocol. We illustrate the event triggers needed in this paper for AODV operation, the varieties of design implementations and its results for our AODV (Ad hoc On- demand Distance Vector) implementation of AODV-UCSB. It helps the examiners for extending their custom designed protocols of on-demand ad hoc routing and support persons using in shaping designs of implementation that suits their requirements.

This paper would be evaluating the different protocols in ad hoc routing and their performance in the perspective of a group of self driven UAVs (unmanned aerial vehicles) [4]. It was recommended that in a network of wireless topology where each node is having an average of 5.1774 log n neighbors, in which n represents the total quantity of nodes in the network and got an increased possibility of having less divisions. At the time of connectivity of ensured network is continued, the spatial multiplexing of the channel of wireless has been exploited by reducing the range of transmission and multi-hop routing implementation amidst the nodes. The recommended process has been computed utilizing the simulator named OPNET for the GPSR (Greedy Perimeter Stateless Routing), OLSR (Optimized Link State Routing), and AODV (Ad hoc On- demand Distance Vector) routing practices just as like a group of UAVs.

UAVs are the promising expertise that offers new-fangled prospects for inventive methodologies and competent total management system in the security of public regions, surveying and cellular networks [5]. One important feature to get the sensible optimizations is a progressed design of the mesh network for the rapid and dependable information sharing amidst UAVs. We examine the presentation of 4 mesh routing practice implementations (open80211s, OLSR, BATMAN, BATMAN Advanced) that are available in the swarming applications framework in this paper. These practices have been calculated through good put by both static and mobile situations utilizing the similar platform of hardware in embedded systems that have been put in UAVs in present examine works. Here, the outputs are showing that the layer-2 practices got improved for applications in mobile when compared with layer.

3 System Analysis

3.1 Existing System

In current system, Reactive practices like AODV, the plan would route when the sent messages, polling the consecutive nodes for discovering a direct path to the final node. The other method i.e. OLSR (Optimized Link State Routing) would take a proactive approach; it fills the network every now and then for producing routing table entries that exist till once a new version comes. These two approaches are unchanged even if the system is moving and are put into practice in UAV MANETS. These two features would make the given practices ideal in using UAVs.

4 Disadvantages in Existing System

- The crucial forms of AODV and OLSR mechanisms of less concerned with security.
- Vulnerable to several security breaches.
- Unable to differentiate perfect nodes from vulnerable nodes.

4.1 Proposed System

Here, we are proposing a novel security practice, SUPERMAN (Security Using Pre-Existing Routing for Mobile Ad hoc Networks). This is designed for addressing of node authentication, having grip over the access of he topology of connected systems, and a safe communication for MANETs utilizing current day routing protocols. SUPERMAN will be combining the routing and security of communication at the layer of network. This would be contrasting along with an existing approaches, which will be providing only routing or security of communication that requires multiple practices to guard the network. SUPERMAN is a structure which would be operating in the networking layer (layer 3) of the OSI model. This is created for giving an entire framework for MANETs by not giving any necessity adjustment in the procedure of routing which calculates packets and offer secrecy.

SUPERMAN provides authentication of the node also.

Advantages of Proposed System:

- Enhance confidentiality of the network
- Enlarge integration of the data
- Checks integrity & authenticity at every hope

1 **System Architecture**

1. This is also named as a bubble chart. Since given one has a plain representation in graph format that is utilized for representing any method using input information that is fed to the system, several calculations and acrions that are performed on this information, and the resultant is produced with our approach (Fig. 1).
2. The DFD (data flow diagram) can be said as one among the important tools in modeling te system components. The mechanisms are the results of system, the information utilized in the given time of execution, the method gets interacted with an outside body and the data flows within the topolgy.

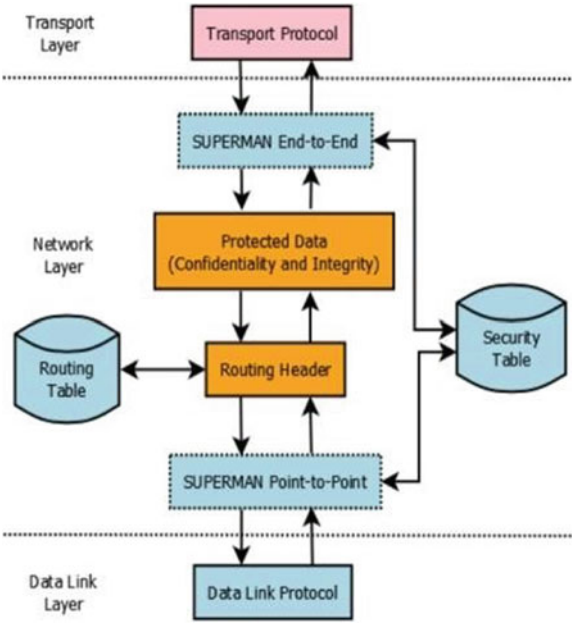


Fig. 1 SUPERMAN security process

3. DFD would be showing the data movement by the system and its customization through a series of transformation. DFD uses graphical approach that portrays the flow of information & alterations that are being used as the data would be moving from input to output.
4. A DFD is utilized for standing for a network at any stage. DFD can be divided furthermore.

:

Modules Description:

1. **System Construction**
   We would be developing the System Construction module along with Source, Router and Destination entities in the first module. The topology is the nodes' arrangement in the region of simulation. The routers have been linked in topology of MANET in which every router is linked to each other by way of other routers (Path). We are utilizing multi-nodes in our simulation as the node of router and the nodes as the node of client-server. We are having multi-nodes in our network completely.

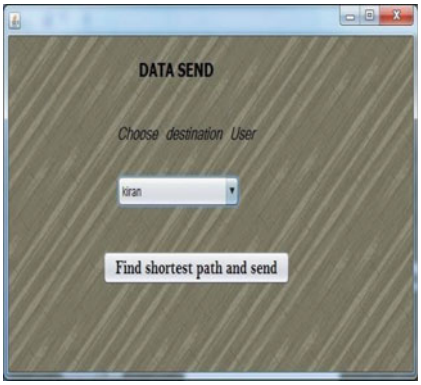
2. **Key Management**
   We would be developing the Key management in this unit. Packet Type will denote function of packets. For detecting the packets that are replayed, timestamping can be very much useful and provides non-repetition of packets.

SUPERMAN creates keys dynamically to present secure data transfer. The Diffie-Hellman key-exchange algorithm is used for providing symmetric SK keys dynamically. These could be produced simply through unsystematic order of series of numbers or through a service of generating a safe key.

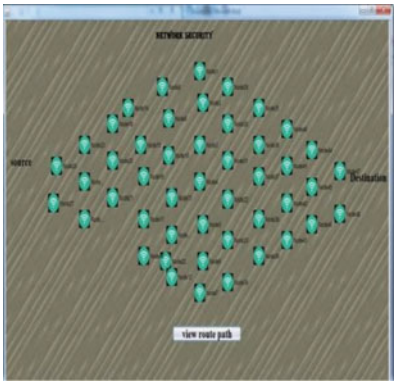
3. **Secure Node-to-Node Keys**
   SKe keys have been utilized for securing entire data transfer in the whole network along with a single *SK* key produced in every node including the same arrangement for other nodes too. *SKp*keys are generated just like *SKe*keys and are used for security purposes in every point. One important point to note is *SKe* & *SKp*keys are dissimilar since topology of nodes requires guarding the content of a packet as well as the taken route. A KDF could be utilized to create these 2 keys in conjunction along with the Diffie-Hellman algorithm outcome, that would be requiring a *DKSp/ DKSpriv* pair, for minimizing the security cost and lessen the reusage of the key and the key usage time. They are created if the nodes would receive DKSp's from others in a SUPERMAN.
4. **Storage**
   SUPERMAN would be storing the keys in every node's table of security. Security nodes' credentials that are used in communicating are stored in the security table. This table contains *n inputs*, in which *n means* the nodes' numbers that are in communication with it. Table interchanges the data with 2 other nodes, X and Y. Then the key of symmetric broadcast (*SKb*) has 2 different forms namely *SKbe* & *SKbp*. They are put inside a table of local security as a part of broadcast address.
5. **Communication Security**
   Once the node united the arrangement, it might engage with safe data transfer with other nodes. Safe data transfer in SUPERMAN would be providing 2 securities; end-to-end & point-to-point. Former one would provide security amidst sender and receiver nodes through utilizing *SKe* shared between them. Privacy and reliability have been provided by utilizing a method of suitable cryptography that is been employed to make an encrypted payload (EP). When it is protected, information is broadcasted in several steps on nodes, gets substantiated in every hop

I. Results

2. Registration with IP address



3.Data sent



4.Network Security (Route path: source to destination)

5 Conclusion

SUPERMAN is a framework of the novel safety that would protect MANETs network and its communication. The main aim is for securing access for a VCN (Virtually Closed Network) that would be allowing an expedient, reliable communication along with the secrecy, reliability and accuracy services. SUPERMAN would address all the 8 dimensions of security given in X.805. Hence, SUPERMAN executes a filled group of safety services to self-rule MANETs. This would fulfill more important features that have been outlined in X.805 than IPsec, because of the focus on network rstger than on the point-to-point orientation.

It has been used for providing protected environment between starting and ending points despite route, and is recommended through few examiners as a feasible option in the safety for MANET. It never expands the safety to the services of routing. And it doesn't give security of low-cost, which requires a lengthy set-up and the process of teardown, typically done in multiple sessions. The simulator assumed and the outcomes are accounted and analyzed for determining the relative security cost for SUPERMAN, when compared against IPsec, SAODV and SOLSR wherever relevant.

SUPERMAN would be providing a VCN, where the foundation security block has been provided through the nodes that are authenticating along with the network. This would enable additional advantages, like the association of safekeeping referral and merging of the network. It will provide a light-weight encapsulation packet relatively and inconsistent length tag. The security overheads of SUPERMAN have been exhibited to be lower than those of IPsec in both CF-CBBA and CBBA. The algorithms of DTA would stand for making a MANET autonomous, by allowing to solve the problems automatically to be occurred in network.

A secured communication is needed to make possible such important and critically contemplated feature while giving safe network wholly. While offering the safety transversely all 8 security sizes through offering the security of lower cost than existing substitutes, SUPERMAN would be proving that it is a feasible and approach of competitive for guarding the communication that is needed by self-governing MANETs.

References

1. Kiran PS (2009) Protocol architecture for mobile ad hoc networks. In: 2009 IEEE international advance computing conference (IACC 2009)
2. Chandra A (2005) Ontology for manet security threats. PROC. NCON, Krishnankoil, Tamil Nadu, pp 171–176
3. Rai AK, Tewari RR, Upadhyay SK (2010) Different types of attacks on integrated manet-internet communication. Int J Comput Sci Secur 4(3):265–274

4. Smith D, Wetherall J, Woodhead S, Adekunle A (2014) A cluster-based approach to consensus based distributed task allocation. In: 2014 22nd euromicro international conference on parallel, distributed and network-based processing (PDP). IEEE, pp 428–431
5. Chakeres ID, Belding-Royer EM (2004) Aodv routing protocol implementation design. In: Proceedings of the 24th International conference on distributed computing systems workshops. IEEE, pp. 698–703
6. Clausen T, Jacquet P, Adjih C, Laouiti A, Minet P, Muhlethaler P, Qayyum A, Viennot L, et al (2003) Optimized link state routing protocol (OLSR)
7. Hyland M, Mullins BE, Baldwin RO, Temple MA (2007) Simulation-based performance evaluation of mobile ad hoc routing protocols in a swarm of unmanned aerial vehicles. In: 21st international conference on advanced information networking and applications workshops, 2007, AINAW 2007, vol. 2. IEEE, pp 249–256
8. Pojda J, Wolff A, Sbeiti M, Wietfeld C (2011) Performance analysis of mesh routing protocols for UAV swarming applications. In: 2011 8th international symposium on wireless communication systems (ISWCS). IEEE, pp 317–321

Attendance Management Automated System Based on Face Recognition Algorithms

E. Suresh Babu, A. Santhosh Kumar, and A. Anilkumar Reddy

Abstract The management of automated attendance method in the paper. This structure is completely depending on face discovery other algorithms of recognition, robotically would detect a candidate whenever he would enter the class and attendance scores by identifying the person. The system algorithms architecture utilized in every phase have been explained here. Dissimilar actual situations were believed to assess the act of several systems of face acknowledgment. It also recommends the practices to be utilized to handle the hazards like spoofing. This system would save the time and also would support to supervise the candidates when it is evaluated to the customary marking of attendance.

Keywords Face recognition · LBP and SVM

1 Introduction

There are the strategies to finish this is by coordinating picked qualities of the facial from the image a face envelope. An arrangement of face ID is a PC application which has limit of confirming or recognizing a person from an image which is advanced or a casing from a wellspring of the video. The Attendance framework that is completely mechanized is the improvement which has been gotten the situation in the computerization region that replaces customary movement of the attendance checking. They are typically founded on the bio-metric, electronic and dependent on the keen card. In this advanced mechanization time, different specialized promotion vancement revelations have acquired situation to the precision

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_34

upgrade, spare work for enhancing the lives. These strategies are extensively used in disparate affiliations. The traditional system of denoting the participation is the utilization of the time and would become troublesome when the strength is additional. This would help for staying away from produced participation.

An automated system of attendance which is built up by utilizing biometrics usually comprised of Database development, Image Acquisition, Pre-processing, Face detection, trait extraction, and categorization phases followed by Post-processing phase. In this paper, the consequent sections are survey of literature, in detail explanation of several phases in the suggested form, outcomes the winding up for improvement scope.

2 Three-Dimensional Recognition

As of late rising propensity, has proclaimed for accomplishing an upgraded exactness, is 3-dimensional face acknowledgment. Such practice utilizes 3D sensors for catching information with respect to the face's shape. Afterward, this information will be used for acknowledgment of unmistakable qualities on the 2 E. Suresh Babu, A. Santhosh Kumar, and A. Anilkumar Reddy face surface, similar to the eye attachments' shape, jaw nose. 3-d face notoriety has its own special points of interest. It may not get roused through changes in lighting installations which incorporates any further strategies. it can perceive a face from a review edges assortment that comprise of a perspective on profile [4, 8]. The spots of three-dimensional measurements from a face enormously finish the exactitude of face affirmation. 3-d watch is ventured forward by utilizing the improvement of confounded sensors that do a superior action of taking pictures three-D symbolism of face. The sensors may canvases by method of anticipating arranged light onto the face. about twelve or more noteworthy of those photograph sensors ought to get situated on the comparative chip of CMOS—each sensor would capture a various detail of the range. A business venture known as a get section to of vision built an answer of organization for 3-D face recognizable proof. Afterward, the undertaking become gotten with the guide of the get passage to of biometric boss Bioscrypt Inc. which has expanded an adaptation called as three-D quick skip.

3 Literature Survey

The writer B. ok. Mohamed C. Raghu, name as "Fingerprint attendance machine for lecture room desires," in India endorsed as identification of the face is an critical region in numerous applications, one this is management system of Attendance. Nowadays, marking the student's attendance has turn out to be a run of the mill process for instructors which includes calling the names, looking ahead to the scholar to respond and additionally this attendance renovation till the month for

producing the record of attendance. An RFID based totally machine has been constructed for producing a control of time-attendance method in this take a look at. The author iris acknowledgment confirmation is the regular personal reputation techniques in biometrics. Together with the fast enhancement of iris affirmation of its acknowledgment, a sever a applications have been recommended until the date which includes method of time attendance etc.

4 Proposed Model

The architecture method has been given in Fig. 1. A suggested system of attendance automated management is relied on the algorithm of face acknowledgment. It is comprehended that at whatever point an individual gets into the room his photograph would be taken by the camera at the room passage. At that point, face region will be taken and consider for additional systems. As not beyond what 2 individuals could go into the homeroom at once for the face location calculation which will have less works. Likewise at whatever point the character of an individual is recognized and afterward it is taken to the following level which post-handling. A calculation of framework has been presented.

A. *Image Capture* The camera records the input data in the form of pixels. The faces of people are also captured into pixels and saved. The chosen picture has to be of the size 640 × 480 to keep away from image resizing since it was noticed sometimes it might not give better results.
B. *Face Detection* A better detection algorithm of face constantly improves the presentation of systems. There are several algorithms which have been recommended for features detection like the methods based on the face geometry, practices based on invariant features, and also the methods of machine learning. From all the above methods, Viola Jones have suggested a structure that can give a high rate of detection and along with it fast. An algorithm of Viola-Jones

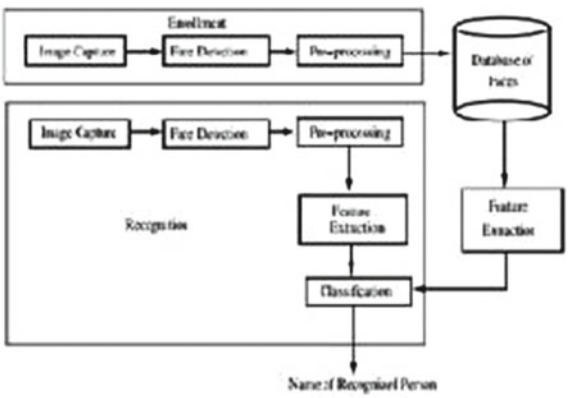

Fig. 1 System architecture

is competent for actual time application since it is super quick forceful. [5] Thus, we would select an algorithm of Viola-Jones to detect the faces and it would make utilization of picture as the classifier. We have noticed this algorithm would give improved outcomes in special lighting terms and we have pooled numerous haar classifiers to attain enhanced rates of detection to 30 degrees angle.

C. *Pre-processing* The detection of appearance is taken out. It is subject matter of preprocessing. Here, it would entail by histogram equalization in this step of pre-processing of the image which is taken. It will be sized again up to 100×100. The common technique of Histogram Normalization is Equalization of Histogram. It enhances the image difference since it also widens the intensities' array in a picture by preparing it to be clearer.

D. *Database Development* Since this system was preferred, the enrollment of each person is needed. The development of database stage will comprise of image arrest of all the persons and taking the biometric features. In such scenario, it is face, and then it is improved by utilizing a pre-processing method and saved in the records. Figure 2 will be displaying the few pre-processed and extracted faces that have been saved in the records.

E. *Feature Classification Extraction* We have compared the effects of dissimilar holistic methods utilized for attribute that have considered and categorization in actual circumstances. Table II would give the comparable details. PCA (Principal Component Analysis) was the initial algorithm which would represent the faces inexpensively. The face pictures in PCA have been represented by using Eigen faces and their projections that are corresponding along with every Eigen face. Instead of utilizing the whole dimensions of a picture only significant measurements are to be considered for representing the picture. Mathematically, a picture using PCA is represented as where is the vector, Y is vector of Eigen face, local Binary sample Histogram (LBPH) has recommended set of rules for extraction of face function. on this manner, LBP photograph has been fragmented to sure neighborhood areas and histogram has also been pulled out and is sequenced to form a face descriptor [7]. The system accuracy has come into image through utilising PCA thru which LDA might be having an effect by using the size of database wherein it isn't always the situation in LBP. [8] usually, the tendencies from PCA and LDA are difficulty be counted

Fig. 2 Extracted & pre-processed faces

of remoteness. The distance between the probe photo capabilities and traits of skilled photos might get analyzed. If the space is lesser than the edge, then it's virtually because the probe image has got diagnosed.

Here, e r denotes Euclidean distance as picture vector i as in number of image trained. We make utilization of some algorithms for improved cataloging that have machine learning. PCA has been utilized for taking out the traits and SVM (Support Vector Machine) would get utilized for the categorization. Recently SVM is been suggested algorithm which is a successful model algorithm of categorization. To recognize the pattern, SVM would find the best possible partition of the points in the terms of training set. This division could be finished either linearly or non-linearly. In this actual situation of the world, a multi-class categorization is required. SVM is been applied to categorise the multi-class. Naive Baiyes classifier is taken into consideration to be a simple classifier which could assume functions' independence of a class. A small amount of education facts is enough for assessment in Bayes class. the recognition of face could involve in 2 levels, element removal and categorization. The above said attribute extractors united with classifiers to be comparable in various real time conditions like lights settings, changes of unintended facial trends (occluded faces), Expressions. The overall performance of device is likewise anticipated inside the 4 E. Suresh Babu, A. Santhosh Kumar, and A. Anilkumar Reddy way of identification charge, time ate up for schooling distance, charge of fake high quality. false fine charges are been computed with the aid of thinking of 60 real time photograph frames in desk the II. some of these are been observed that LBP primarily based algorithm might deliver the least false superb charge and good detection fee because it properly distinguishes between the known and unknown faces. LDA should make accurate intolerance midst the photos only if the prejudice is given inside the statistics (for instance, images at assorted conditions of lighting). the gap could play as a criterion in this gadget model because the picture frames are been arrested whilst an character enters the room and face place is resized.

F. *Post-processing* It simply spoofs about the heavy chance to the systems of face identification. as a result, the approach of anti-spoofing consisting of detector of eye blink is taken in the gadget. For noticing the blink of eye, the quantity be counted of eye recognition and iris region detection may be taken into comparison. The quantity of times eye may be detected is equal to the range of times the iris location in nevertheless photograph will be identified or iris location popularity count could move for 0 (if character closes his eyes). This be counted may be incremented for assured body numbers. Parent 3 shows that the eyes that are taken out of the photo with the aid of utilising haar classifiers as in (i), eye area is translated to image of gray scale as in (ii) and the photo is the subject for inversing suppression through utilizing binary threshold filter out. Later, iris section gets a cost of 255 grey scales and the relaxation is of the worth 0. If eyes are closed the inverted photograph is absolutely black. The blink rely might be evaluated based at the blink (Fig. 3).

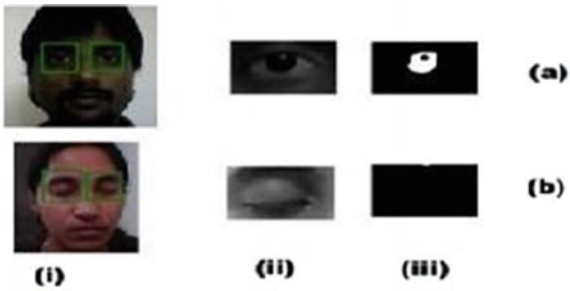

Fig. 3 Eyes and Iris region extraction

To look at consistently the accessibility of the people in the class of live gushing which is incorporated simultaneously

5 Graphical User Interface (GUI)

The GUI has been reached out by using Application of Winforms in Microsoft Visual C and EmguCV wrapper. The front end is upgraded is as shown in the Fig. 4. The technique would give the capacities which are given beneath:. Select the info source (Webcam/Recorded Video) . For refreshing the records Select . a calculation for direction and classification (PCA/LDA/LBPH/PCA + SVM/PCA + Bayesian) Declare the Attendees' Names Option to recognize the • . squint The messages and exceed expectations information has been made when distinguishing proof is done. Figure 5 shows the face territory that is taken out and update of the database post pre-handling technique. Figure 6 would enlighten us concerning the identification strategy.

Fig. 4 User interface of the system proposed

Fig. 5 Extraction and updating database

Fig. 6 Recognizing the faces

6 Future Work Conclusion

Participation Automated Systems on face acknowledgment techniques subsequently evil spirit strated to be made sure about and time spared. This procedure could be used to perceive an obscure person. LBPH plays out different calculations alongside great distinguishing proof rate continuously and low bogus decidedly appraised. Bayesian SVM check to be acceptable classifiers while contrasted with the space classifiers. The further strategies are for the acknowledgment improvement pace of calculations where there are unintended varieties in an individual, for example, with scarf, tonsuring head, and facial hair. The technique enlarged just recognizes face up to 30° edge changes that ought to be improved further. Step recognizable proof could intertwine alongside the frameworks of face distinguishing proof to accomplish better introduction of the technique.

References

1. Mohamed BK, Raghu C (2012) Fingerprint attendance system for classroom needs. In: 2012 Annual IEEE India Conference (INDICON). IEEE, pp 433–438
2. Lim T, Sim S, Mansor M (2009) Rfid based attendance system. In: IEEE symposium on industrial electronics applications, ISIEA 2009, vol. 2. IEEE, pp 778–782
3. Kadry S, Smaili K (2007) A design and implementation of a wireless iris recognition attendance management system. Inf Technol Control 36(3):323–329
4. Roshan Tharanga JG, Samarakoon SMSC, Karunarathne TAP, Liyanage KLPM, Gamage MPAW, Perera D (2013) Smart attendance using real time face recognition
5. Viola P, Jones MJ (2004) Robust real-time face detection. Int J Comput Vision 57(2):137–154

6. Zhao W, Chellappa R, Phillips PJ, Rosenfeld A (2003) Face recognition: a literature survey. ACM Comput Surv (CSUR) 35(4):399–458
7. Ahonen T, Hadid A, Pietikainen M (2004) Face recognition with local binary patterns. In: Computer Vision-ECCV. Springer, pp 469–481
8. Qasim R, Mutsaied Shirazi M, Arshad N, Qureshi I, Zaidi S (2013) Comparison and improvement of PCA and LBP efficiency for face recognition 2013
9. Faruqe MO, Al Mehedi Hasan M (2009) Face recognition using PCA and SVM. In: 3rd international conference on anti-counterfeiting, security, and identification in communication, ASID 2009. IEEE, pp 97–101

Lightweight Fine-Grained Search Over Encrypted Document

U. Mahender and S. Kiran Kumar

Abstract In fog computing, we mainly focus on lightweight fine-grained ciphertexts search (LFGS) which is a composite of CP-ABE and SE technologies, fog computing is used as an additional technology of cloud computing. The LFGS can transfer computation and storage from user to fog nodes. Its main focus on using attributes update in order to prevent unauthorized access which automatically resist CKA and CPA. In the modern world, this demo proved LFGS system performance efficiency and workable nature.

Keyword Identity-Based Encryption · Attribute-Based Encryption · Searchable encryption

1 Introduction

The promising cloud model shows that the client can reduce more storage space and ciphering cost by using it. But on the virtual network due to the reduction of data transmission potentiality and low services among user and client. To overcome this, researches find a new technique that is Fog computing which mainly inserts nodes in the center of cloud and user which enable the user to perform ciphertext, storage space for sensor nodes and wide range data terminals nearer to the user than cloud [1, 2].

The similar data like text, images, etc. are created data insecurity in data transmission, this results from data holders lose control on their data in the cloud. To reduce insecurity to data transfer, data encryption is a perfect process for this, but converting the received encrypted data is found a complex task. In order to

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_35

amend control over encrypted data and to provide data Security, we have two methods

1. Identity-Based Encryption
2. Attribute-Based Encryption

Another Technique called Searchable Encryption (SE). Which enable a user for secure searching and retrieving records from encrypted data. This CP-ABKS scheme is more recognizable in both educational and business level because in this scheme user can decrypt data only if it satisfies attribute policy [3–5].

The cryptographic CP-ABKS tool used to gain control over key work functionalities. This Tool is more recognizable in IoT devices due to reduction of storage space and computational time even at complex access is because of managing proxy to perform partial computation replacing IoT devices which results less computation to generate indirect and decrypting ciphertexts. Under this scheme, designing basic LFGS on encrypted data in a fog to gain key search and control over multiple users to prevent potential and grid blockages in the cloud computing model.

By using CP-ABKS Technique, cipher text, and storage space of users reduced using LFGS system and it is opposite in dynamic application, but in some cases, harmful end users can access illegal computation using old secret keys. But extending the LFGS system to update an attribute and conjunctive keys search it facilitate elaborated LFGS to support only the refined updated key search like individual key and conjunctive key to reducing the user ciphertext burden to prevent indirect access, thus LFGS gives security and performance to end-users [6, 7].

2 System Analysis

Sang et al. proposed the first SE scheme which provides an essential solution for search queries for encrypted data but computational was linear in size. To overcome this, Boneh et al. proposed Public Key Encryption with keyword search (PEKS) Scheme.

Many SE schemes were proposed with different benefits like Single, Multiple, Fuzzy, verifiable and ranked keyword search Multiple keyword searches can reduce bandwidth range and computation cost to reduce intolerance in the keyword search. The fuzzy keyword is used to enhance system usage by increasing locality sensitive hashing techniques called BL techniques.

The cloud system is a third party operation which saves computation resources or conceal data corruption traffic, whereas Verified keyword verifies the formed result is right or wrong and Ranked keyword arrange the score in chronological order to keywords

ABE scheme differentiates two features to achieve access control over the system, Key-Policy ABE and Ciphertext-Policy ABE. Cloud computing focuses on

transmission of resources from far end which cause blockage of network.Fog computing is an additional cloud computing which supports IoT applications like portable devices, wireless sensors etc. with given storage and manageable range.

Zuo et al. created CP-ABE scheme to combine cloud and fog computing in Computing domain. but due to the key-delegacy issue, Jiang et al. proposed a trackable CP-ABE scheme which gives protection against key disclosure. Control CP-ABE scheme used to increase outsourcing capacity and updating keys process in fog systems, which was proposed by Zhang et al.

Encryption and Decryption operations in this scheme taking more time taking and the number of operations in this scheme automatically increasing difficulty of access policy. Hence it increases resource cost to end users in the system. According to Lai et al. verifiable decryption scheme to recover the converted cipher text it requires less computing, but whereas Maluhi et al. CP-ABE scheme cannot apply in keyword search but can support in lightweight IoT devices.

According to Zheng et al. there are two keyword scheme policy namely KPABKS and CP-ABKS, where CP-ABKS is more cryptographic primitive for access control. but according to Sun et al., this scheme is multi-feature layout by utilizing proxy re-encryption and slow encryption methods. but this schemes got high negative rating by BL. Finally, Fan et al. describes that this CP-ABKS scheme verified correctness of results by joining signature to each and every file. But proved that it cannot implement in fog computing. This scheme is time consuming and less effective due to the absence of Keyword-based Search Techniques and loses access control due to the absence of CP-AKBS Technique.

In this system, KGC is most trusted unit than CSP and FN but third parties accomplish limited protocols to gather important data from storage and illegal entry. In the LFGS system EUs cannot collaborate with each other. Based on this important data CSP and FNs adopt two models.

1. Known cipher text model As per this model, CSP and FNs can gather conceal data from files, indexes and unauthorized access
2. nown background model. This model shows that CSP and FNs are acquired more capability than General cipher text model

LFGS system focus on multiple encryptions which gave access to control over due data to reduce the disadvantage of cryptography schemes. The Additional LFGS system promote updated keys and prevent indirect access which enables the user to take less time and gain more performance in the system.

3 Implementation

3.1 Data Owner

The consumer performs operations like uploading, outlook entire files and testing isolation data coalition

3.2 User

After using credentials logins, user execute operations like Request keys, Searching data using crucial words and downloading the files.

3.3 Key Generation Centre

Request outlook and Creating key and Reporting can be seen in this module

3.4 Fog Node

Request outlook, Legal PKC and Reporting can be seen in this module

3.5 Cloud Server

This server control server to provide storage services and some operations like viewing Data holders and Consumers, Viewing all files and their reports even it specifies Hackers and amount of time wastage during the amount (Fig. 1).

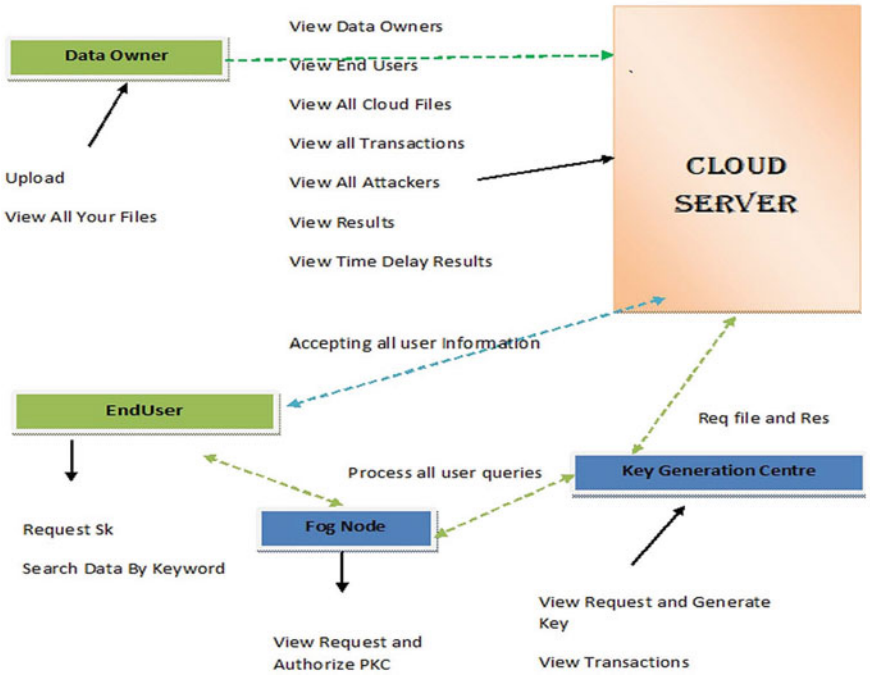

Fig. 1 System architecture

4 System Architecture

1. The DFD is also called as bubble chart. It is a simple graphical formalism that can be used to represent a system in terms of input data to the system, various processing carried out on this data, and the output data is generated by this system.
2. The data flow diagram (DFD) is one of the most important modeling tools. It is used to model the system components. These components are the system process, the data used by the process, an external entity that interacts with the system and the information flows in the system.

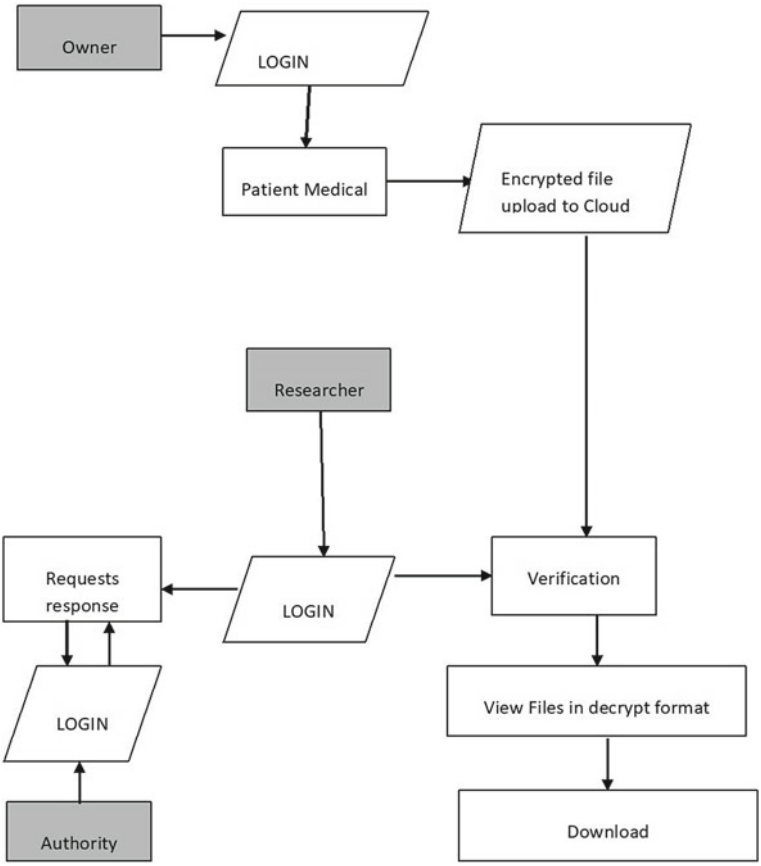

Fig. 2 Data flow

3. DFD shows how the information moves through the system and how it is modified by a series of transformations. It is a graphical technique that depicts information flow and the transformations that are applied as data moves from input to output.
4. DFD is also known as bubble chart. A DFD may be used to represent a system at any level of abstraction. DFD may be partitioned into levels that represent increasing information flow and functional detail (Fig. 2).

5 Results


Fig. 3. Home page


Fig. 4. Registration Page

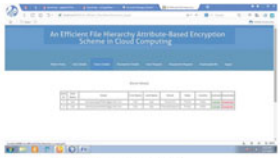
Fig. 5. Owner details

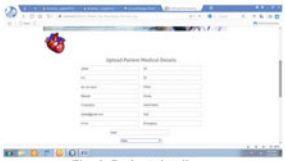
Fig. 6. Patient details


Fig. 7. Patient file upload


Fig. 8. Patient file encrypted

6 Conclusion

In LFGS system there is two processes. Firstly, To reduce storage space and computational time cost without leaking important data, Secondly using updated attributed keys in order to avoid unauthorized access. Which ultimately proves the efficiency and flexibility by securing data from CKA and CPA in fog computing. The efficiency of LPGS can be improved by adding Fuzzy keyword and Semantic keyword to prevent Communication burden on the system.

References

1. Li J, Yao W, Zhang Y, Qian H, Han J (2017) Flexible and fine grained attribute based data storage in cloud computing. IEEE Trans Serv Comput 10(5), 785–796. https://doi.org/10.10007/1234567890
2. Yan H, Li J, Han J, Zhang Y (2017) A novel efficient remote data possession checking protocol in cloud storage. IEEE Trans Inf Forens Secur 12(1):78–88
3. Stergiou C, Psannis KE, Kim BG, Gupta B (2018) Secure integration of IoT and cloud computing. Future Gener Comput Syst 78:964–975
4. Liu X, Deng RH, Yang Y, Tran HN, Zhong S (2018) Hybrid privacy-preserving clinical decision support system in fog–cloud computing. Future Gener Comput Syst 78:825–837
5. Wu D, Zhang F, Wang H, Wang R (2017) Security-oriented opportunistic data forwarding in mobile social networks. Future Gener Comput Syst 87:803–815
6. Wu D, Si S, Wu S, Wang R (2017) Dynamic trust relationships aware data privacy protection in mobile crowd-sensing. IEEE Internet Things J 5:2958–2970
7. Wu D, Yan J, Wang H, Wu D, Wang R (2017) Social attribute aware incentive mechanism for device-to-device video distribution. IEEE Trans Multimed 19(8):1908–1920

A Complete Home Automation Strategy Using Internet of Things

Deva Sai Kumar Bheesetti, Venkata Nikhil Bhogadi, Saran Kumar Kintali, and Md. Zia Ur Rahman

Abstract In this cutting-edge world, everyone wants to make their lives simple and secured, which can be accomplished by using Home Automation. It is an inclining word that is getting prevalent on account of its numerous lineaments. The concept of IoT renders the chance of Implementation of Home Automation. Internet of Things makes it possible to control and monitor different devices through the Internet. By connecting the IoT devices to the Internet or Cloud network, users can experience an automated home. The reason for this considerable demand for networkenabled home automation systems is because of their simplicity, comfortability, and affordability. IoT uses several technologies like cloud computing, which is used to connect the IoT devices to different platforms on the Internet and to access them at any time and anywhere in the world. In this project, we are using the Blynk platform to monitor our connected devices through the Internet. It provides us with various widgets and userfriendly interface to control our device. To control our devices with a voice, we are providing access to voice assistants like Google Voice Assistant, Alexa, Cortana, so on through a web-based service called IFTTT (If This Then That). It is an automation platform that provides communication between different web-based services, apps, or devices. In this project, we are implementing a model through which we can control and monitor all the connected sensors and actuators, and we are also connecting them to our voice assistant.

Keywords Arduino · Blynk · Cloud computing · Home automation · IFTTT · Internet of Things (IoT)

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_36

1 Introduction

In this era of modernization, individuals were enamored with smart devices, which can be controlled remotely and can be automated. The community of the Internet of things (IoT) making a smart device more intelligent through innovations [1]. The future IoT and its significant innovations can be identified with digitized sensor advancements, which include Nanotechnology, Miniaturization, and Wireless Sensor Networks (WSN) [9–14]. With the assistance of IoT, considerably being away from home and from anywhere in the world where there is internet connectivity, the client can monitor and control his entrance door, different devices and can make his television to be ON or OFF without his intercession. Later with the development of Cloud-computing and data analysis concepts, which enables smart frameworks to analyze and dissect the information in a progressively proficient way. Through the Internet of Things, we can control appliances remotely with gestures by utilizing motion detection or on-body sensors. Communication is the foundation for the Internet of Things since it is set up by protocols utilized by communication systems assorted with wireless system protocols that are being utilized in digitized home automation. In the IoT systems, a portion of the gadgets is embedded in quotidian items, and in this manner, they must have a small size, limited computational assets, and vitality constraints. IoT can also be integrated with trending technologies like machine learning and artificial intelligence [16–20]. By using these technologies, we are making these devices operate by themselves by analyzing our activities and daily life work. Imagine a smart home with a centralized hub that monitors your stress levels and Temperature of your surroundings through the smart-watch and sets an ambient room temperature suitable for us before we reach our home. A hub which notifies us regarding our daily tasks and controls all the appliances without human intercession even through mobile, A hub which takes decisions on its own through the data from smart-watches, smartphones, and other sensors which we use for our household purpose. In this paper, we discuss designing a system that implements the concept of the Internet of Things to control smart IoT devices that utilize NodeMCU, IFTTT, and Blynk application. The inputs for this system were taken from various sensors and were displayed in the user interface of the Blynk application, and the user gives instructions through widgets in the Blynk app, which were processed to control various smart home appliances through a relay. We can also control these appliances using voice assistants like Google, Cortana, and Alexa. Several signal processing techniques useful in this contest are reported in [21–25].

2 Methodology

2.1 Proposed System

The hardware model mentioned in this paper satisfies the novel requirements of expanding the populace of the present world. The primary advantage of our project is to control different devices which were both electrical and as well as electronic without any effort In this busy world, there may be several works that need our presence at various other places away from our home, and at the same time, we may have to control some device in our house either by turning it ON or OFF, our project comes into handy in such situations. To have control over smart devices wirelessly, these devices have to be connected to the primary server. The client has to create a unique user ID and password and use them to sign in the Blynk application. By doing so, he can control any appliance sparing money, time, and energy. It also provides a secured outright system that collectively provides maximum proficiency since it saves money, time, oversees power utilization, and makes the clients living more secure and astute. We can monitor the readings of a sensor, control the sensitivity of lights, and set timers and scheduling for IoT devices. We can also control our home appliances through our voice assistants like Google voice assistant, Cortana, and Alexa. This feature can be achieved by connecting our voice assistant to our Blynk app through WebSocket service provided IFTTT applets.

2.2 Network Architecture

In any IoT device, the fundamental element is its cloud server. It's the core for all Internet of Things based operations. For this project, we are using the Blynk server for storing data, processing information, and analyzing sensor data. We should make an implicit association between the server and our IoT devices. We can achieve this connection by using end-to-end WebSocket service. Through this web association, we can connect the smart home hub and cloud server through which we can access our IoT devices and make legitimate decisions. To interface the android gadget with the primary server, we have to perform some configurations through our computer [2]. We use Blynk libraries to program our IoT devices, and we use blynk-ser.sh file to connect our device with the Blynk server. We can connect our mobile to the Blynk server through Blynk application, to create a secure environment for this system, the client is provided with a User Id and password, which were created during the device installation. Once these devices are connected to the primary server client can access them through this User Id and password. Hence, he can monitor and control the status of his IoT devices [4–6]. These devices can be accessed by the client through voice assistants by connecting the Blynk server with respective voice assistants. This concept can be achieved by creating an applet in the IFTTT app or website. The entire IoT system has to be online for the proper

working of all the features mentioned above. Here the Internet is the crucial element of the entire network. This proposed model will give simple access and a secured environment if the IoT gadgets and the client are associated with the web [7, 8, 15].

3 System Design

3.1 Software Design

BLYNK. Blynk is an open-source platform that is used to monitor and operate IoT devices remotely. It can be accessed through app stores of both Android and IOS operating systems. Through these applications, users can create a realistic interface to control a hardware model by just dragging and dropping the available widgets. It is easy to set up or create an Interface by Blynk that controls our smart devices. Blynk is not associated with a specified hardware board or shield. We can connect our desired hardware without any complexity as shown in (Fig. 1).

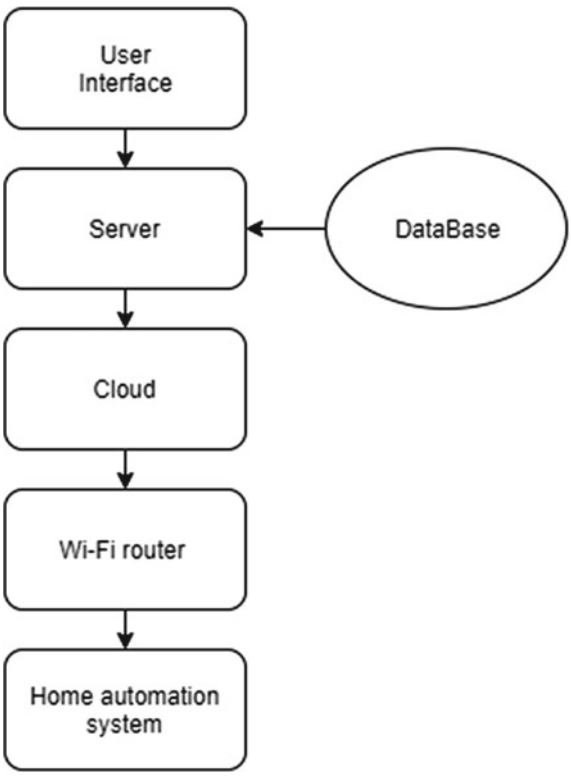


Fig. 1 Flow chart of Home Automation network architecture

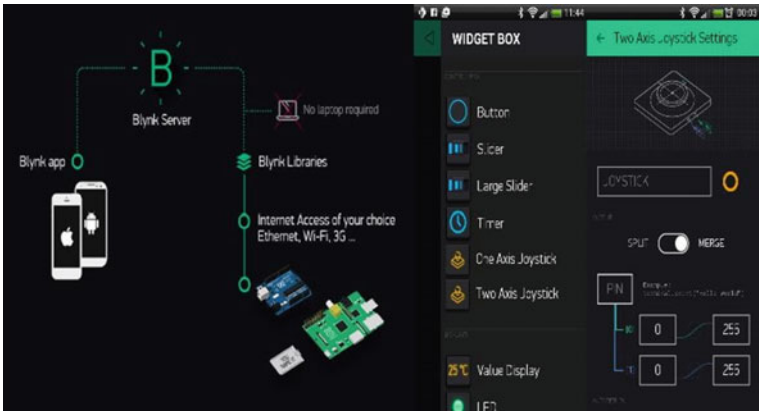


Fig. 2 Connection between Blynk server and application

Now visualize, each time you press a Button in the Blynk application, the message goes to the Blynk Cloud, where it mystically discovers its way to your equipment. It works equivalent the other way, and everything occurs in a blink of an eye. You can visualize it in (Fig. 2) [3].

IFTTT. IFTTT gets its name from the limited programming articulation "if this, then that." This open-source platform associates applications, gadgets, and services from various developers to trigger one or multiple automation, including those applications, gadgets, and services. The automation can be achieved through applets—which are similar to macros that associates various applications to run automated instructions. You can make an applet turn on or off utilizing IFTTT's site or mobile applications. You can likewise make your very own applets or make modifications of existing ones through IFTTT's easy to understand and smooth interface. IFTTT is simple to utilize. You have to download applications for Android or ios and sign up into a new account, and you're ready for action with automation in minutes.

There is a puzzling cluster of applets available, so IFTTT supportively gives automation proposals to new clients to attempt. Its Collection of bunches together applets for various platforms like iOS, Android, and voice assistants – and workout everything from applets for news and climate services to home automation. It is likewise conceivable to scan for particular applets or search under-classes, for example, business applications, connected vehicles, or health and fitness services. The "My Applets" screen gives clients a chance to oversee which applets are turned on at present and gives a history of those that have been utilized already. Clients can make their required applets by consolidating different application "services" and setting trigger parameters.

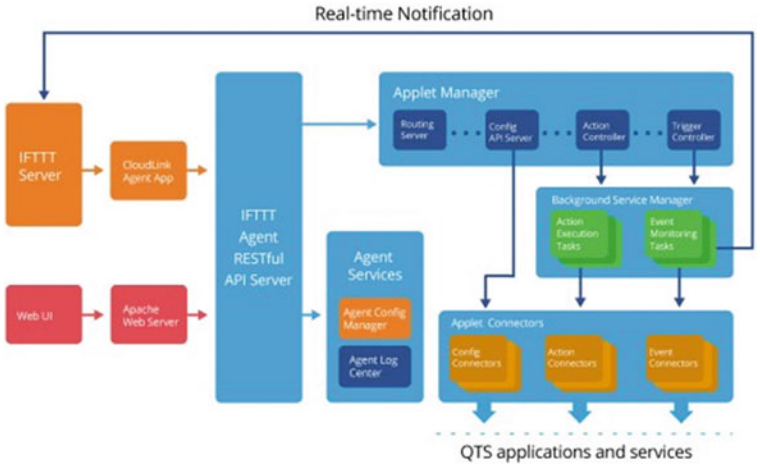


Fig. 3 IFTTT server architecture

Essential features of IFTTT:-

- Applet repository
- IF recipes (applets/services)
- Do recipes (applets/services)
- Guided custom recipe
- Analytics

Concerning clients, IFTTT presents them with an enormous archive of applets and services running from the imperative to the trivial. From climate to education, social media notifications to health alerts, the applets and services run the array of applications and smart appliances that can be connected. For instance, an applet can make Alexa call an appliance with the IFTTT integrated. Another case is to spare IOS contacts to your Google contacts. You can visualize IFTTT architecture in (Fig. 3).

3.2 Hardware Design

Arduino. At the point of discussing the Internet of Things, there is an essential association of specific innovations. So here, we will exhibit this fundamental structure blocks the Internet of Things. We have to have a decent web association which frames the critical component for information transfer. The Internet is a need so you can transfer the detected information from the hubs to the core center.

Microcontroller Unit (MCU) - ESP8266. ESP8266 is a simple micro-controller chip that acts as a wi-fi module to connect the IoT devices through the internet. To program esp8266, we need a microcontroller board like Arduino or FTDI converter

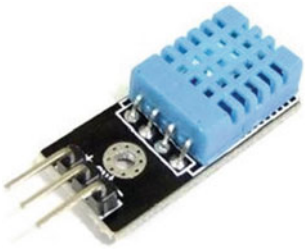
or USB to TTL converter. NodeMCU is an advanced version of esp8266, which comes with a microcontroller board and extra GPIO pins. It comprises of 64 KiB of programming RAM, and 96KiB of information RAM. It has up to 16 GPIO pins and provides SPI along with the I2C communication system. It is an ultra-low power-consuming hardware element with sufficient processing speed.

Sensors. *PIR Motion Sensor.* PIR motion sensor is a low-cost device that is commonly used to detect the presence of humans. They even consume less power. They are often used in home Automation in applications that involve the prevention of burglary and automation of lights based on the presence of humans. They are frequently alluded to as PIR, "Passive- Infrared," "IR-motion," or "Pyroelectric" sensors. PIR sensors are typically made of a pyroelectric sensor which can identify levels of infrared radiation. Every object produces some lowlevel radiation, and the hotter an object, the more radiation is transmitted. The sensor in a motion-detecting device has two halves. We have used Hc-sr501 PIR motion sensor in this project (Fig. 4).

Humidity and Temperature Sensor. In this project, we are using DHT11 as humidity and temperature sensor. It contains a capacitive humidity sensor and a Thermistor. It has an inbuilt 8-bit microcontroller. Most moisture sensors use capacitive measurements to decide the measure of humidity noticeable in the air. DHT11 sensors have an extremely accurate humidity calibration chamber. It is small, consumes less power, and has a signal transmitting range of 20meters. Because of its features, it can be used in many applications, even the most critical ones. It is a single row package with 4 pins. It can be interfaced easily and based on the applications special packages were used. DHT11 Temperature and Humidity sensor module (Fig. 5).

Fig. 4 PIR Sensor

Fig. 5 DHT11 Sensor



4 Results and Discussion

To execute our home automation network, we have to prepare an experimental setup, as appeared in Fig. 6. We use a PIR motion sensor, which on recognizing the absence of people for a particular time, turns off the device. It can also be used to notify the user when an intruder arrives at the door for security purposes. We can control the intensity of led bulbs, mood lights, and speed of the fan by using the slider widget, and we can monitor the readings of Temperature and humidity sensor through Gauge or History graph widgets in Blynk application. We can access our IoT through voice commands by creating applets in IFTTT web service through our google account. We have implemented our home automation setup on our experimental arrangement, which worked effectively with no error and is shown in Fig. 6.

The proposed model of the framework was structured for the minor project of our college. Four different isolated sub-systems in our project are:

i. To control the Relay circuit associated with smart devices.
ii. Temperature and Humidity sensor associated framework.
iii. PIR sensor for movement detection.
iv. IFTTT to provide voice access services.

These were connected through Wi-Fi utilizing the NodeMcu controller chip. The present and past information of temperature and humidity can be acquired from anyplace utilizing the Blynk application. Further, this framework can be utilized in

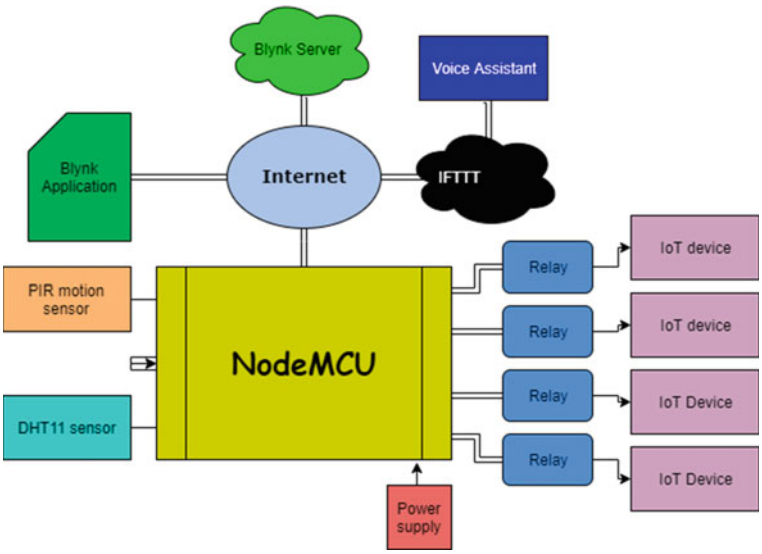


Fig. 6 Block Diagram of proposed model

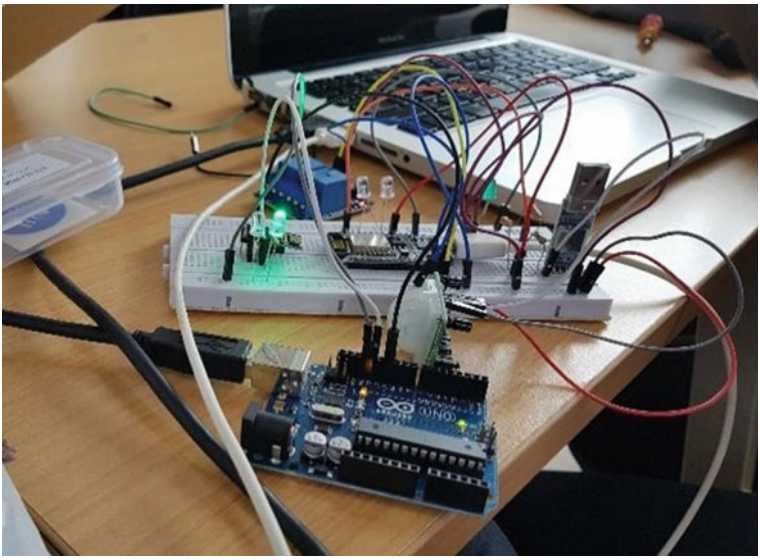


Fig. 7 Hardware design of proposed model

numerous spots like banks, houses, nursery, roads, private lofts, clinics, traffic stations, poultry ranches, research centers, and so forth. This framework can be utilized in various fields and territories to cause them to work adroitly. Our experimental demonstration is shown in Fig. 7.

5 Conclusion

In this paper, we have presented a home administration and security framework. This paper is primarily centered on implementing a simple, smart home where one can operate their appliances remotely, schedule their cellar and balcony lights, control the intensity of mood lights, operating appliances through voice, analyzing room temperature and moisture content, and intrusion detection. It can also be used in the garden alongside drip irrigation, which saves many resources like energy, water, time, so on. Our prototypical framework is appropriate to home security, mechanization, observing, and controlling of remote frameworks. The future works include connecting our IoT module with daily life smart devices like fit bands or smart-watches, mobiles, and various sensors. All these devices are connected to a centralized hub that can make decisions on its own by analyzing user stress levels, surrounding temperatures, and various others. These decisions operate our connected IoT devices without human or application intercession. By implementing such a prototype, we can further advance the IoT implementation.

References

1. Dey S, Roy A, Das S (2016) Home automation using Internet of Thing. In: 2016 IEEE 7th annual ubiquitous computing, electronics & mobile communication conference (UEMCON)
2. Kranthi Kumar K, Rachamalla S, Sindhu P, Vijaya Laxmi S (2018) Cloud based home automation: surveillance with mobile phones. In: 2018 3rd international conference on communication and electronics systems (ICCES)
3. Mahindar R, Prakash M, Ghosh S, Mukherjee S, Ghosh R (2007) IoT-based home appliances control system using NodeMCU and Blynk server. Int Adv Res J Sci Eng Technol 5(6):1–7 ISO 3297:2007 Certified
4. Kousalya S, Reddi Priya G, Vasanthi R, Venkatesh B (2018) IOT based smart security and smart home automation. Int J Eng Res Technol (IJERT) 7(04). ISSN 2278-0181
5. Abdul AM, Krishna BM, Murthy KSN, Khan H, Yaswanth M, Meghana G, Madhumati GL (2016) IOT based home automation using FPGA. J Eng Appl Sci 11(9):1931–1937. ISSN 1816949X
6. Neelima V, Naveen Kumar P, Padma Priya NV, Sripath Roy K, Sripriya K, Matin Kausar SK (2018) Implementation of home environmental conditions monitoring system by multiplexing technique on NodeMCU. Int J Pharm Res 10(3):371–377. https://doi.org/10.31838/ijpr/2018.10.03.006
7. Gadde SS, Ganta RKS, Gopala Gupta ASALG, Raghava Rao K, Mohan Rao KRR (2018) Securing Internet of Things (IoT) using honeypots. Microsyst Technol 24(3):1609–1614. https://doi.org/10.1007/s00542-017-3563-x. ISSN 9467076
8. Gopi Krishna P, Srinivasa Ravi K, Hareesh P, Ajay Kumar D, Sudhakar H (2018) Implementation of bi-directional blue-fi gateway in IoT environment. Int J Eng Technol (UAE) 7:733–738. ISSN 2227524X
9. Pavithra T, Sastry JKR (2018) Strategies to handle heterogeneity prevalent within an IOT based network. Int J Eng Technol (UAE) 7(2):203–208. https://doi.org/10.14419/ijet.v7i2.7.10293. ISSN 2227524X
10. Rambabu K, Venkatram N (2018) Contemporary affirmation of security and intrusion handling strategies of internet of things in recent literature. Int J Eng Technol (UAE) 7(2):127–130. https://doi.org/10.14419/ijet.v7i2.7.10278. ISSN 2227524X
11. Poonam Jain S, Pooja S, Sripath Roy K, Abhilash K, Arvind BV (2018) Implementation of asymmetric processing on multi core processors to implement IOT applications on GNU/Linux framework. Int J Eng Technol (UAE) 7(1.1):494–499. ISSN 2227524X
12. NagaGeetha M, Ramesh NVK (2018) An efficient IoT based smart irrigation system and plant diseases detection: a review. Int J Eng Technol (UAE), 7(2):77–83. https://doi.org/10.14419/ijet.v7i2.7.10264. ISSN 2227524X
13. Narayana MV, Dusarlapudi K, Uday Kiran K, Sakthi Kumar B (2017) IoT based real time neonate monitoring system using arduino. J Adv Res Dyn Control Syst 9:1764–1772. ISSN 1943023X. Special issue 14
14. Madhav B, Dheeraj GS, Raghavarapu SS (2018) Multiple band mobile antenna for LTE, GSM, PCS, UMTS & IoT applications. J Adv Res Dyn Control Syst 10(4):369–373. ISSN 1943023X
15. Pavithra T, Sastry JKR (2018) Strategies to handle heterogeneity prevalent within an IOT based network. Int J Eng Technol (UAE) 7(2):203–208.https://doi.org/10.14419/ijet.v7i2.7.10293. ISSN 2227524X
16. Rambabu K, Venkatram N (2018) Traffic flow features as metrics (TFFM): detection of application layer level DDOS attack scope of IOT traffic flows. Int J Eng Technol (UAE) 7(1.1):554–559. ISSN 2227524X
17. Bohara B, Maharjan S, Shrestha BR (2016) IoT based smart home using Blynk framework, Zerone Scholar, vol. 1, no. 1
18. Panwar G, Maurya R, Rawat R, Kanswal R, Ranjan P (2017) Home automation using IOT application. Int J Smart Home 11(9):1–8

19. Fathima SY, Zia Ur Rahman Md, Murali Krishna K, Bhanu S, Shafi M (2017) Side lobe suppression in NC-OFDM systems using variable cancellation basis function. IEEE Access 5 (1):9415–9421
20. Soumya I, Zia Ur Rahman Md, Reddy DVRK, Lay-Ekuakille A (2015) Efficient block processing of long duration biotelemetric brain data for health care monitoring. Rev Sci Instrum 86:035003-1-10 (2015)
21. Zia Ur Rahman Md, Ajay Kumar, V, Karthik GVS (2011) A low complex adaptive algorithm for antenna beam steering. In: IEEE 2011 international conference on signal processing, communications, computing and networking technology (ICSCCN 2011), pp 317–321
22. Sowmya I, Sathi Raju Ch, Zia-Ur-Rahman Md, Reddy DVRK (2011) Respiration baseline wander removal from cardiac signals using an optimized adaptive noise canceller. Can J Signal Process 2(3):27–31
23. Zia Ur Md, Ahamed SR, Reddy DVRK (2011) Stationary and non-stationary noise removal from cardiac signals using a constrained stability least mean square algorithm. In: IEEE ICCSP 2011, NIT Calicut, India, 10–12 February 2011, pp 485-488
24. Zia Ur Rahman Md, Khaja Mohedden Sk, Rama Mohana Rao BV, Jaipal Reddy Y, Karthik GVS (2011) Filtering non-stationary noise in speech signals using computationally efficient unbiased and normalized algorithm. Int J Comput Sci Eng 3(3):1106–1113
25. Zia Ur Rahman Md, Kumar VA, Karthik GVS (2011) A low complex adaptive algorithm for antenna beam steering. In: 2011 international conference on signal processing, communication, computing and networking technologies, Thuckafay, pp 317–321

Retinal Vessel Tracking Using Gaussian and Radon Methods

N. Jaya Krishna, Fahimuddin Shaik, G. C. V. Harish Kumar, D. Naveen Kumar Reddy, and M. Bala Obulesu

Abstract Retinopathy is one the cause of impairment of eye vision which leads to damage to the retina. Irregular sugar levels in the blood flow, abnormal blood flow in the retina and hypertension causes retinopathy. with the help of computer application tracking and estimating the diameter of a blood vessel is possible. The MATLAB software is used to track and estimate the blood vessel. In this software, the retinal image is given as an input image and the image processing methods are carried out to determine the diameter and track the retinal blood vessel. This technique distinguishes bifurcation focuses which might be valuable for further post - quantitative and compositional investigation.

Keywords Gaussian process · Radon transform · Vessel tracking · Retinal imaging · Image processing · Diameter estimation

1 Introduction

Image is a meaning of light intensity f(x, y) in which x and y are spatial coordinates, f is a grey or brightness scale. Colour image types, binary image, grey image, indexed image [1]. With the development of medical imaging and computer

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_37

technology, medicinal picture handling has become increasingly important in the diagnosis. Radiography obtains enormous amounts of medical images, CT, MRI, etc. They provide essential information on the basis of advanced computer vision techniques for efficient and accurate diagnosis.

Image processing methods in medical applications related retinopathy is commonly utilized to identify eye disorders in a simple and well-organized way [2]. The main aim is to break the chain between the disorder to disease to avoid the morbid situations. It helps ophthalmologists to test their patients and also make a clinical analysis. This research statistics helps the medical professionals to have a clear picture on the entire issues related to retinal problems when they have a specific categorized data in hand [3]. Diabetic retinopathy, glaucoma, age-related macular degeneration are major eye disorders that trigger blindness across the world. In the United States, nearly 950,000 people were blind in 2002 and 2.5 million people found that they had visionary problems due to these diseases [4]. The constriction of the blood vessels in the retina gives information about this retina-related eye disease. Some of the eye symptoms, i.e., nerve blood vessels, Fovena, optic disk (OD) are used to detect diabetic retinopathy (DR) and other eye-related diseases Digital fundus cameras are used to take retinal character pictures. Therefore, the process of obtaining excessive lighting, setting, and fundus image will degrade the image quality to some extent. Image enhancement is often necessary to improve the quality of the desired image [9].

Researchers are proposing other methods for improving the quality of the retinal image. Some of the researcher's image processing techniques used to diagnose eye diseases include Image Enhancement, Registration, Fusion, Segmentation, and Feature Extraction. Registration of images is used to detect changes in the medical images. In a single coordinate system, diverse images taken from dissimilar angles are associated to get registered successfully. Using image fusion, different kinds of data from various images are merged into a single image. Segmentation is used to split an image into separate regions based on color, intensity, and objects. The Image Classification procedure is used based on grey values or other parameters to mark the pixel group [9]. Analysis of the pictures is used to make the image content simple to understand. Diabetic retinopathy is one of the world's most severe eye disorders and a cause for blindness. Most of the times the main goal of the computational algorithms in these type of applications is to forecast the depth of the problem and paving a way to the medical professionals to find better solutions which follows all the medical norms for the betterment of the human race.

2 Literature Review

In [1] the color image of the eye is given as an input for edge detection and to distinguish between spatial domain edge detection to that of the 2-DGradientfilter, Mean and variance value seems to be diminished by the applied techniques. So, the gradient filter edge detection is more efficient than normal edge detection for

ophthalmologists to treat the only affected part as it extracts the various pathologies of retinal disease lesion. In [2] Color image of a human is given as input and it undergoes preprocessing and enhancement phase, number of microaneurysms are detected in the output. So, median filters are used for noise reduction and applied to extended minima transform and this system helps to detect faster. These filters are used as front run methods in most of the pre-processing algorithms to remove the artifacts which have been induced into the images during the process of Image acquisition. This process of filtering is very significant in medical applications as each and every details counts to find the better solutions in health care.

In [3] the retinal image of an eye is used as an input in four different image enhancement and detection techniques, the noise of an image is removed and threshold values are calculated in the output. So, Image line cross-section, edge enhancement and edge detection, modified matched filtering and continuation algorithm techniques are used,In these four techniques, EEED and CA techniques are more effective and important on commercial grounds. In [4] an eye retina image and an unsupervised line detector technique is used to identify blood vessels. For each pixel location, a window is assigned to determine the average gray-scale. Within this area twelve lines were drawn, all passing through its center. The mean gray rates along each line was then estimated. The reported analytical time (2.5 s) is less than the normal analysis time (7.9 s). Yet the findings published are less accurate.

In [5] the CCD camera is used to image the weld surface, and noise filters have been used to eliminate the noise due to the difficulty of the welding process. The optimal algorithm is capable of efficiently eliminating noise in the complexities of the welding environment. Finally, with its lower processing time and memory cost, it can be implemented in hardware also.

In [6] the authors established an unsupervised retinal image segmentation technique for the blood vessels. They used the ISNT rule to segment the blood vessels, mainly concentrated in the lower and higher quadrants of an optic disk. If glaucoma is present, ONH will be moved. This causes these vessels to shift towards the nasal side, which in turn causes blood vessels to decline in the lower and upper regions. Blood vessels were extracted along with a mask using all of this material. No findings have been published indicating the accuracy of the segmentation, although this information indicates the accuracy of the measured disk ratio when used as an indicator for glaucoma detection. Also, their method does not deal with the identification of tiny blood vessels and closes large vessels in the region of the disc. It is worth noting that this method has only been tested on a small area in the retina, namely the disk, and therefore needs to be tested on a full image. In [7] the retinal image is given as an input image and it undergoes preprocessing and postprocessing. the retinal image is diagnosed by giving VCD and VDD values. so, the retinal images which are affected are diagnosed by using MATLAB software and implemented using GUI. If it is affected the lines plot of the image is clear else unclear.

In [8] the fingerprint is used to capture its ridge and valley orientations as an input image. The transformation of the Radon has the capability to absorb certain orientations. The results obtained clearly show that the proposed method provides a suitable tool for extracting the directional features of the fingerprint images.

However, it does not require pre-processing such as the approach based on minutiae extraction. The findings indicate that the system is not responsive to the fingerprint image acquisition quality. It could be noticed that the assumption of an image alignment limits this method's usefulness. The method proposed is versatile and simple. In [9] the researchers developed a method to remove blood vessels from the fundus image after the optic disk is segmented. The input image is also a retinal eye image. It used the 555-pixel strength and distance from the center of the disk in a gray image, since the gray level value of the pixel decreases as its distance from the center of the disk increases. The R pixel which relates to the segmented vessel is replaced by the pixel median from R to the optic disk center. In this case, however, efficiency tests are less reliable for the segmentation of the vessels.

3 Proposed Method

First, we portray our strategy for centreline vein following utilizing GP relapse and changing radon. Next, we utilize numerous GPs to expand the technique for distinguishing bifurcations and following breadths. The proposed technique is partitioned into three principle ventures for better delineation.

3.1 Vessel Centerline Tracking Method
3.2 Bifurcation Detection
3.3 Diameter Estimation

3.1 Vessel Centreline Tracking Method

To follow the centrelines of the vein, we expect that the bend fluctuates easily and has a Gaussian dispersion in a solitary vessel section without bifurcations. Accordingly, we expect that the ebb and flow of the veins is a GP with a zero mean by separating their positive and negative qualities.

3.2 Bifurcation Detection

To date, just straightforward vessels without bifurcations have been depicted to be followed. Bifurcations should be identified and used to start further following so as to acquire a progressively exhaustive depiction of the whole vascular tree. Note that the proposed calculation in Sec faces a bifurcation.

Track the way with a littler directional change, in light of the fact that the ebb and flow in the vein is expected to have a zero mean Gaussian conveyance. Along these lines, just a single GP is utilized.

It is conceivable to reject a branch with a bigger edge of deviation. Thusly, we will utilize numerous GP's to empower following through the two branches to address this issue. To identify the spreading focuses, an alternate arrangement of Radon change highlights are utilized.

3.3 Diameter Estimation

The width esteems are likewise followed utilizing an autonomous GP notwithstanding the vessel centerline. Here, we expect that the measurement fluctuates easily as indicated by its underlying incentive after a non - zero mean Gaussian conveyance.

4 Results and Discussion

Here the retinal image is considered as an input image as shown in Fig. 1, the proposed method is carried out and hence one can estimate the diameter and track the retinal blood vessel. By changing the values of the direction and diameter we got the following shown in Fig. 2.

By applying the input values to the input image as step size and diameter and direction values those are step size = '1', diameter = '2', direction = '6' after giving the input values we observed that output Fig. 3. In this output figure we observed the blue colour covered curvature line has been formed on retinal blood vessel at particular area. The blue coloured curvature area represents the bifurcation levels of the retina. Here the step size, diameter are kept constant where as the direction values can be varied. The bifurcation levels starting from 'm1' to 'm2'. If the direction value decrease bifurcation ranges also increased as shown in bifurcation graph. The role of bifurcation ranges from values m1 and m2 represents estimation of diameter and tracked the blood vessel of the retina.

Fig. 1 The Input image to perform tracking and diameter estimation technique

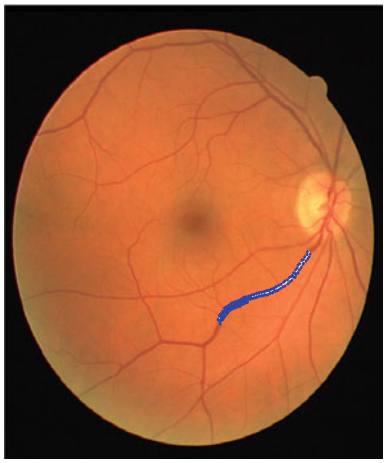

Fig. 2 Output image

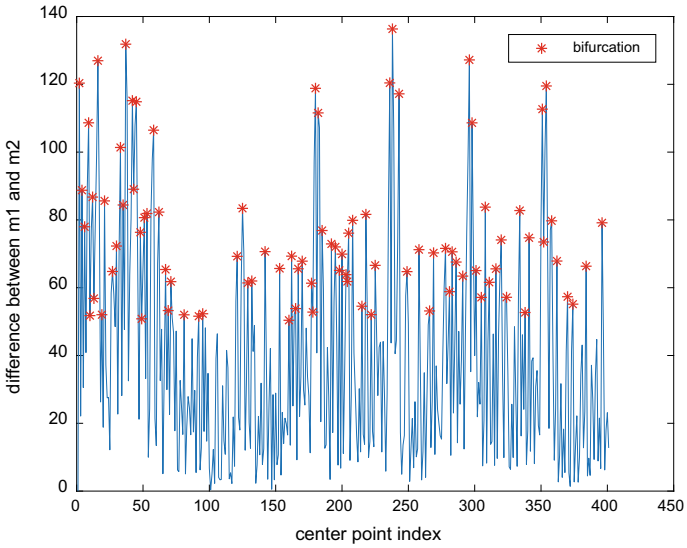

Fig. 3 Bifurcation graph

By applying the input values to the input image as step size and diameter and direction values those are step size = '1',diameter = '4',direction = '6' after giving the input values we observed that output Fig. 4. If the direction value decrease bifurcation ranges also increased as shown in bifurcation graph Fig. 5. The role of bifurcation ranges from values m1 and m2 represents estimation of diameter and tracked the blood vessel of the retina.

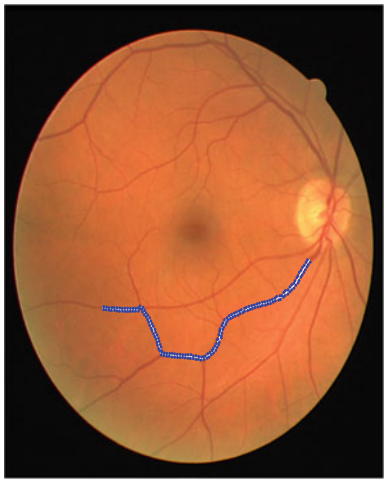

Fig. 4 Output image

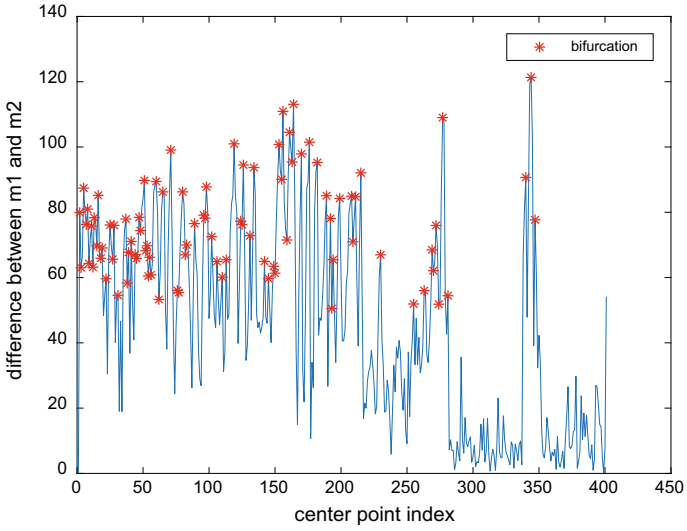

Fig. 5 Bifurcation graph

By applying the input values to the input image as step size and diameter and direction values those are step size = '1', diameter = '8', direction = '6' after giving the input values we observed that output Fig. 6.

If the direction value decrease bifurcation ranges also increased as shown in bifurcation graph Fig. 7. The role of bifurcation ranges from values m1 and m2 represents estimation of diameter and tracked the blood vessel of the retina.

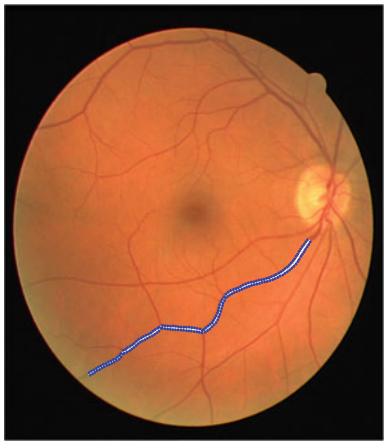

Fig. 6 Output image

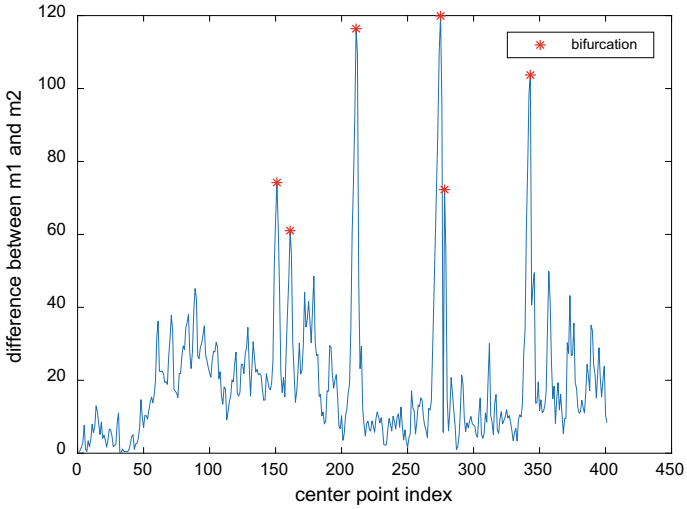

Fig. 7 Bifurcation graph

By applying the input values to the input image as step size and diameter and direction values those are step size = '1', diameter = '12', direction = '6' after giving the input values we observed that output Fig. 8.

If the direction value decrease bifurcation ranges were increased as shown in bifurcation graph Fig. 9. The role of bifurcation ranges from values m1 and m2 represents estimation of diameter and tracked the blood vessel of the retina

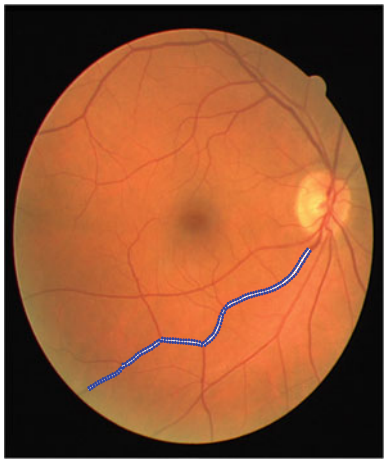

Fig. 8 Output image

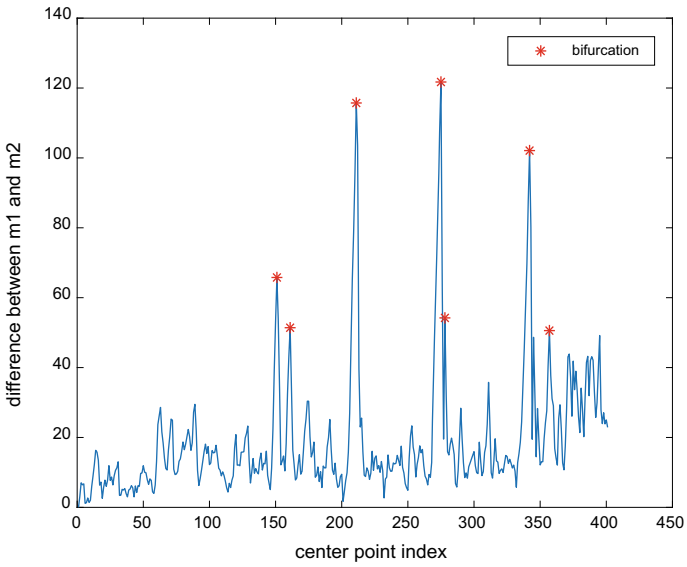

Fig. 9 Bifurcation graph

5 Conclusion and Future Scope

Thinking about the flare-up of diabetes, its impact on retinal vessels and the expanding interest for occasional examination of retinal pictures, the programmed investigation of retinal pictures is a pertinent issue in the preparing of medicinal pictures. In this paper, we displayed another way to deal with following the middle

lines of veins and their widths dependent on GP and Radon change. We expected that the ebb and flow and distance across of a solitary section of a vessel are GPs whose piece parameters are advanced by amplifying the information likelihood. The proposed strategy has been appeared to be strong to commotion and consequently fit for following slight structures and focal blood vessel reflexes where the nature of the flag drops extensively. This property is first because of nearby power mix used to figure the Radon changes. What's more, the middle line smoothness is authorized by spatial relationships of GP forecasts. Contrasted with different techniques, the outcome is an expanded dimension of particularity. The proposed technique estimates the vessel breadths legitimately and distinguishes the bifurcation focuses which might be valuable for further post - quantitative and compositional investigation. The technique proposed depends on turning around covariance frameworks and PC line integrals for radon changes, which can be computationally costly. The improvement of an instrument to make the calculation computationally increasingly effective is one conceivable intriguing exploration course.

References

1. Shaik F, Ravindraiah R, Giriprasad MN (March 2011) Qualitative and quantitative analysis of segmentation of human retinal images. In: IEEE international conference (ICCET- 2011). Published by IEEE Press and in IEEE Explorer, T.N, India, pp 76–80
2. Abràmoff MD, Garvin MK, Sonka M (2010) Retinal imaging and image analysis. IEEE Rev Biomed Eng 3:169–208
3. Taylorand HR, Keeffe JE (2001) World blindness: a 21st century perspective. Br J Ophthalmol 85(3):261–266
4. Abràmoff MD et al (2010) Automated early detection of diabetic retinopathy. Ophthalmology 117(6):1147–1154
5. Shaik F, Sharma AK, Ahmed SM (April 2016) Hybrid model for analysis of abnormalities in diabetic cardiomyopathy and diabetic retinopathy related images. Springer Plus Journal, Springer Publications. (ISSN:2193-1801)
6. Faust O et al (2012) Algorithms for the automated detection of diabetic retinopathy using digital fundus images: a review. J Med Syst 36(1):145–157
7. Zhao YQ et al (2014) Retinal vessels segmentation based on level set and region growing. Pattern Recognit 47(7):2437–2446
8. Shaik F, Sharma AK, Ahmed SM, Gunjan VK, Naik C (2016) An improved model for analysis of Diabetic Retinopathy related imagery. Indian J Sci Technol 9(44). (ISSN: 0974-6846)
9. Fraz MM et al (2012) Blood vessel segmentation methodologies in retinal images: a survey. Comput Meth Programs Biomed 108(1):407–433

Color Image Segmentation Using Superpixel-Based Fast FCM

Jala Himabindhu and V. Sai Anusha

Abstract A large number of improved variants of the Fuzzy c-means were used to segment the gray scale and color image. Nevertheless, some of them take time to yield the best and optimal results and for two reasons cannot produce adequate segmentation results for color images. This work proposes a simple FCM clustering algorithm based on the Super pixel Algorithm (SFFCM), which is considerably faster and more robust for image segmentation applications which are based purely on the color parameter. In this research work, to attain an accurate contour super pixel image for improved local spatial neighborhoods, an efficient algorithm referred as multi-scale morphological gradient reconstruction (MMGR) operation is originally described. The significance of the proposed method lies in the relationships between the pixels and how they are utilized in the flow of the application. Compared to the conventional adjacent fixed-size and shape frame, the super pixel image provides improved adaptive and exact amount of irregular local spatial communities which help to enhance color image segmentation. Coming to the next step, the original color image is essentially based on the obtained super pixel picture, and the number of pixels in each super pixel region easily decides its histogram. Ultimately, FCM is implemented to obtain final segmentation results that increase the histogram parameter on the super pixel picture. The performance of the proposed method is computed using Matlab computing language and also a statistical measure is carried out based on different parameters and their respective graphical representations.

Keywords Pixel · Clustering · Image segmentation · FCM · Images

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_38

1 Introduction

Segmentation of images is a key step of computer vision identification and detection of objects. In this aspect of image processing, the image in question is segmented depending on specific characteristics such as regions and boundaries. While a large number of algorithms have been developed for the segmentation of images, image segmentation is still one of the most challenging research topics as none can provide a coherent framework for fast and effective segmentation of images. The primary part of the process is that image segmentation is a multiple solution problem, i.e. for one image, several best segmentation tests are conducted. Second, the picture of light, light and low-signal uniformity is often challenging [1]. These problems are caused by the intrinsic properties and the actual behavioral qualities at the given moment of the tools used for photograph collection. The difficulties in segmenting images can be due to two factors. First, the segmentation of the images is a multitude of problems, i.e. the existence of several best results for a single picture. The issues related to image attributes play a vital role in assessment of the methods that are employed in the various algorithms to find the probable best solution which is optimally good and perfect. The precise outcomes are always wanted in the most of the clustering applications as they depend on the random variables and their internal arrangements. Clustering is one type of significant and prevalent procedures for the purpose of segmenting grayscale and color images in unsupervised algorithms, for the reason that it is appropriate and beneficial for both low- and high-dimensional data. This type of segmentation method is highly commendable in the applications where the extraction of important features is a significant part of any of the image processing research programs [2].

This article focuses on the clustering segmentation of the image by raising an objective feature. K-means and FCM are known for their grouping of algorithms through minimization of a target function. These algorithms works finely depending on the grouping nature of the instructions, however FCM is most preferred amonst the two methods. Because k-means is a difficult algorithm for clustering, they are likely to initial clusters or membership centers. In comparison, FCM is a poor algorithm that confirms kmeans' shortcomings at the cost of increased iteration. The number of iterations which are needed for an algorithm to work is purely based on the part of the features that are required to be extracted from the entire image. However, due to missed local pixel information, both k-means and FCM are subject to noise for signal segmentation. The pixel informations such as their relationships with adjacent and neighborhood pixels is a very important factor while using these methods as the features can only be extracted based on their internal connections. Therefore, pixels and their relationships are seriously concerned to draw the particular region in an image based on the type of application opted for. A large number of improved clustering algorithms, which incorporate local spatial information into their objective function, have been proposed in recent years to address this shortcoming [3, 4]. Superpixels can absorb image continuity and reduce the difficulty of subsequent image processing tasks considerably. Typically, the

superpixel is created by grouping identical pixels, and the methods for extraction of Superpixels can be narrowly divided into two groups: graph based [5, 6] and gradient based solutions [7, 8].

We propose a super pixel-based Fast FCM (SFFCM), with the exception of FCM S and FLICM, to increase the computational complexity. The outcome is completely based on the pixel and region of the feature which is targeted to obtain from the image. The proposed algorithm can achieve a very low computational cost of segmenting the light image, resulting in a fast segmentation process.

There are two contributions: A multi-scale morphological gradient reconstruction technique (MMGR) is provided to create super-pixel image with proper boundaries which helps to incorporate adaptive neighboring information and the number of differences. The rendering of morphology-based images relies on the form theory of the objects in the picture, which also applies set theory in mathematical calculations [9]. Morphology is shape based science which has emerged as one of the most used methods in most of the image segmentation problems to attain the promising results because it purely depends on the structural characteristics of the concerened images for the particular application. We suggest a simple method of computing the color histogram using a super-pixel image obtained from MMGR which can be used to measure a single-color histogram [10]..

2 Methodology

For the segmentation of the gray scale and color picture, the large numbers of enhanced C-means (FCM) cluster algorithms were commonly used. But some time is time-consuming and cannot achieve optimal segmentation efficiency. Before moving to the main process, the acquired images are to be verified for their correctness in connection to the size, artifacts and type of modality used to acquire the image. In simple, the knowledge of how the image has been captured or where from the image has considered for operation is minimum required in most of the image processing procedures like these.

The FCM takes a great deal of time to segment the color image and the histogram of the color image is difficult to calculate. The histogram processing of color images is a complex issue due to the color models which are inherited into the image, as it is difficult to understand the types of color spaces utilized to create a particular image. We are proposing a simple super pixel FCM (SFFCM) to tackle this problem for the segmentation of color images. At very low computational costs, the proposed algorithm can achieve color image segmentation while ensuring high precision segmentation.

This methodology consists of 2 programs:

- We present a multilevel morphologic gradient reconstruction procedure (MMGR) to produce super pixel images with precise boundaries that helps to integrate neighboring adaptive information and reduces the numerous color pixels of different gradients.
- We are proposing a simple color histogram calculation method based on the MMGR pixel image to obtain a quick FCM algorithm to the color pictures section.
- Because a pixel image is superior to a near image's fixed dimensions and shape to provide better local spatial information. The proposed SFFCM algorithm involves primarily 5 steps in the proposed algorithm (Fig. 1).

Algorithm:

Step1: Acquisition of images

Step2: For the success of super pixel image segmentation.

Step3: Multi-scale operation performing Morphological Gradient Reconstruction (MMGR) that enlarges the shape of an image.

Step4: Cluster an image

Step5: Display the resulting image to make a simple flush cs

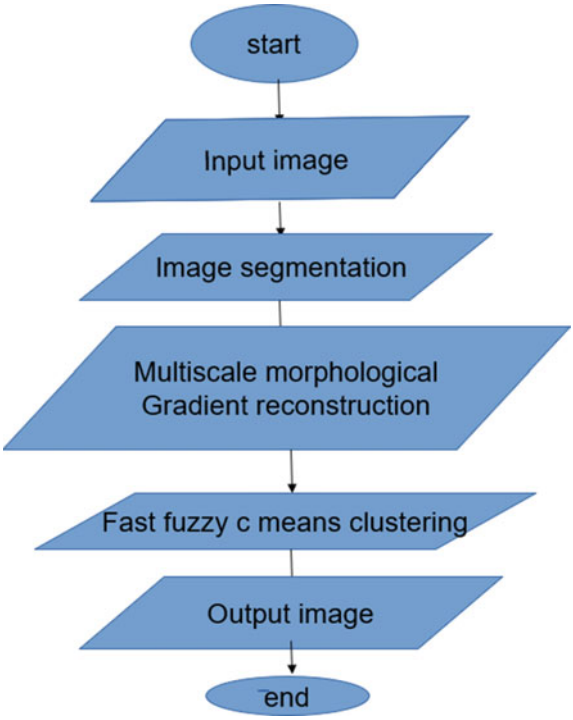
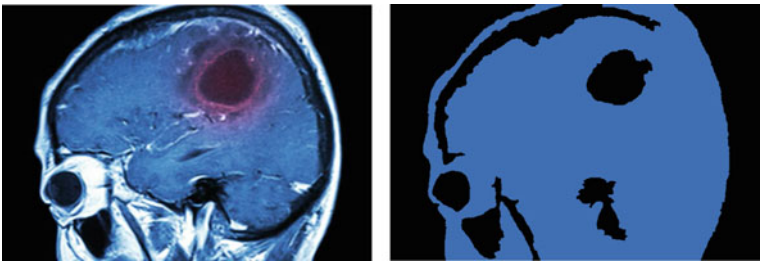


Fig. 1 Proposed process flow

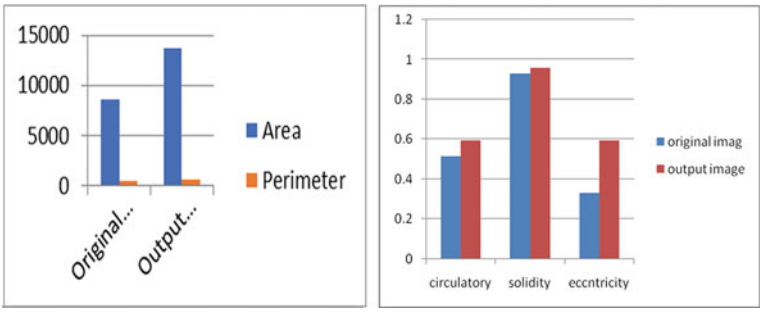


(a) (b)

Fig. 2 (a) Original image (b) Output image

Table 1 Parameter values of MRI image

Parameters	Original image	Output image
Area	8636	13659
Perimeter	434.578	577.027
Circulatory	0.5746	0.5155
Solidity	0.9503	0.9392
Eccentricity	0.3314	0.5951



(a) (b)

Fig. 3 **(a)** Area and perimeter graphical representation **(b)** parameter representation

3 Results and Analysis

The original MRI image as shown in Fig. 2(a) is subjected to the proposed fast superpixel algorithm which provides the segmented fig as shown in Fig. 2(b). In this process the histogram is regarded as a parameter or objective function for segmentation of colour image. Simultaneously its parameter values are computed as shown in Table 1 and its corresponding graphs are plotted in Fig. 3(a) and 3(b) respectively.

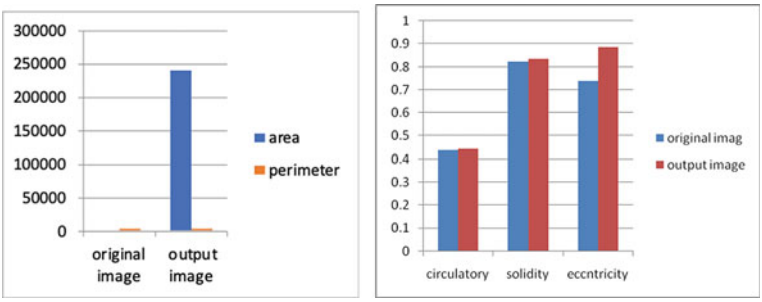
The original Vegetables image as shown in Fig. 4(a) is subjected to the proposed fast super pixel algorithm which provides the segmented fig as shown in Fig. 4(b). In these process the histogram is regarded as a parameter or objective function for segmentation of color image. Simultaneously its parameter values are computed as shown in Table 2 and its corresponding graphs are plotted in Fig. 5(a) and Fig. 5(b) respectively.

(a) (b)

Fig. 4 **(a)** Original Image **(b)** Output image

Table 2 Vegetable image parametric values

Parameters	Original image	Output image
Area	226299	239419
Perimeter	2545.783	2909.6196
Circulatory	0.4388	0.4446
Solidity	0.8217	0.8342
Eccentricity	0.8733	0.8844



(a) (b)

Fig. 5 (a) Area and perimeter graphical representation (b) parameter representation

4 Conclusion

In this color image segmentation project, a superfast FCM clustering algorithm (SFFCM) was proposed based upon super pixels. There are two major contributions to that. We made our first contribution to the MMGR process to gain a clear overview of the super pixels. The second contribution is to incorporate the color histogram into an objective method to achieve quick segmentation of the image. On both real and synthetic images, the new SFFCM is being checked. The SFFCM proposed is superior to the most sophisticated clustering algorithms and gives the best results and the shortest possible time. The main contribution is that we have integrated the histogram into an objective function to quickly segment the image. Finally, in order to obtain the final segments result, we implement FCM with histogram parameter in the superpixel picture. Experiments on synthetic and real images reveal the better segmentation outcome of the proposed algorithm and less time is required than state-of-the-art clustering algorithms for the segmentation of color images.

References

1. Lei T, Jia X, Zhang Y, Liu S, Meng H, Nandi AK (2019) Superpixel-based fast fuzzy C-Means clustering for color image segmentation. IEEE Trans Fuzzy Syst 27(9):1753–1766. https://doi.org/10.1109/TFUZZ.2018.2889018
2. Zeng S, Wang X, Cui H, Zheng C, Feng D (2018) A unified collaborative multi-kernel fuzzy clustering for multiview data. IEEE Trans Fuzzy Syst 26(3):1671–1687
3. Ma J, Li S, Qin H, Hao A (2017) Unsupervised multi-class cosegmentation via joint-cut over L1-manifold hyper-graph of discriminative image regions. IEEE Trans Image Process 26 (3):1216–1230
4. Gong M et al (2016) Nonparametric statistical active contour based on inclusion degree of fuzzy sets. IEEE Trans Fuzzy Syst 24(5):1176–1192
5. Kumar A, Shaik F (May 2015) Image processing in diabetic related causes. Springer-Verlag Singapur Publishers (Springer Briefs in Applied Sciences and Technology-Forensics and Medical Bio-informatics). (ISBN:978-981-287-623-2)
6. Bai M, Urtasun R (2017) Deep watershed transform for instance segmentation. In: Proceedings of IEEE conference computer vision pattern recognition. (CVPR), Honolulu, HI, pp 2858–2866
7. Comaniciu D, Meer P (2002) Mean shift: a robust approach toward feature space analysis. IEEE Trans Pattern Anal Mach Intell 24(5):603–619
8. Achanta R, Shaji A, Smith K, Lucchi A, Fua P, Susstrunk S (2012) SLIC superpixels compared to state-of-the-art superpixel methods. IEEE Trans Pattern Anal Mach Intell 34 (11):2274–2281
9. Pham DL, Prince JL (1999) An adaptive fuzzy c-means algorithm for image segmentation in the presence of intensity inhomogeneities. Pattern Recogn Lett 20(1):57–68
10. Cocosco CA, Kollokian V, Kwan RK-S, Evans AC (1997) BrainWeb: online interface to a 3D MRI simulated brain database. NeuroImage 5:S425

An Investigation on the Impact of Machine Learning in Wireless Sensor Networks and Its Application Specific Challenges

K. Praghash, T. Karthikeyan, K. Suresh Kumar, R. Sekar, R. Ramesh Kumar, and S. Arun Metha

Abstract The importance of Machine Learning (ML) in advanced system technologies are proven in literature. This chapter investigates the role of ML in Wireless Sensor Networks and the challenges specific to its applications. We discuss the background literature of the renowned ML concepts and ML techniques. Further we distinguish the role of ML in WSN with detailed literature review. Subsequently, ML techniques for WSN are discussed from the literature. This chapter ends with the description of Functional and application specific challenges.

Keywords Machine Learning (ML) · Wireless Sensor Networks (WSN) · Application · Challenges

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_39

1 Introduction

The current life scenarios associate numerous environmental data collected by sensors that are dynamic and vast. These data include but not limited to geo-location, frequency, electrical fluctuations, gas composition, image data and so on. Therefore, to process these data for a desired application or outcomes needs an advanced and high-performance technique. The architecture of Wireless Sensor Network (WSN) is more efficient in gathering such data and routing it to earmarked devices or nodes. We are all aware of the components of a typical WSN such as randomly deployed sensor nodes with a base station (BS) or sink node. An important significance of WSN is bidirectional functionality that it can transport the data from any node to BS or BS to any node via proper routing techniques.

The movement of WSN was supported for the most part by military applications for example war zone reconnaissance; right now this sort of systems is utilized in a few business just as purchaser applications, for example, business technique following and furthermore handle, machine well-being following, natural location and living space following. The WSN is made of hubs by a few different enough hubs which known as bits, in which each hub is associated with a solitary sensor. Each this sort of sensor arrange hub offers commonly numerous parts: a radio handset with an inward receiving wire or even connection to an external reception apparatus, a microcontroller, an electronic circuit for interfacing with the sensors and a force asset, generally a battery or a decorated sort of vitality Harvesting.

A sensor hub may shift in measurements from that of a shoe box down to the size of a grain of residue, while working "bits" of veritable tiny measurements have anyway to be made. The cost of sensor hubs is in like manner variable, running from a few to a ton of bucks, in view of the complexity of the sensor hubs. Size and cost limitations on sensor hubs lead to related limitations on resources for example vitality, memory, computational speed, and correspondences data transfer capacity. The topology of the WSNs may shift from an essential star system to a more significant level multi-bounce remote work organized [1]. The spread strategy between the jumps of the system might be chosen impacted by steering or flooding convention. A WSN may be used for various programs; we can summarize part of the tremendous applications, for example, habitat/vicinity watching, environmental/earth checking, crucial occasions/forest hearth acknowledgment and information logging. AI (ML) is the research of having pcs to study and act like people do and improve their mastering after some time in self-overseeing configuration, via dealing with this records and data within the structure of discernments and actual correspondences.

The remote sensor networks (WSN) is an important element on the internet of factors (iot). The little assessed, low filled sensors are organized for seeing what is greater, collecting facts from situation. Most of the progressing research works have not concentrated to offer a reaction for isolating the possibly huge share of statistics introduced through these sensor factors. On this manner, there may be a necessity for AI (ML) figuring in WSNs. On the factor when volume, velocity, and style of

information created through WSN is high, with the aid of then records exam gadgets are required for records collection and bundling. ML units are used in multiple makes use of, for instance, interference revelation, target following, social safety, home computerization, sagacious metropolis. The rule purpose of this segment is to offer main facts in AI and its packages in WSN.

2 The ML - A Background Study

For the most part, the creators of sensors represent AI as a part of fake insight, and it is an assortment of calculations that is fit for making expectation models. On the other hand, ML specialists portray it as a field, which is having colossal measure of examples, subjects valuable in sensor organize applications. Administered learning is only a detailing of the idea of gaining from models [3]. Administered learning approach is utilized to determine different issues for WSNs, for example, occasion location, objects focusing on, limitation, handling of question, Medium Access Control (MAC), interruption identification, security, information honesty, and QoS.

The choice tree arrangement includes anticipating yield marks by rehashing contribution of information utilizing tree of learning. Through the iterative system, a correlation of highlight assets virtual to choose circumstances is accomplished for spreading a specific classification. A lot of research was done in utilizing choice trees to address diverse structure difficulties in WSN, for example, recognizing joint dependability in WSNs utilizing choice trees [2]. Here the utilization of choice trees offers a general strategy for perceiving basic highlights for connect unwavering quality including misfortune rate, Restore MeanTime just as Failure Mean Time.

Bolster Vector Machines offer options for neural systems that are favored choices for taking care of nonconvex unconstrained improvement issues. With regards to WSN, they have been utilized for interruption location or distinguishing the malignant conduct of sensor hubs, security, and localization. With SVM, it is conceivable to reveal the spatial relationships in information, as the calculation includes developing a lot of hyper planes isolating WSN information estimations in highlight space, by as wide as potential edges.

Neural systems are one of the most well-known for taking in calculations for gaining information and can work with the assistance of choice units falling chains regularly called discernment and outspread premise capacities. The falling chains of choice units permit acknowledgments of non-direct and complex connections in information. In any case, the learning procedure with different falling chains is profoundly calculations escalated.

The K-NN is administered learning calculation and in this learning calculation, a test information is grouped dependent on the names of closest information tests. By processing a normal of readings inside its neighborhood, the absent or obscure test estimation is anticipated. Assurance of a closest arrangement of hubs is finished by utilizing various strategies [4]. One of least difficult techniques to decide the area is by utilizing the Euclidean separation between various sensors. As the separation

measure is figured utilizing barely any neighborhood focus with k typically a little positive whole number, the k-NN approach need not bother with high computational force. Because of its effortlessness, the k-NN calculation is reasonable for inquiry handling assignments in WSNs.

While most of the machines learning calculations require an enormous number of preparing tests to master, learning strategies dependent on Bayesian insights require lesser preparing tests. The learning occurs in Bayesian strategies by adjusting the likelihood dissemination to productively get familiar with the dubious names [5]. The significant part of this learning strategy is it utilizes the present information (that the gathered information tests (D)) to refine estimations of earlier conviction into back conviction esteems.

For unaided learning, there are no names given or there is no yield vector. The example set is characterized into unmistakable sets by looking at the similarity between these with a solo learning calculation. This kind of learning calculation discovers use in WSN hub bunching or information accumulation at sink code situations. Without any marks given, the solo AI calculation finds the shrouded connections and is reasonable for WSN issues, with complex connections between factors [6]. Two most significant sorts of calculations in this class are K-implies bunching and Principal part examination.

This learning calculation is very famous in the information pressure field and is utilized for dimensionality decrease. It is a multivariate strategy and intends to extricate significant data from information regarding head parts, which is nothing anyway a lot of new symmetrical factors [7]. The information pressure and dimensionality decrease are a multivariate strategy. Its target is to remove pivotal data from information. Likewise, it has a few new symmetrical factors known as head parts. These central parts are requested to such an extent that the main head segment is adjusted toward the most noteworthy difference in information, with diminishing variety for extra segments all together.

This allows the base change segments to be deserted as they essentially incorporate least data content, causing dimensionality decline. For WSN circumstances, this could bring down the amount of information getting transmitted among sensor hubs by getting a small pair of uncorrelated straight mix of inventive readings. Further, it can take care of the large information issue into little information by permitting determination of just huge head parts and disposing of other lower request irrelevant segments from the mode.

3 WSN with ML

Structuring a directing convention for WSNs desires to bear in mind exceptional plan difficulties, for example, energy utilization, deficiency resistance, versatility, and records inclusion [8]. Sensor hubs are supplied with restrained making ready capacities, little reminiscence also, low transfer velocity. Typically, it is not sudden to plot a directing issue in far flung sensor arrays as a diagram g = (v, e), wherein v

speaks to the association all matters considered, and e speaks to the association of bidirectional correspondence channels interfacing the hubs. Using this model, the directing difficulty can be characterized because the way towards finding the bottom price way starting on the supply vertex, and arriving at all aim vertices, via making use of the handy chart edges. This manner is a spreading over tree t = (v, e) whose vertices contain the source (i.E., a root hub) and dreams (i.E., leaf hubs that do not have any child hubs). Unraveling one of these trees with perfect information collection is visible as np-difficult, in any event, when the entire topology is understood [9].

A general system for sensors information demonstrating. This dispersed structure depends on the system hubs for fitting a worldwide capacity to coordinate their own estimation. The hubs are utilized to execute a part direct relapse in the type of weighted segments. Bit capacities map the preparing tests into some component space to encourage information control (allude to [10] for a prologue to portion strategies). The proposed structure misuses the way that the readings of numerous sensors are profoundly related. This will limit the correspondence overhead for recognizing the structure of the sensor information. Aggregately, these outcomes fill in as an significant advance in building up an appropriated learning structure for remote systems utilizing straight relapse strategies. The primary favorable circumstances of using this calculation are the acceptable fitting results, and the little overhead of the learning stage. Be that as it may, it cannot learn non-straight and complex capacities.

"Sensor Intelligence Routing" (SIR) by utilizing SOM solo figuring out how to distinguish ideal directing ways. SIR presents a slight alteration on the Dijkstra's calculation to frame the system spine and most limited ways from a base station to each hub in the system. During course learning, the subsequent layer neurons contend with one another to save high loads in the learning chain. In like manner, the loads of the triumphant neuron and its neighboring neurons are refreshed to further coordinate the info designs. Unmistakably, the learning stage is a profoundly computational procedure because of the neural system age task.

Accordingly, it ought to be performed inside a creative focal station. Notwithstanding, the execution stage does not bring about computational expense, and can be run on the system hubs. Accordingly, this half and half method (i.e., a blend of the Dijkstra's calculation and the SOM model) considers the QoS necessities (inactivity, throughput, bundle mistake rate, obligation cycle) during the way toward refreshing neurons' loads. The principle hindrances of applying such a calculation are the multifaceted nature of the calculation and the overhead of the learning stage for the situation that the system's topology and setting change.

The utilization of Q-learning calculation to improve multicast steering in remote impromptu systems. Essentially, the Q-MAP multicast steering calculation is intended to ensure solid asset assignment. A portable impromptu system may comprise of heterogeneous hubs, where various hubs have various abilities. Furthermore, it isn't plausible to keep up a worldwide, exceptional information about the entire system structure. The multicast courses are resolved in two stages.

The principal stage is "Join Query Forward" that finds an ideal course, just as updates the Q-values (an expectation of potential compensations) of the Q-learning calculation.

The subsequent stage, called "Join Reply Backward", makes the ideal way to permit multicast transmissions. Utilizing Qlearning for multicast directing in portable impromptu systems can decrease the overhead for course looking. Be that as it may, vitality effectiveness is the key necessity for WSNs, so Q-MAP needs to be altered for WSNs.

4 Functional Challenges

There are various operational or practical issues in the structure of WSNs, for example, vitality and memory requirements of sensor hubs, topology changes and correspondence associated destructions and decentralized administration. These sorts of operational issues can be settled from expending AI ideal models in the techniques for the WSNs work. The occasion acknowledgment and question preparing are fundamental operational needs of huge scope WSNs. The usefulness required after is a genuine occasion planning and acknowledgment with ostensible human contribution. Ordinarily, WSN following is ordered as an occasion driven. With AI subordinate occasion observing technique [11]. It is conceivable to obtain efficient occasion recognition and question handling cures under confined conditions with restricted inquiry zones.

Embracing AI subordinate techniques for these activities can prompt different preferences. Encourage development of solid occasion location procedures utilizing learning calculations and straightforward classifiers, especially with the restricted accessibility of capacity and registering assets. Encourage the development of valuable question preparing techniques for WSNs, for example, make sense of the query regions at whatever point an inquiry is originating from, and limit the correspondence endeavors there, rather than flooding the entire system.

A couple of the helpful systems involve depicting a harsh edge and incentive for pattern being detected and activating cautions for each infringement, albeit most recent WSN courses of action use significantly more complicated procedures than utilizing simple limit esteems. The multifaceted, developing techniques utilized propelled AI subordinate throwing of an issue for occasion recognition and question handling. There are a lot of issues in the plan of MAC conventions for WSNs, for example, power admission, idleness, and conjecture exactness and so forth., alongside key operational trademarks that plenty of sensors participate to adequately move information. Thus, the MAC conventions should be planned effectively to empower monetary information transmission just as inclusion of the sensor hubs [12]. Of late, various AI techniques additionally have been recommended for structuring reasonable MAC conventions just as expanding the presentation of WSNs.

Utilizing the correspondence foundation of the system to adaptively decide the responsibility succession of a hub. Here, which are powerful to anticipate despite the fact that different hubs transmissions are going to do, can sleep meanwhile and stand up just in spite of the fact that the station is relied upon to be best with no additional hub transmitting. Utilizing the ideas of making sure about information transmission alongside AI in planning the MAC layer convention. Such a protected MAC layer plan would be free of the proposed application and can learn inconsistent assault designs, iteratively

While the sensor hubs have limited preparing highlights, minimized memory, and lower transmission capacity, plans for a directing convention for WSNs need to regard various structure issues, for example, vitality utilization, adaptation to internal failure, adaptability, and information inclusion. The creation of a directing issue in remote sensor organizations generally is led as a charting issue G = (V, E), where V shows the pair all things considered and E speaks to the pair of bidirectional correspondence channels connecting the hubs [13]. Utilizing this chart demonstrating the system, the directing issue can be known as the way toward getting the negligible cost route from the source vertex to all goal vertices, by using the accessible diagram edges. The strategy of deciding geographic directions of system's hubs is known as limitation and area consciousness of sensor hubs in WSNs is a significant capacity. Utilization of GPS equipment in each hub of WSN, in any case, can gracefully area cognizance it unrealistic cost insightful. Also, GPS administrations are most likely not possible in saw remote and specific indoor areas. Moreover, GPS administration is most likely not open in the distinguished condition. Further, by applying closeness subordinate confinement [14]. These separation limits could be processed by different systems for example Received Strength Signal Indication, Arrival Time and Arrival Difference Time. Moreover, specific rakish estimations are accessible by using compasses or even interesting brilliant radio wires. Some proper techniques proposed by researchers for WSN limitation utilizing AI methodologies.

This truly is deficient to move whole information for sink in a split second to huge scope vitality compelled sensor systems. An inexhaustible proficient procedure ought to be to cross the information to a middle group head which is likewise presented neighborhood information gatherers which amasses information by whole the sensors into. It is a bunch just as advanced as a sink hub or the base station hub [15]. Dictated by how the bunch head determination or political race is led, you can achieve significant vitality reserve funds. Along these lines, various calculations are really proposed for group head determination/political race to build vitality productivity.

5 Application Specific Challenges

The steady learning framework is remotely associated with the patient, furthermore, gets the surge of information parameters from tolerant for a fixed time of interim. RBAIL calculation performs relapse on the significant wellbeing parameters for foreseeing the rashness of the patient. Framework utilizes history of the patient to check whether past inconsistencies were there in request to get the updates and criticisms. Fundamental includes here are accumulation, learning, and forecast [16]. Accuracy of the parameter is checked during accumulation. On the off chance that past information and current input information are substantial and parameter esteem is more noteworthy than a limit esteem, at that point variation from the norm is distinguished. If the distinction of current and anticipated esteem gets more noteworthy than an edge, at that point specialist gives input to address the learning.

Forecast rationale is utilized to anticipate the specific area of the sink hub utilizing current area. The assessed position is sent to Cluster Head to awaken the hub which is in rest mode. The blend of rest wake booking, grouping, following, expectation rationale, and most brief way directing limit the vitality utilization in sensor systems. Sink hubs conscious group head that assists with arriving at target.

Further unpredictable occasions handling motor is utilized for distinguishing irregular occasions in a multisensory situation. Semantics Intrusion Detection System consolidates design coordinating, state change, and information digging for expanding the precision of interruption location. Different sensors are sent in the sensor zone [17–20]. The occasions created by sensors are connected in time spatial space. The yields from the sensors are represented as examples and states. When the designs produced by sensors damage the standard, it is identified as an interruption. Semantics rules are created utilizing Another Tool for Language Acknowledgment. An Online Incremental Learning Algorithm is proposed for preparing the information on the web. It employs the blend of relapse and input system to diminish the expectation mistake and consequently improves precision. The crucial wellbeing parameters are gotten from the body sensors of a patient. Online Incremental Calculation assesses a few parameters based on the got information and checks whether any peculiarities are found. An alarm is set to the specialist if any inconsistencies are identified. Relapse based strategy is utilized to foresee the next occasion.

Expectation of every patient is customized as indicated by his/her wellbeing parameters. This calculation computes in general pattern by long worth, late pattern by short an incentive in wellbeing parameters. The parameters maxthresh and minthresh catches the most extreme and least limit estimation of resistance. Distinction between maxthresh and minthresh is caught by a parameter diffthresh. Quiet affectability range can be characterized through affectability go parameter by the specialist. History factor is a parameter that characterizes the number of times a patient is influenced to variations from the norm [21–24]. In the wake of perusing each new occurrence, these parameters are refreshed, blunder is balanced, what's more, as indicated by that expectation is made. The calculation predicts the

variation from the norm utilizing refreshed parameters and triggers alert. Hereditary Algorithm-based Personalized Healthcare Framework employs a sensor coordinated wearable chest lash for the non-obtrusive checking of physiological parameters and body parameters. Wrist wear remote Circulatory strain (BP) sensor is utilized for checking circulatory strain. A fingertip wearable oxygen immersion level (SPO2) sensor is utilized to identify blood oxygen immersion level.

The variation from the norm levels of the fundamental parameters are ordered into low (VL), low (L), medium (M), high (H), high (VH) and encoded into a 5-piece portrayal to decide the seriousness level of the patient. Utilizing fitting capacity, the best chromosome that speaks to the customized indispensable parameter of the patient is gotten. The productive medicinal services framework to serve the destitute patient in opportune time by the specialist Conventional Radial Basis Function (RBF) has issues with utilizing total preparing set and huge number of neurons [25]. Because of these issues, calculation time and intricacy are expanded. Dynamic More elevated Level Learning RBF is applied to wellbeing parameters to discover ordinary and irregular classes.

The DHLRBF utilizes both subjective and more significant level learning segments for successful order with less intricacy. Most of the current strategies experience issues to separate among unique and fall like examples. Insightful Modeling strategy, Adaptive Neuro-Fuzzy Inference System is utilized for identifying the fall consequently with higher precision and less unpredictability. The information got structure 3 pivot accelerometer is arranged into five states (sit, stand, walk, untruth, and fall) utilizing ANFIS model. Mean, middle, also, standard deviations are chosen for preparing the neural system. At the point when the state is distinguished as fall, it looks at ECG and pulse of patient to check the irregular condition and raise alert calculation.

6 Conclusion

This chapter analyses the importance of Machine Learning (ML) in advanced system technologies. The role of ML in Wireless Sensor Networks and the challenges specific to its applications are studied. Also, we discussed the background literature of the renowned ML concepts and ML techniques. Further we distinguished the role of ML in WSN with detailed literature review. Subsequently, ML techniques for WSN are discussed from the literature. This chapter ends with the description of Functional and application specific challenges.

References

1. Xiao Z, Liu C, Chen C (2009) An anomaly detection scheme based on machine learning for WSN. In: 2009 first international conference on information science and engineering. IEEE, pp 3959–3962
2. Alwakeel SS, Alhalabi B, Aggoune H, Alwakeel M (2015) A machine learning based WSN system for autism activity recognition. In: 2015 IEEE 14th international conference on machine learning and applications (ICMLA). IEEE, pp 771–776
3. Di M, Joo EM (2007) A survey of machine learning in wireless sensor networks from networking and application perspectives. In: 2007 6th international conference on information, communications & signal processing. IEEE, pp 1–5
4. Alsheikh MA, Lin S, Niyato D, Tan H-P (2014) Machine learning in wireless sensor networks: algorithms, strategies, and applications. IEEE Commun Surv Tutorials 16(4):1996–2018
5. Ayadi H, Zouinkhi A, Boussaid B, Naceur Abdelkrim M (2015) A machine learning method: outlier detection in WSN. In: 2015 16th international conference on sciences and techniques of automatic control and computer engineering (STA). IEEE, pp 722–727
6. Khan ZA, Samad A (2017) A study of machine learning in wireless sensor network. Int J Comput Netw Appl 4:105–112
7. Förster A, Murphy AL, Schiller J, Terfloth, K (2008) An efficient implementation of reinforcement learning based routing on real WSN hardware. In: 2008 IEEE international conference on wireless and mobile computing, networking and communications. IEEE, pp 247–252
8. Ahmadi H, Bouallegue R (2017) Exploiting machine learning strategies and RSSI for localization in wireless sensor networks: a survey. In: 2017 13th international wireless communications and mobile computing conference (IWCMC). IEEE, pp 1150–1154
9. Dwivedi RK, Pandey S, Kumar R (2018) A study on machine learning approaches for outlier detection in wireless sensor network. In: 2018 8th international conference on cloud computing, data science & engineering (Confluence). IEEE, pp 189–192
10. Warriach EU, Tei K (2013) Fault detection in wireless sensor networks: a machine learning approach. In: 2013 IEEE 16th international conference on computational science and engineering. IEEE, pp 758–765
11. Kulin M, De Poorter E, Kazaz T, Moerman I (2017) Poster: towards a cognitive MAC layer: predicting the MAC-level performance in dynamic WSN using machine learning. In: EWSN, pp 214–215
12. Varman SAM, Baskaran AR, Aravindh S, Prabhu E (2017) Deep learning and IoT for smart agriculture using WSN. In: 2017 IEEE international conference on computational intelligence and computing research (ICCIC). IEEE, pp 1–6
13. Lei F, Cai J, Dai Q, Zhao H (2019) Deep learning based proactive caching for effective WSN-enabled vision applications. Complexity 2019 (2019)
14. Alshinina Remah A, Elleithy Khaled M (2018) A highly accurate deep learning-based approach for developing wireless sensor network middleware. IEEE Access 6:29885–29898
15. Fadlullah Z, Tang F, Mao B, Kato N, Akashi O, Inoue T, Mizutani K (2017) State-of-the-art deep learning: evolving machine intelligence toward tomorrow's intelligent network traffic control systems. IEEE Commun Surv Tutor 19(4): 2432–2455
16. Vijaya Lakshmi A, Nagendra Babu KVT, Sree Ram Deepak M, Sai Kumar A, Chandra Sekhar Yadav GVP, Gopi Tilak V, Ghali VS (2019) A machine learning based approach for defect detection and characterization in non-linear frequency modulated thermal wave imaging. Int J Emerg Trends Eng Res 7(11):517–522
17. Sampath Dakshina Murthy A, Satyanarayana Murthy P, Rajesh V, Hasane Ahammad S, Omkar Lakshmi Jagan B (2019) Execution of natural random forest machine learning techniques on multi spectral image compression. Int J Pharm Res 11(4):1241–1255

18. Sreedhar Babu S, Bojja P (2019) Machine learning algorithms for MR brian image classification. Int J Recent Technol Eng 8(3):6744–6747
19. Maddisetti L, Senapati RK, Ravindra JVR (2019) Supervised machine learning for training a neural network as 5:2 compressor. Int J Innovative Technol Exploring Eng 8(10):2079–208
20. Dudi B, Rajesh V (2019) Medicinal plant recognition based on CNN and machine learning. Int J Adv Trends Comput Sci Eng 8(4):999–1003
21. Maddisetti L, Senapati RK, Ravindra JVR (2019) Training neural network as approximate 4:2 compressor applying machine learning algorithms for accuracy comparison. Int J Adv Trends Comput Sci Eng 8(2):211–215
22. Raju K, Pilli SK, Kumar GSS, Saikumar K, Jagan BOL (2019) Implementation of natural random forest machine learning methods on multi spectral image compression. J Crit Rev 6 (5):265–273
23. Mittal S, Mittal VK (2019) Biomedical requirements for human machine interface towards building a humanoid: a review. In: 2019 IEEE 16th India council international conference, INDICON 2019 - symposium proceedings, vol 1, pp 1–6
24. Sripath Roy K, Roopkanth K, Uday Teja V, Bhavana V, Priyanka J (2018) Student career prediction using advanced machine learning techniques. Int J Eng Technol 7(2.20):26
25. Danthala S et al (2018) Robotic manipulator control by using machine learning algorithms, a review. Int J Mech Prod Eng Res Dev 8(5):305–310

Morphology and ADF Based Brain Tumor Detection System from MR Images

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Abstract Brain tumor is a chronic disease, which can not be correctly identified without an MRI. To minimize the contrast between consecutive pixels in order to pave the way for morphological operation on the MRI image, the image must first be filtered from this paper using the Anisotropic Diffusion Filter (ADF) to. After that, the image must be resized and converted physically to a black and white image using a threshold value. The primary filter considers potential locations for a tumor to develop. In this semi-image, morphological operations would be performed, and information on the solidity and regions of appropriate locations was obtained. The minimum value of both characters is determined on a statistical average of various tumor-containing MRI images. The key aim of this work is to classify the tumor by collecting 2D tumor image data by MRI photographs obtained from various angles of a single individual, and to examine them to show the precise 2D location of the tumor. To achieve this, for greater precision, 2D detection and segmentation of tumors has been established, so that 2D detection can be more accurate. This research work is implemented in MATLAB method with version R2015a or higher.

Keywords Brain tumor · MRI images · Anisotropic diffusion filter · Morphological operations · MATLAB

1 Introduction

Brain is one of the vastest and most complex structures of the human body. This consists of over 100 billion nerves participating in trillions of the connections that are called synapses. A tumor has the capacity to influence output. Brain Tumor will be the development of irregular neural tissue cells. As of the 2018 India

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_40

cancerindia.org.in study, 28,142 new cases are identified due to brain tumour [6]. This left 24,000 people homeless. It ranked 10th among all tumors identified. This has a death rate of 3.34 per cent.

MRI is preferred among them all the other imaging modalities for its better performance. On the paper defined in reference [2] multiple filtering is used to minimize the noise in an image. For that reason we are using Strong Velocity, Median, Adaptive, Average, Gaussian Filters etc. Image segmentation is a process used to divide the image into various regions. Any of the techniques used to segment the image are Thresholding, clustering, the process of setting thresholds etc. Morphological operations are used as a post-method to retrieve an image of the tumor. For this function may be used dilation, oxidation, open filter, close-filter. These procedures are conducted on the binary image, and the tumor can be located in the image of the MRI brain data by combining all of the disjointed images. From the paper entitled "Brain Tumor Diagnosis Using Anisotropic Filtering," cited [1], the limitations are: High-pass filters offer the highest MSE values, Gaussian and Adaptive filters will not give low-noise images and above filters are capable of producing low-noise images Low prices to PSNR. Anisotropic diffusion filter has the ability to reduce noise more than that of mean and median filters from the paper described in reference [3]. Thresholding technique gives the best segmented image by using the black and white classes from the paper described in reference [5]. The paper stated in reference [4] notes that by classifying the total image into black and white pixels, the thresholding operation provides the position of the tumor.

MRI images are more advantageous than CT images, as shown in the reference paper [7]. They offer the images with definite edges which can be processed using different edge detection techniques.

2 Image Processing Techniques Used

The anisotropic diffusion filter generates images with high PSNR (Peak Signal to Noise Ratio) values and lowest MSE (Mean Square Error) values, as well as a greater reduction of noise [8]. The suggested system is comprised of three levels. The first step is to reduce noise, which can be accomplished by filtering the MRI image of the brains through Anisotropic Diffusion. The second stage is related to the segmentation cycle, which can be accomplished by thresholding procedure [9]. The final stage includes morphological operations on the segmented specimen, which detect the presence of the tumor in the MRI data image. The various phases can be pictorially depicted in the process flow diagram in Fig. 1.

Several abnormal MRI images can be obtained from hospitals or clinics. Preprocessing the images is a simple step in this regard to eliminate objects that are present if any. A single MR image may be used as an reference for identification of the tumor. The data is measured at 256 * 256 pixels and 8-bit grayscale. Standard image does not include high density areas but an unusual image includes high density areas that need to be studied (Fig. 2).

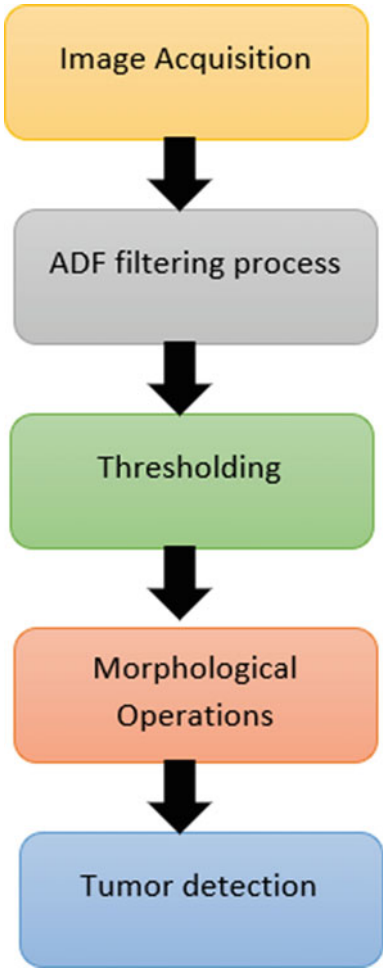
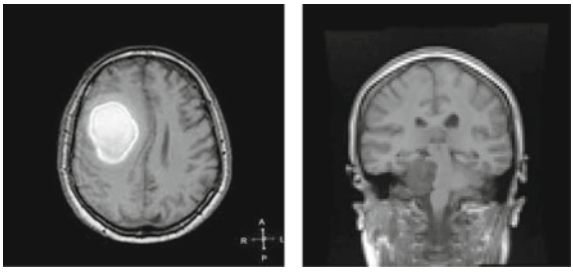


Fig. 1 Process flow of the proposed system



(a) Normal MR scan (b) MR image with abnormality

Fig. 2 MR images of brain

In tumor identification we choose MR images primarily because of its inherent characteristics to separate soft tissues from hard tissues and also its advantages. The benefits of MRI are based on the ability for detecting irregularities that may not be apparent or that can only be seen incorrectly on CT. MRI is less dangerous than X-rays, and less attenuated to the bone.

Anisotropic filtering
Filtering methods are primarily used in digital images to eliminate the noises. Noise shortens the picture quality. The image has so many forms of eliminating the noise. Most algorithms for image processing don't work well in the noisiest conditions. For this algorithm Anisotropic filter is mostly used among different filters.

Image segmentation using thresholding
Thresholding is a easy but efficient way to partition an image into a backdrop and a foreground. This technique is a kind of segmentation of images that isolates objects by transforming grayscale images as binary images. Increasing pixel on an image is replaced with a black pixel in thresholding, if the image intensity is less than some specified constant. Or a white pixel, if the color of the image is greater than the constant. There are other thresholding methods, such as the shape-based Histogram methods, clustering methods, Techniques based on entropy, methods dependent on object attributes, and spatial and local methods. But we use clustering strategy, where specimens of the gray level are clustered in the background and foreground.

Morphological operations
Morphology is an tool for extracting image structures that are valuable in taskforce and also as boundaries, skeletons, and convex hulls are a recital of area shape. Structuring element (kernel) is necessary for morphological activity. In reality, the kennel used is usually much smaller than a 3* 3 matrix sometimes used in the picture.

3 Experimental Results

Through this study, we have attempted to identify the tumor inside an irregular MRI image of the brain. Noise reduction using Anisotropic filter is conducted to detect the tumor, segmentation using thresholding, and morphological operations. The Fig. 3 depicts the ultimate performance with the answer for each move.

The statistics regarding with the result gives the location of the tumor present in an MRI image. The value for performing the thresholding operation is taken as 0.6 and the dilation factor is taken as 5. Thus the code captures the regions where the image density is more than the threshold value.

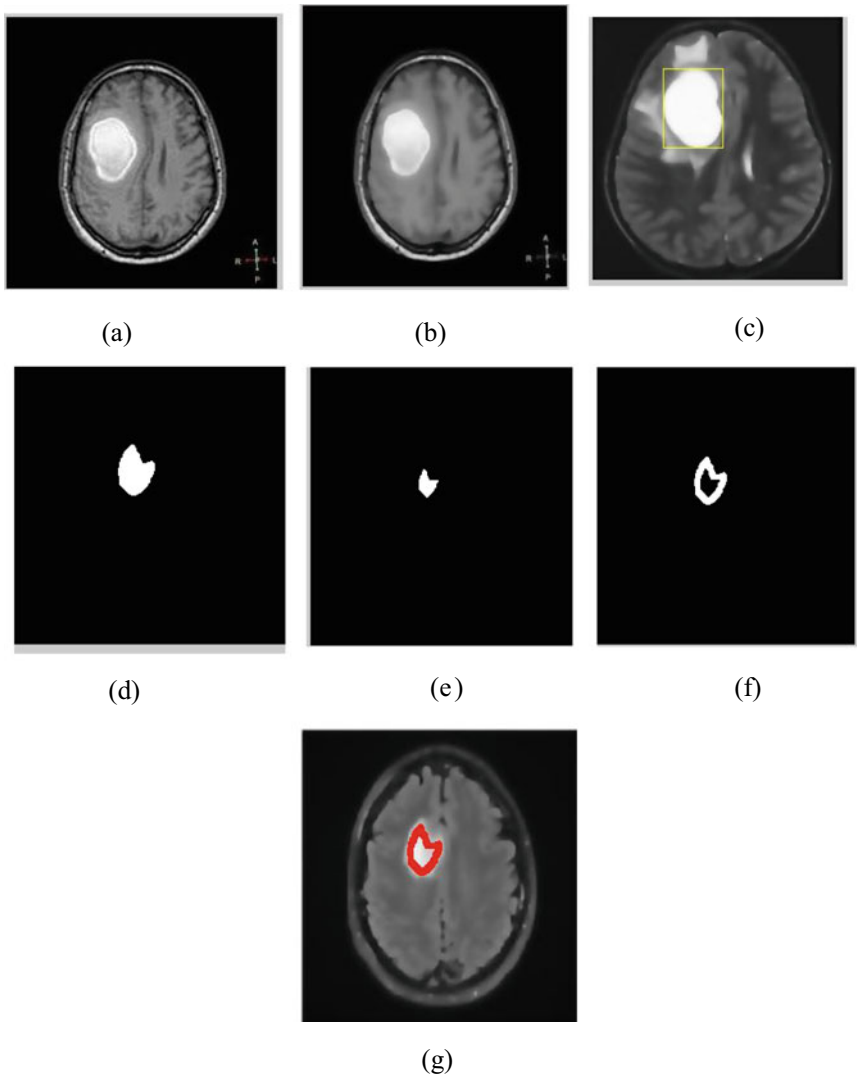


Fig. 3 Combine output of various operations on brain MRI image: (a) Original Input image (b) Enhanced image (c) Tumor alone (d) Bounding box (e) Eroded image (f) Tumor outline (g) Detected tumor

4 Conclusion

The original image of the MRI Brain input which has been acquired by the modality has various noises such as salt and pepper noise, Gaussian noise, etc. and it should be noise-free, for proper segmentation and morphological efficiency. Thus in this

research work Anisotrop Diffusion filter is used in comparison with High Pass and Wiener filter for better efficiency. Thresholding is used for purposes of segmentation and classifies the pixels into two classes. Morphological operation is used to extract the tumor part from segmented image for displaying the final output.

References

1. Rashid MHO, Mamun MA, Hossain MA, Uddin MP (2018) Brain tumor detection using anisotropic filtering, SVM classifier and morphological operation from MR images. In: 2018 international conference on computer, communication, chemical, material and electronic engineering (IC4ME2), Rajshahi, https://doi.org/10.1109/ic4me2.2018.8465613, pp 1–4
2. Kapoor L, Thakur S (2017) A survey on Brain Tumor Detection using Image Processing Techniques
3. Palma CA, Cappabianco FAM, Ide Paulo JS, Miranda AV (2014) Anisotropic diffusion filtering operation and limitations-MRI Evaluation
4. Handore S, Kokare D (2015) Performance analysis of various methods of tumor detection. In: Proceedings of "international conference on pervasive computing (ICPC)
5. Nandi S (2015) Detection of human brain tumor using MRI image segmentation and morphological operators. In: Proceedings of IEEE international conference on computer graphics, vision and information security (CGVIS)
6. Murugavalli S, Anitha V (2016) Brain tumor classification using two-tier classifier with adaptive segmentation technique. IET Comput Vis J 10(1), 9–17, 18
7. Suneetha B, Jhansirani A (2017) A survey of image processing techniques used to detect brain tumors using Magnetic Resonance Imaging. IEEE Edition 2017
8. Santosh S, Kulkarni S, Raut A (2017) Implementation of image processing for brain tumor identification. IEEE 2017
9. Kumar A, Shaik F (May 2015) Image processing in diabetic related causes. Springer-Verlag Singapur Publishers. Springer Briefs in Applied Sciences and Technology-Forensics and Medical Bio-informatics. (ISBN:978-981-287-623-2)

Optic Disk Segmentation for Glaucoma Detection in Retinal Images

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Abstract Segmentation of optical disk and optical cup from retinal fundus images help to diagnose the abnormalities such as Glaucoma and can help to create awareness among the common man to plan for proper treatment plan in order to avoid complete visual morbidity. The original input image is at first filtered by means of histogram processing and further subjected to morphological image processing in order to classify the positions of optic cup and optic disk. This complete computation procedure is simulated using Matlab technical computing language.

Keywords Recognition of the features · Graphic retinal fundus · Morphological closure · Optical disk and cup · Segmentation

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_41

1 Introduction

Thanks to the efficient use of retinal image by biomarkers in early detection of many conditions such as cardiovascular disease, asthma, glaucoma and diabetic retinopathy (DR), etc., the automated retinal image analysis has gained considerable research attention in recent years, the automated retinal image analysis has gained considerable interest in recent years. Glaucoma is associated with leading causes of blindness, with suffering globally affecting around 415 million people. Glaucoma is an eye abnormality that can affect human vision, or even cause irreversible loss of vision. However, the patient can't recognize visual impairment at the early Glaucoma stage, which can result in loss of vision for a long life. A patient also needs a route examination which will help him/her delay the onset of vision loss or blindness. Through careful analysis of the patient's retinal image, Glaucoma can also detect its early stages through trained ophthalmologists. This will help in the proper use of preventive drugs and successful therapies to reduce life losses. The small number of ophthalmologist's specialists, however, can't keep up with the drastic rise in the number of patients suffering from Glaucoma. Therefore, the development of an automatic Glaucoma detection system based on the digital retinal fundus photograph is impending and urgent [1].

Optical disk segmentation is also important to the automated detection of other ophthalmic pathologies. Glaucoma is one of them, and perhaps the most notable. It is the world's second most severe cause of blindness by identifying the form, color, or depth changes it causes in the OD. Hence its segmentation and analysis may be used to reliably diagnose glaucoma signs.

This work introduces the development of a new Optical Disk (OD) segmentation technique based on OD's statistic properties. This strategy initially centered on the location of the OD's theme pixel, which can also be called Optic Disk Pixel (ODP). When extracting the ODP from the retinal image, the sub-image is filtered and processed for blood vessel removal. Circular Hough Transform (CHT) is in fact implementing a new approach for segmentation of OD [2].

2 Need and Importance

Optical disk (OD) is considered to be one of the most important aspects of retinal fundus image detection OD in many retinal structure automated image segmentation systems, a typical stage in most retinopathy screening procedures. The OD has a vertical oval outline (elliptical) separating the central region or cup and the peripheral zone or neuroretinal field into two distinct regions. In this post, we use Optical Disk segmentation strategy technique that is based on OD's statistical properties.

The need for this model is to segment the optic disk (OD) and create a standard framework for treating pathologies of the optic nerve head, such as glaucoma.

Therefore a robust OD segmentation technique is necessary for the automatic detection of abnormalities in the head of the optic nerve [3].

The purpose of this model is to define the outer boundary of the optic disk which may enable ophthalmologists to measure changes in the optic disk quantitatively over time. Segmentation of the OD is required in order to establish a frame of reference within the retinal image and is therefore important for any interpretation of the picture analysis.

3 Literature Review

The ratio of optic cup to disk (CDR) in retinal fundus images is one of the key physiological features for the diagnosis of ocular disease, glaucoma. The CDR is currently measured manually, and can be arbitrary, thus preventing its use in mask screening. The algorithm for climbing the Hill extracts values from k, the cluster tool used to remove the optical disc. A sample of 50 retinal images is used to test the CDR output decided on the clinical CDR and 90% accuracy is derived from the CRD-decided tests [3]. The results show the potential applicability of the approaches in automated and objective mass screening for early glaucoma detection.

This [4] paper suggests a computer-aided decision support framework for the automated identification of monocular images of the glaucoma background. Detection of Glaucoma using fundus images involves calculation of the size, shape of the Optic Cup and the surface of the Neuro retinal. Identification of the Optical Cup is a challenging task because of the cup's interweaving with the blood vessels. Using K- means clustering, a new color model technique is used to differentiate the boundary between the Optical cup and the disk, based on the pallor of the fundus images. The procedure varies according to the original measurement of the optic cup area accompanied by the blood vessel erasure.

In addition to the shape-based features, textural features are extracted to better define pathological subjects, the optimal set of features chosen by the Genetic algorithm are fedas input to the Adaptive Neuro-Fuzzy inference method for classifying images into regular, suspected and abnormal categories. 55 photographs combined with normal and glaucoma pictures tested the method. In terms of classification accuracy and convergence time the performance of the proposed approach is contrasted with that of the Neural Network and SVM Classifier. Experimental studies indicate that the functions used are clinically relevant to good glaucoma diagnosis [6].

The texture features of the glaucoma picture are evaluated based on the probabilistic neural network [7]. The extracted features are correct and the Glaucoma is graded based on energy transfer and the study of the key components. The PCA-PNN and DWT-PNN have reached 90 percent and 95 percent respectively strong classification. This demonstrates the effectiveness of wavelet as an extractor feature and PNN as a classifier-relative to another recent study [5.]

Provide a phase method-by-phase analysis of the correct evolution of the optical coherence tomography(OCT) photos and the morphology of the Retinal Nerve Fiber Layer (RNFL). RNFL thickness decreases as the pressure increases which contributes to glaucoma. Using Entropy equation, the RNFL is segmented. The segmented RNFL is has been smoothed with Bezier curve technique. The lower-superior temporal nasal (ISNT) ratio experiences variations in glaucoma status. The algorithm is verified by means of 12 standard RNFL images and 45 RNFL images collected from patients with glaucoma [8].

In this [9] paper it is suggested that glaucoma detection be detected by separate segmentation algorithm from the fundus picture and the spectral scope of optical coherence tomography is proposed. Specific segmentation algorithms are introduced to separate areas of discs and cups. Algorithms are Otsu, a clustering the field, c-means and climbing up the hill. The retinal nerve segmentation Fiber helps to assess disk and cup thickness [5].

4 Existing Method

The purpose of this analysis is to first segment the disk. The test images from DRISHTI-GS dataset are regarded as feedback for the current method.

Otsu thresholding is the process that already exists. In this step, the retinal image is first pre-processed by adding equalization to the histogram. The spherical optic disk is segmented by the adding of the circular detector Hough transform. The optical cup is just separated from the retinal image's green channel. Measurements of results including dice coefficient, average boundary location and error in the cup-disk ratio. RGB (red, green, and blue) refers to a color representation scheme that will be displayed on a computer monitor. To achieve some color red, green, and blue should be mixed in various quantities in the visual spectrum. R, G and B concentrations should range from 0 to 100 percent of the maximal resistance. The set of decimal numbers from 0 to 255 (256 levels for each color) is specified for each level, similar to the set of binary numbers from 00000000 to 11111111 or hexadecimal 00 to FF. The total number of available colors is 256 x 256 x 256, or possible colors are 16,777,216. The planes red (R), green (G) and blue (B) are divided and strengthened by an equalization of histograms. Histogram Equalization is a digital image analysis tool used to improve image contrast. This is done by transmitting the most frequently used strength values efficiently, i.e. by extending the range of the image. This method typically enhances total image contrasts as accessible data is represented as by near-contrast values. It results in a stronger contrast for low-spatial-contrast regions.

5 Proposed Method

MESSIDOR offers methods for testing the Retinal Ophthalmology segmentation and indexing process. The primary goal of the MESSIDOR project in the sense of Diabetic Retinopathy and Diabetic Maculopathy is to compare and assess:

- Different segmentation algorithms build for the identification of lesions present in color retinal images;
- Tools for indexing and maintaining image repositories.

The suggested approach called gray level thresholding is to eliminate certain pixels representing an object from the image. Objects are often descriptions of text or other line images (graphs, maps). All target pixels have a gray level after thresholding the image, and the background pixels have a different color. The highest threshold is the one that selects all entity pixels the black and maps it. Unfortunately, constructing a specific threshold that is 'efficient' for an arbitrary gray-level image is not generally feasible, while creating an image that cannot be a good threshold for a specific value is a straight forward matter. In actual photos, this sort of condition may also occur due to noise or non-uniform lighting.

Gray Level Co-Occurrence Matrix
Texture analysis Using the Gray-Level Co-Occurrence Matrix (GLCM) The Gray-Level Co-Occurrence Matrix (GLCM), also known as the Gray-Level Spatial Dependency Matrix, is a mathematical method for texture analysis that recognizes the spatial relation between pixels Abstract- Feature Extraction is a process of gathering the visual quality of photographs for indexing and retrieval. Gray-Level Co-occurrence Matrix (GLCM) method is a means of eliminating second order statistical texture features. The GLCM functions define the texture of an image by calculating how often pixel pairs of different values occur in an image, producing a GLCM, and then extracting statistical measurements from the matrix.

Support Vector Machine
Support Vector Machines (SVM): A simple and efficient classification algorithm with a limited amount of data that performs very well. The Support Vector Machine (SVM) is a supervised learning model with related learning algorithms in machine learning which analyzes the data used for classification and regression analysis. This is used mainly in classification problems. The data object is plotted as a point in n-dimensional space in this method (where n is number of features), with the value of each element being the value of a particular coordinate. The distinction is then made by determining the hyper-plane which distinguishes the two groups better. Besides performing linear classification, SVMs can effectively perform non-linear classification by mapping their inputs indirectly into high-dimensional spaces of attributes.

6 Methodology

Algorithm for image segmentation using Gaussian mixture models

Step1: Image acquisition from data base.
Step2: Applying gray thresholding.
Step3: Removal of the inappropriate edges by filling and deleting process.
Step4: Repeat the step3 to remove two large blobs.
Step5: Circles are drawn on the basis of the centroid, the major axis length and the board axis length.
Step6: Displaying the display picture of the disk and cup boarder.
Step7: Obtain Cup-disk ratio and Rim-disk ratio.
Step8: Classification of the issue of the patient's symptoms.
Step9: Using Gray level co-occurrence matrix (GLCM) to remove various parameters.
Step10: Using Support vector machine (SVM) to identify the final diabetic retinopathy (or) diabetic maculopathy.

Optic disk (optical nerve head) is the circular cup region, where the ganglion cell axons detach from the body. Although the optic disk has no rods or cones, each pupil leads to a small blind spot. The optic disk is often an entrance point for large blood vessels that supply the retina. The area between the cup border and the disk border is considered the surface layer of the neuroretinal. The boundary segmentation was centered at the boundary between the disk and the retina (Fig. 1).

7 Results and Analysis

The database reference picture of the retina is represented using two blobs, i.e. disks and cup circles, to be repeated over two periods. Gray limits are eliminated and the edges formed by the filling and dilation operations. The performance photographs collected are also categorized on the basis of characterized such as patient age, diabetes and glaucoma. Depending on the signs and combination of Gray Level Co-occurrence Matrix and Support Vector Machine, if glaucoma is observed, it helps to assess whether the current glaucoma is converted to diabetic retinopathy (or) diabetic maculopathy; Within this relationship, five photos were considered for scientific research, and their respective disk and cup pictures and boundaries can be seen in Figs. 2, 3, 4, 5 and 6

A comparison table is then defined for parameters such as centroid, length of main axis, length of small axis, CDR, RDR [9] along with comments about whether glaucoma is present or not. Besides the tabular chart, it can be observed that the specific age groups were specified for the analysis of the proposed program. Depending on the age, records of diabetes and glaucoma such as 'No Glaucoma,'

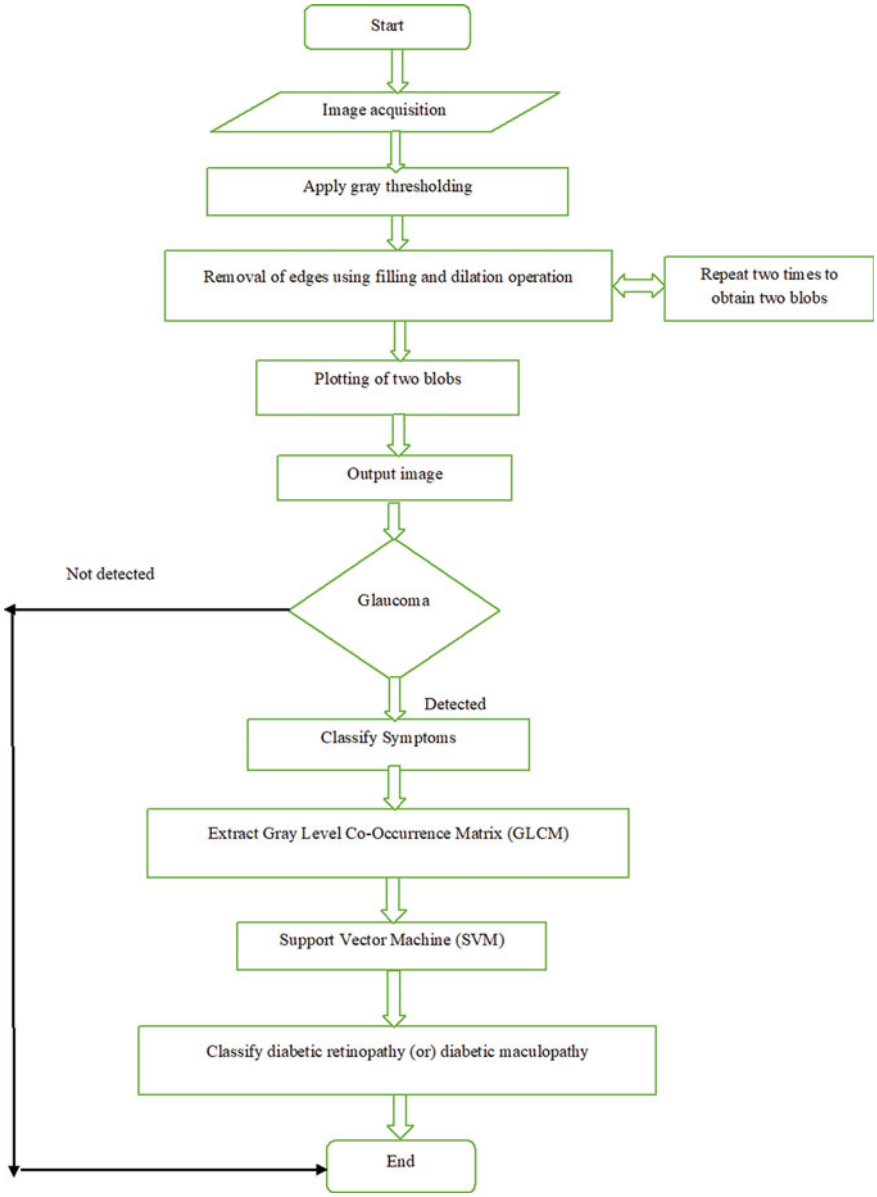

Fig. 1 Proposed process flow

2-month check-up alert of the individual's impending glaucoma, 'Glaucoma chance' and circumstances of 'Glaucoma risk' (Table 1).

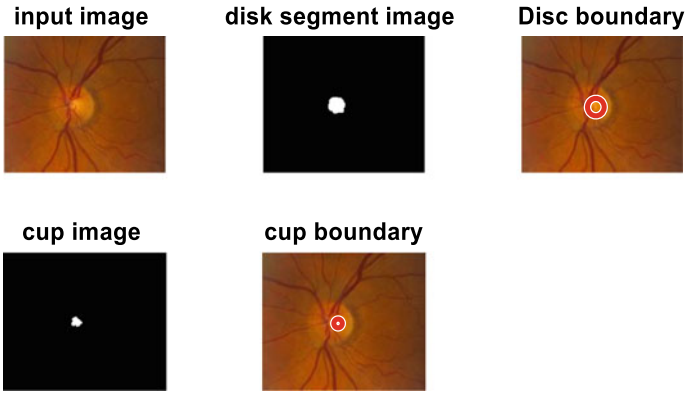

Fig. 2 Disc and cup extraction of 1st image

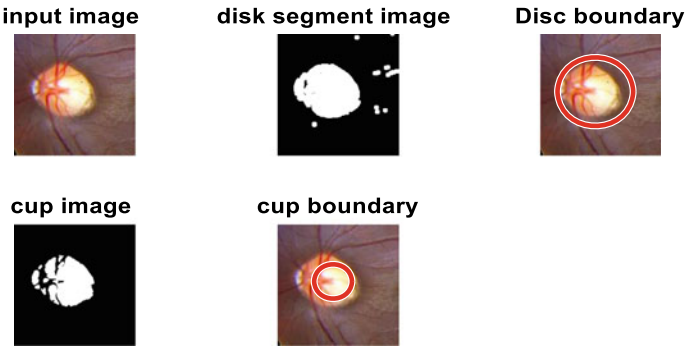

Fig. 3 Disc and cup extraction of 2nd image

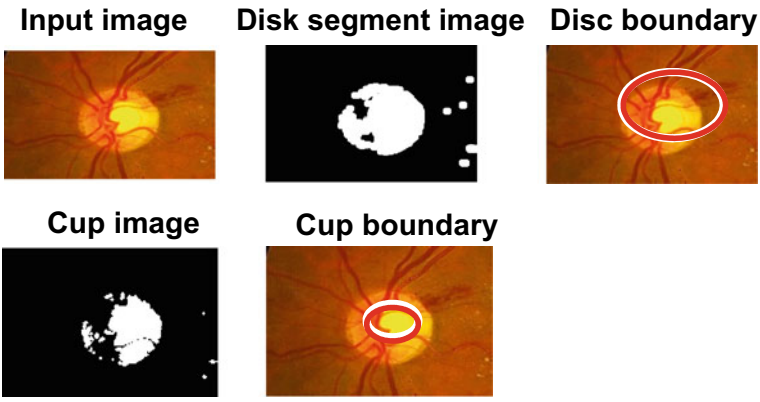

Fig. 4 Disc and cup extraction of 3rd image

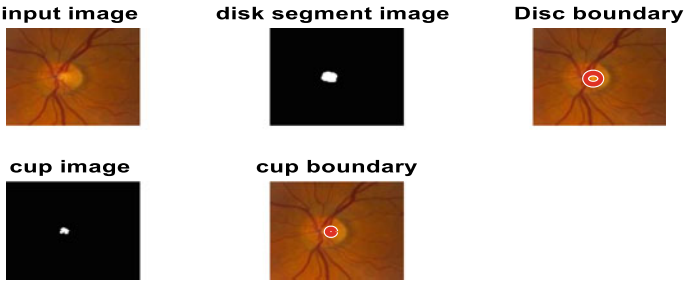

Fig. 5 Disc and cup extraction of 4th image

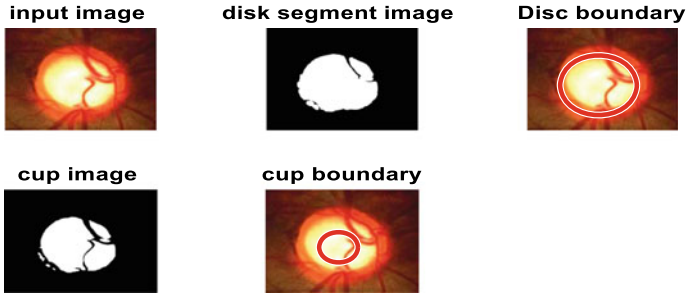

Fig. 6 Disc and cup extraction of 5th image

Table 1 Comparison of parameters

S. no	Attributes (age, diabetics, glaucoma)	Centroid	Major axis length	Minor axis length	CDR	RDR	Remarks
1.	30,4.4,13	[134.3295 120.4711]	31.1875	28.5086	0.315231	1.106104	No glaucoma
2.	36,7,25	[126.8268 143.5169]	192.1792	149.7244	0.256474	0.66664	Very high risk
3.	37,5.5,22	[167.2276 121.4413]	150.8038	119.4714	0.39059	0.568217	Risk glaucoma
4.	40,5,15	[137.3227 155.3978]	36.4336	32.1224	0.329069	1.033654	No glaucoma
5.	47,8,26	[232.8340 236.0730]	259.5391	234.1010	0.826816	0.106892	Very high risk

8 Conclusion

This paper is used to diagnose the detections of glaucoma from the images of the fundus and OCT. We need human comprehension of the optical disks and cups portion. Computer algorithms are used to classify the optical disk and cup to avoid duplication and to get right results. The cups are defined using the Gray Thresholding type. The form and scale of the structuring element as well as the boundary processes are used to learn the value of the Cup-Disk and Rim-Disk ratio using a statistical morphological method. Glaucoma is done for a diabetic patient because of the combination of the boundaries between the cup and the disc. Patients of diabetes get exudates in their plasma.

References

1. Muramathsu C, Nakagawa T, Sawada A, Hatanaka Y, Yamamoto, Fujita H (2011) Automatic measurement of cup to disc ratio based on line profile analysis in retinal images. In: Annual International Conference of the IEEE Engineering in Medicine and Biology Society, pp 3387–3390
2. Yin F, Liu J, Wong DWK, Tan,NM, Cheung C, Bascaran, WTY (2012) Automatic separate of an optical disk & optical cup in glaucoma diagnostic picture. In: 25th IEEE international symposium on software-based medical applications
3. Ho MH, Chutatape O (2003) limitation of optical disc using the improve ASM process. Pattern Recogn 36(9):1993–2004
4. Ho C, et al (2013) Identification of Superpixel-centric optical disk and optical cup segmentation for glaucoma safeguard. Uh. IEEE Def IEEE Trans Med Oh Imaging 32(6), 1019–1032
5. Tan NM, Xu Y, Goh WB, Liu J (2015) Reliable multi-scale super pixel labeling for optical cup location. This is programing U. Pharm Man Oh Med Imaging 40:182–193
6. Almazroa, man, man (2015) Optical disk and optical cup segmentation methodologies for the identification of glaucoma picture: study. L Ophthalmol. 189972-1–180972-28
7. Shaik F, Sharma AK, Ahmed SM, Gunjan VK, Naik C (2016) An improved model for analysis of Diabetic Retinopathy related imagery. Indian J Sci Technol 9(44). (ISSN: 0974-6846)
8. Mathworks I (2014) MATLAB: R2014a. Math works Inc., Natick
9. Sivaswamy J, Krishnadas SR, Joshi GD, Jain M, Tabish AUS (April 2014) DRISHTI-GS: retinal picture dataset for segmentation of the optical nerve head (ONH). In: IEEE 11th international symposium on biomedical imaging, pp 53–56

Speckle Based Anisotropic Diffusion Filter for Ultrasound Images

P. Siva Kalyani, S. Nazeer Hussain, N. Vishnu Teja, S. Younus Hussain, and B. Amarnatha Reddy

Abstract Imaging of Ultrasound (US) presents significant challenges in visual medical inspection and creation of automated speckle-based analytical approaches that adversely influence tissue boundary detection and the efficacy of automatic segmentation techniques. A number of filtering strategies are usually used as a pre-processing phase before automatic review or visual inspection methods to minimize the impact of speckle. Many state of the art filters seek to decrease the speckle effect without recognizing its significance to tissue structure classification. This loss of expertise is further magnified due to the iterative process of some speckle filters, e.g. diffusion filters, which tend to produce over filtering during the diffusion period due to a progressive shortage of critical details for diagnostic reason. In this one we suggest a filter of an anisotropic diffusion that contains probabilistic-driven memory of probabilistic-driven scheme which can solve problem of over filtering by pursuing philosophy of a selective tissue. In general, we can design formula for the function of memory as a diffusion differential equation for the tensor of diffusion whose behavior depends on statistics of the tissue, by speeding up the cycle of diffusion in unnecessary regions and by utilizing the effect of memory in places where valuable knowledge must have to be stored in reliable manner. Tests of two photos which are real ultrasound and synthetic photos confirm the usage of the mechanism of probabilistic memory to maintain scientifically appropriate frameworks that the state-of-the-art filters are removing.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_42

Keywords Imaging ultrasound · Speckle removal filter · Anisotropic diffusion · Memory-based expressions · Volterra related expressions

1 Introduction

Imaging ultrasound has become a commonly used medical diagnosis tool thanks to its non-invasive nature, related low cost and workability in real time. While the optical clarity of the pictures and field of view drawbacks are its main weaknesses relative to other systems, it does has certain benefits, such as portability and real-time imaging without ionizing radiation emission [1].

For many specific surgical disorders and specialties, including cardiology, gynaecology, neonatology, ophthalmology, and orthopaedics, the US provides diagnostic and rehabilitation procedures. The US tests are seen in two different forms specifically for medical uses: objective analysis and visual evaluation. Quantitative research requires data collection (manual or automatic) to generate tests that can be viewed as diagnostics or biomarkers. Such tests usually refer to the spatial distances and volumes. Additionally, in vivo US imagery provides tools for real-time visual analysis that doctors typically use to enhance their diagnosis [2]. Because of the having of a likelihood pattern of grain known as speckle which reduces sharpness. The signal-to-noise ratio (SNR) of specific tissue information, all the modes of analysis which are, both visual and quantitative, are especially challenging tasks in the ultrasound images.

Bad contrast and large intensity variation hamper post-processing strategies such as segmentation, minimizing the risk of using general-purpose segmentation approaches that can contribute to incorrect assumptions or segmentation algorithms with extreme power shortages [3].

The Speckle pattern results from the influence of scattering as US waves spread across a biological medium. The numerous mirrored echoes in the resolution cell that rely on the interaction of the US waves along with the tissues. Alternatively, action is modelled using the principle of differential dispersion. In addition, the process of backscattering within the resolution unit is understood to be the interaction of Scatterers of a distinct community of scattering objects, which decide the effective intensities of the reflected echoes. The scatterers' random location depends upon the tissue's micro-structure [4].

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2 Background

2.1 Classical Filters

Several filters were built to cope with speckle as stated in the introduction, with variations in the premises surrounding the speckle form, where the most widely employed multiplicative form is. First approaches to filtering speckles assumed the noise was multiplicative where g(x) is specified as follows:

$$\mathbf{g}(\mathbf{x}) = \mathbf{f}(\mathbf{x})\mathbf{n}(\mathbf{x}) \tag{1}$$

where f is the "real" picture, n is disturbance of noise and n is the space location. The noise is expressed in Gaussian with a unitary mean μ and a fixed standard deviation x. Instead, the picture f is determined by a estimator [1] of a local linear minimum mean-square (LLMMSE).

2.2 Speckle Diffusion Filters

In this field a fundamentally different theory has started concerning speckle filtering which operates on the basis of anisotropic diffusion techniques.

2.3 Speckle Based Non-local Means Filters

Another solution which is totally different is based on the filter named non local means which in short cut called as NLM. In this methodology, the intensity of a single voxel of source image g is determined by a weighted average of the intensities of different neighbourhood voxels. The exact weights are determined regardless of variations between the values and the voxel scale. The technique was extended to the US, with the well-known spoken Bayesian of optimized NLM (OBNLM). In addition to constructing an enhanced version of NLM utilizing a block-wise method, they proposed a Pearson distance based on the probabilistic model instead of the Euclidean norm

$$\mathbf{g}(\mathbf{x}) = \mathbf{f}(\mathbf{x}) + \mathbf{f}(\mathbf{x})\mathbf{n}(\mathbf{x}) \tag{2}$$

where n is zero-mean and defined standard deviation of Gaussian noise.

3 Proposed Methodology

3.1 Anisotropic Speckle Removal Filter of Diffusion with Mechanism of Memory

The principle that is adapted to the medical imaging background in the US. The main advancement outside theory is to prevent the effect of gradient details due to a lack of contours and low contrast in U.S. images by probabilistic-driven selective filtering that retains critical science expertise due to the position in memory equation in regions of concern [3].

In order to maintain useful clinical information, two separate methods are intended to take advantage of tissue characterization: Firstly, by probabilistic tissue study, we use a every diffusion method in US images. Here consists of two sequences of conditions. First and most importantly, to create different memory trends dependent on the content we extend the technique to a probability directed memory network. The first contributes to more rigorous filtering in regions with no specific clinical information, while in regions with presumable specific awareness, diffusion is restricted. Second, we use a preferred diffusion method in U.S. photos via probabilistic tissue characterization. Second, and more significantly, we expand the formulation into a likelihood-guided memory system to construct unique memory trends, depending on the information. The results that are in the first are more intense filtering of regions with no applicable clinical data, while Diffusion is minimized in areas with a presumable basic information (areas of medical systems and textures).

3.2 Memory with Selective Definition Based on T(X) and S{.}

The sensitive recall can be accomplished by correct tissue grouping according to different tissues. In the introductory section, We support the usage of a probabilistic definition focused on the Speckle Statistics already influenced. While considering the information provided by the probability of belonging to certain stuff, the relaxation time τ is selective for the tissue as well as for the operator S{.} [6] (Fig. 1).

We're seeing in this research upon the easiest situation, i.e., τ and S{.} While this scenario is not restricted to the hypothesis mentioned in the previous section, it relies on only one likelihood map. In appropriate areas, If the filter does not develop and the structures are conserved, the filter will enter stationary $((\partial u(x, t)/\partial t) = 0)$. This can be achieved by describing the S{.} filtering tensor operator as the instantaneous transforming of diffusion tensor to a zero tensor at locations x where preservation is required.

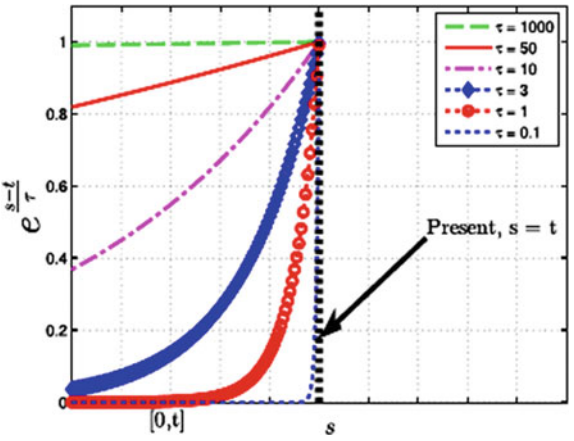


Fig. 1 Window of temporal Effective for different τ values

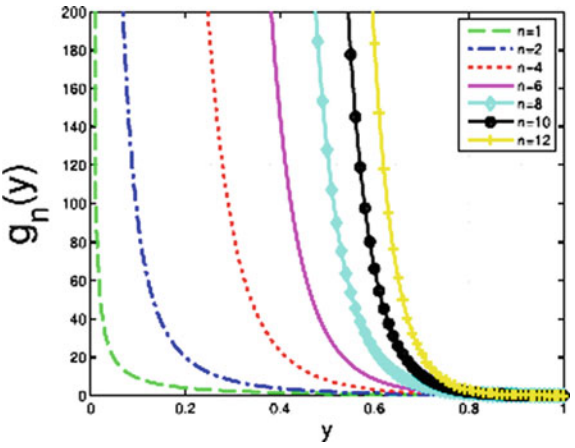


Fig. 2 The family of logical functions executes $g_n(y)$ dependent on n. As n grows, memory processes don't just impact regions with a large y frequency. Therefore the buffer will appear to be more traditional

Increasing of Function Monotonically and Continuously

Such constraint is imposed to maintain consistent memory behavior, since continuous spatial variance of likelihood maps can allow stable preservation of the data.

The scope of functions that these properties provide for is relatively large. Regardless of its one-parameter description this functionality family meets the above specifications and provides a practical implementation. We are all forever derivable and is an necessary property in the numerical application scheme to provide consistency. This family feature is shown in Fig. 2 of different significances [7].

4 Implementation

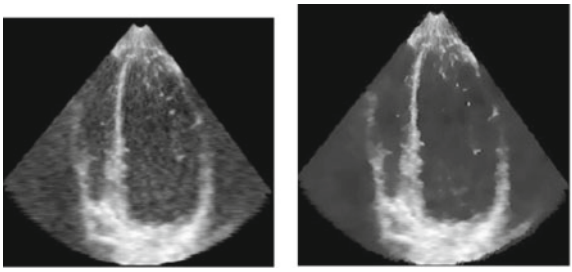
4.1 Characterization of the Speckle

The characterization of probability given by the process of selective memory which depends upon the distributions of speckle likelihood. In this job since we require the use of the Gamma method after interpolating linear filtering procedures, which has proven its suitability for completely developed and solved speckles [8]. As a consequence, the diffusion tensor D(x, t), is extracted from the density probability function combination. Gamma Amplitude is the components of their features. The system is what we term Mixture Gamma process (GMM). Remember that the approach we suggest is independent of the descriptions used to characterize it, and that any other definition can be used, like the Nakagami or Rayleigh. In our work we consider the blood regions as negligible areas of expertise. Since the echo-lucent response is typically lower than in areas of tissue, the class of the blood region was chosen as the least mean number. So in that case $\bar{p}c(x, t)$ is gained as a posteriori chance [9]. To optimize the log-likelihood equation, the GMM parameters are determined using the Expect of Maximization method.

5 Experimental Results

In this project, a 2D Echocardiography input image as shown in Fig. 3(a) is subjected to priori estimations and applied to Gaussian model by defining the image parameters [10]. Further, the resulted image is processed through the anisotropic diffusion in order to filter the speckles captured during the image acquisition process. Thus, the filtered image is shown in Fig. 3(b).

Similarly, for an IVUS input image in normal form as shown in Fig. 4(a) is subjected to priori estimations and applied to Gaussian model by defining the image parameters. Further, the resulted image is processed through the anisotropic



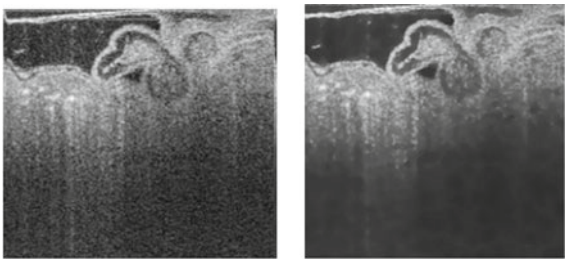
(a)Original (b)Filtered

Fig. 3 A 2d echocardiography sequence (dynamic) is filtered with the anisotropic diffusion

diffusion in order to filter the speckles captured during the image acquisition process. Thus the filtered image is shown in Fig. 4(b).

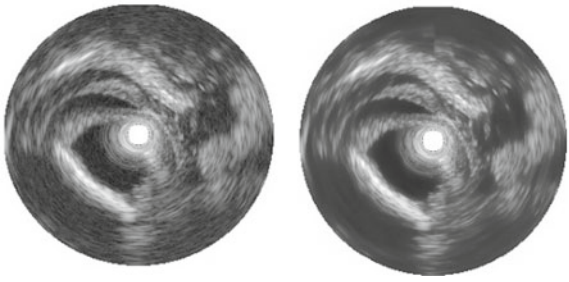
Similarly for an IVUS input image in polar form as shown in Fig. 5(a) is subjected to priori estimations and applied to Gaussian model by defining the image parameters. Further, the resulted image is processed through the anaisotropic diffusion in order to filter the speckles captured during the image acquisition process. Thus the filtered image is shown in Fig. 5(b).

Similarly for 2D ultrasound input image as shown in Fig. 6(a) is subjected to priori estimations and applied to Gaussian model by defining the image parameters. Further, the resulted image is processed through the anaisotropic diffusion in order



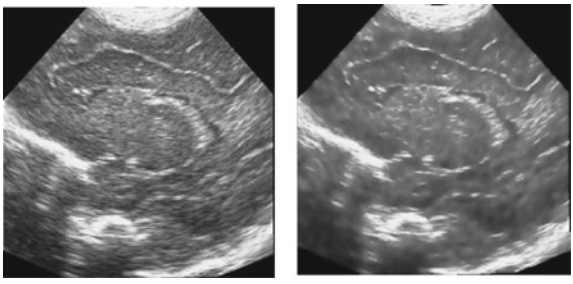
(a)Original (b)Filtered

Fig. 4 An IVUS image is filtered with the anisotropic diffusion



(a)Original (b)Filtered

Fig. 5 A ivus image in polar form is filtered with the anisotropic diffusion



(a)Original (b)Filtered

Fig. 6 A 2d ultrasound image is filtered with the anisotropic diffusion

to filter the speckles captured during the image acquisition process. Thus the filtered image is shown in Fig. 6(b).

6 Conclusion

In this project, a speckle filter was described as an anisotropic diffusion, depending on the statistics of speckle with a mechanism of memory. The mechanism of memory is the cause for alleviating drawbacks of two major state-speckle filters: (1) Because of inaccurate characterization of tissue the sensitive data of the tissue would be lost and (2) Over-filtering, particularly in the filters of diffusion, as the diffusion process progresses due to a progressive lack of awareness of the initial true image. For the diffusion tensor the memory system is added as a DDE, where a tissue-Volterra equation is applied by the diffusion flux function.

The behavior which is selective is connected to the period of relaxation time, which determines the "effective" temporal window for each organ, while overlooking the mean temporal length in areas where no appropriate knowledge is accessible, such as blood, is required. In an extraordinary case the recall mechanism is turned off for medical purposes in places where no suitable systems exist. The mechanism of memory is also centered on a S{.} tensor operator, which enables the attainment of stationary states in tissues where the speckle is meant for further study or recovery. Stationary state output offers a robustness that prevents over filtering and removes the need for a stop criterion to be set. This finding is verified by the results of real US image studies where there is no over-filtering relative to the existing diffusion filters, even with more iterations. The filter proposed for the MSE and SSIM phases provides good (if not the best) performance. In addition, their robustness was demonstrated when specific equilibrium combinations of various kinds of phantoms were tested in original photographs. Some diffusion filters typically have satisfactory results for both MSE and SSIM but obscure the specificity of the structural tissue in actual photographs. Conversely, the OBNLM filter displays weak numerical results, with maximum phantom parameters obtained.

Nevertheless, it increases significantly as visual inspection requirements are adjusted. This finding demonstrates the lack of robustness of the OBNLM which leads to real scenarios for manual tuning. Quantitative evaluation for individual images often demonstrates robustness and substantial contrast enhancement in intravascular representation, preventing over filtering and curing lack of evidence. In view of these findings, it can be concluded that the suggested technique maintains and improves sufficient tissue sensitivity and may be useful for healing purposes. It has also shown a beneficial toughness that indicates its suitability for usage in multiple scenarios.

In future along with medical and clinical purposes it can also be used on general physical and biological creatures for experimentation and investigation and can get better results on them.

References

1. Marwick TH (2006) Measurement of strain and strain rate by echocardiography: ready for prime time? J Amer Coll Cardiol 47(7):1313–1327
2. Seabra JC, Ciompi F, Pujol O, Mauri J, Radeva P, Sanches J (2011) Rayleigh mixture model for plaque characterization in intravascularultrasound. IEEE Trans Biomed Eng 58(5):1314–1324
3. Gopichand Merugu P, Rudra Kumar M, Ananda Rao A (2012) Change requests artifacts to assess impact on structural design of SDLC phases. Int J Comput Appl (0975–8887) 54 (18):21–26
4. Destrempes F, Meunier J, Giroux MF, Soulez G, Cloutier G (2009) Segmentation in ultrasonic B-mode images of healthy carotid arteries using mixtures of Nakagami distributions and stochastic optimization. IEEE Trans Med Imag 28(2):215–229
5. Szabo TL (2004) Diagnostic ultrasound imaging: inside out (biomedical engineering). Elsevier, Amsterdam
6. Vegas-Sachez-Ferrero G, et al. (2014) Gamma mixture classifier for plaque detection in intravascular ultrasonic images. IEEE Trans Ultrason Ferroelectr Freq Control 61(1):44–61
7. Tay PC, Acton ST, Hossack JA (October 2006) Ultrasound despeckling using an adaptive window stochastic approach. In: Proceedings of IEEE International Conference Image Processing, pp 2549–2552
8. Krissian K, Westin C-F, Kikinis R, Vosburgh KG (2007) Oriented speckle reducing anisotropic diffusion. IEEE Trans Image Process 16(5):1412–1424
9. Coupe P, Hellier P, Kervrann C, Barillot C (2009) Nonlocal means based speckle filtering for ultrasound images. IEEE Trans Image Process 18(10):2221–2229
10. Aja-Fernández S, Alberola-López C (2006) On the estimation of the coefficient of variation for anisotropic diffusion speckle filtering. IEEE Trans Image Process 15(9):2694–2701

Investigation of Level Set Segmentation Procedures in Brain MR Images

S. Fayaz Begum and B. Prasanthi

Abstract The task in this research is to evaluate the efficiency of the six level-set algorithms in 2D brain segmentation on a given MRI image. For both algorithms and the comparison contour used for the computation of the dice criteria, the initialization used is the same MATLAB tool-backed application is used to measure the efficiency, particularly in biomedical image processing, of different level-based segmentation algorithms. This work includes a comparative study of clustering algorithms according to their performance. Although some findings indicate that MRI images segmentation of the brain tumor is time-consuming, it is an essential work.

Keywords MR images · Image enhancement · Brain tumor · Level set · Image processing

1 Introduction

An abnormal development of the brain cell is caused by the brain tumour. Brain tumor usually grows from brain cells, blood vessels or brain nerves. Early brain tumor diagnosis is required because the mortality levels in people with brain tumours are higher [1]. According to 2007's figures, in India there are completely 80,271 tumors [4]. Since several decades, vision detection methods have been in use for brain tumor sensing [8]. We aim to utilize the technology developed through this project as a Computer Automated based GUI to provide ease of access to medical professionals, researchers and health care providers. A simple prerequisite of internet knowledge is enough to use this product. Picture segmentation is the separation into several parts of a visual image (sets of pixels, or superpixels) [2].

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_43

Used to identify artifacts and limits in pictures (lines, curves, etc.). More specifically, each pixel in an picture is given a label such that certain features of pixels with the same label share. The product of the segmentation of the image is a collection of segments comprising the entire image or a series of contours derived from the scene. Each pixel in one region is equivalent to other properties such as colour, color or shape, as characteristic or computed [3].

Concerning the same features, similar areas are substantially different. In this article, we present a review of segmentation algorithms, viz. Caselles, chan & vese, algorithms Li, Lancton, Bernard and shi. We tested such algorithms using a dice coefficient that calculates the correlation between the specialist's comparison and the segmentation outcome of each algorithm [4]. That algorithm also measures the computation time needed to execute the segmentation.

2 Proposed Methodology

We also applied 6 algorithms on various medical images in the suggested methodology. The energy criterion calculation based on regional statistics is based on the existing method such as chan & vese. It allows a picture to be differentiated by their mean value into two homogeneous regions. The development of this algorithm is determined on a low level band such that it can be initialized. But the chan and vese algorithm has some limitations: if the image size is too high, this approach operates gradually, video sequences with effective image implementation can be used in real-time applications.

We use a software tool in this work that accesses all algorithms set at all levels. All six algorithms were precoded into one setting. This often accommodates the functionality required to improve the segmentation algorithm output in a single application, so such algorithms can be used effectively [9]. Supports the segmentation and comparison of parametric results of all types of image formats.

The implementation of each algorithm defines its properties and measures related parameters specific to all of the above algorithms. The Caselles approach explains the creation of narrow band segmentation and energy minimisation is based on contour. Chan & Vese and Shi methods define the energy criteria minimization as an area-based and segmentation efficiency efficiency creation as a restricted unit [5]. Recent algorithms such as Chumming Li and Lankton are regionally oriented, with innovations being the entire area and the small band. Bernard has region-based criteria and development performance for the entire field. Chumming Li and Lankton are located regionally based among all these methods [6]. This increases computation in boundaries and shapes of each pixel in an image. Localized region-based methods that initialize each pixel with an initial contour and neighboring artifacts in the narrow section [10, 11]. The dynamics of this measurement differ from the energy criteria applied [7].

The following diagram Fig. 1 shows chronological process of the present method.

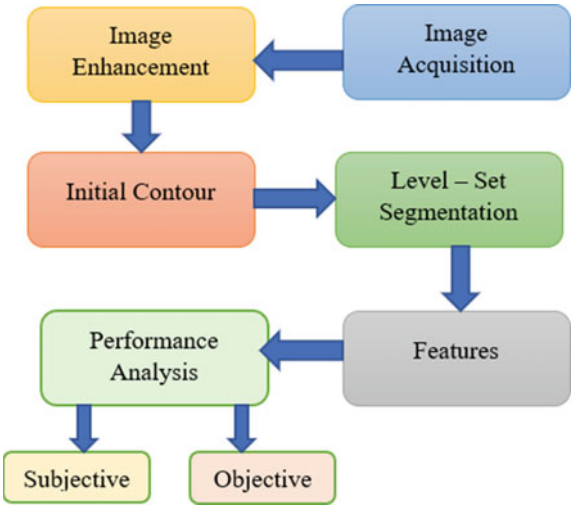


Fig. 1 The block diagram shows the process of implementation

Algorithm:

Step-1: The image processing module enables the consumer to load a color or grayscale file.
Step-2: In the pre-processing unit, the Initialized image is improved using the Enhancement methods and the Enhanced image output is collected.
Step-3: In the post-processing device, where ever needed, an initial contour is chosen from the reference image. And introduce level-set methods, to store the output of level-set methods.
Step-4: Use a software tool to execute level set algorithms one by one after another. You can save the result of the each algorithm. The calculations for any algorithm are then estimated.
Step-5: Visualization of performance, analysis of the segmented image shows the contour of the single algorithm and the reference image.

3 Result Analysis

A basic assessment of the image segmentation is given by the subsequent analytics screen. Users will conveniently select all level of algorithms from the introduced ones. The consequence contours of each system are shown on the same picture that can be named as a reference image after the segmentation phase has been completed. The picture includes various colors, differentiating algorithm form by colour. Within this section we address how the level-set segmentation approaches operate.

Caselles is a short, contour dependent energy source and segmentation evolution. The energy source and origin were the same for Chan & Vese, Bernard but for Bernard. Bernard's development is the whole sector. The last two strategies, including Li and Lankton, are focused on the energy form of the Localized Area. Next, the reference representation of the brain is initialized. For both algorithms and the comparison contour used to calculate the Dice criteria the initialization used is similar. The final segmentation evolution of the images obtained by each algorithm.

Existing Method Results:

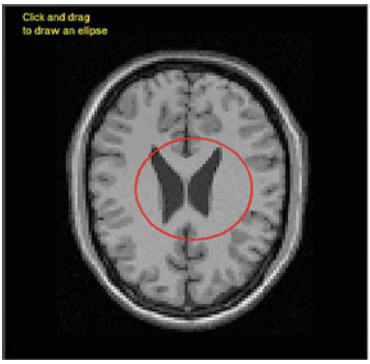
The final segmentation of picture evolution resulting from current approaches such as Chunming Li, Shi, and Caselles as shown in Fig. 2. In Brain MRI picture the original contour was chosen and the initialization was then done. The representation of initialization is seen on Fig. 2(a). Reference image is a segmented file, which is used for parameter calculations. This is expressed in Fig. 2(b) Chunming Li conducted level-set algorithm after initialization file. The energy criteria is determined on the basis of the localized area form, and the segmentation mechanism progresses on the entire domain. This can be seen in Fig. 2(c). Another method for level set, as described by Shi in Fig. 2(d). In Shi, the energy criterion is regional and development is limited. The energy requirement is determined on the basis of the contours and the segmentation progression is short. In Table 1, parametric values explain how the level-set algorithms are changing. The time needed to determine the number of iterations and parametric values is specified. The coefficient of dice for li and shi is null, which for caselles is almost zero and 0.57. For convergence, the dice coefficient will be optimal.

The value of PSNR is 0.80 for Li, 0.83 for Shi and 6.66 for Caselles. Chunming Li and Shi has the minimum values. Hausdorff value is 14.87 for Chunming Li method which is minimum and same for Shi, Caselles has better value which is 18.25. MSSD value is 48.48 for Chunming Li which is also minimum and same for Shi. Caselles has the maximum value which is 90.23. Among all the three methods, In terms of dice coefficient, PSNR, Hausdorff and MSSD, Caselles has better results. However, in Caselles there are certain limitations.

Proposed Method Results:

In proposed level-set algorithms implemented in the application of medical images. Initially, the input image is taken as Brain MRI image and performing the initialization by selecting a initial contour in image. The initialization image is shown in Fig. 3(a). Then reference image is loaded which is segmented image used for computations of parameters. After initialization image, implemented the level set algorithms which are Bernard, Chan & Vese and Lankton.

After implementation of Bernard, the resultant image is segmented image collected which is shown in Fig. 3(c). The Energy criterion is calculated in Bernard is



(a) Initialization image

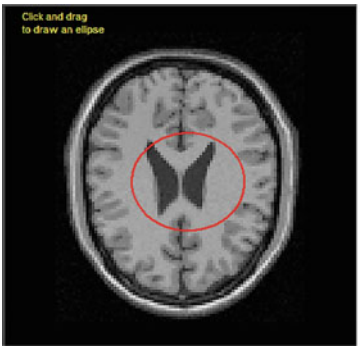
(b) Reference image

(c) Chunming Li

(d) Shi

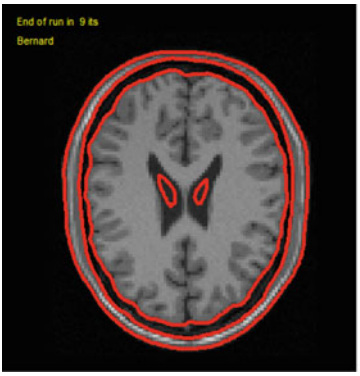
(e) Caselles

Fig. 2 Segmentation images of brain MRI obtained from Li, Shi and Caselles methods

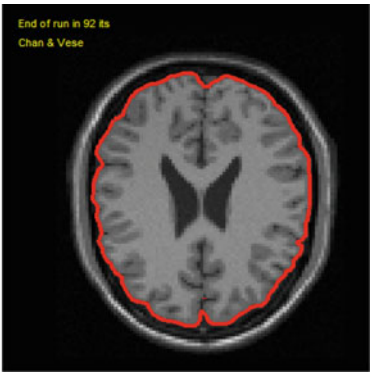


(a) Initialization image

(b) Reference image



(c) Bernard



(d) Chan & Vese

(e) Lankton

Fig. 3 Segmentation images of brain MRI obtained from Bernard, Chan & Vese and Lankton methods

Table 1 Statistical parameters

Parameters	Existing methods			Proposed methods		
	Chunming Li	Shi	Caselles	Bernard	Chan & Vese	Lankton
Computation time (s)	0.50	0.51	0.86	6.81	0.30	4.48
Dice coefficient	0.0	0.00	0.57	0.60	0.62	0.63
PSNR	0.80	0.83	6.66	7.16	7.56	7.72
Hausdorff	14.87	14.87	18.25	16.12	16.03	17.09
MSSD	48.48	48.66	90.23	58.44	54.59	86.18

on region based and evolution of segmentation is whole domain. Another method Chan & Vese is implemented, the resultant image is a segmented image collected. Which is indicated in Fig. 3(d). In Chan & Vese the energy requirement is determined based on area, and segmentation evolution is a narrow unit. Within data the parametric values are processed. The Lankton level set algorithm is then applied, and the corresponding segmented image is shown in Fig. 3(e). In Lankton the energy criteria is determined dependent on Localized area and segmentation evolution is narrow band. The resulting parametric values are then saved and evaluated as described. In Table 1 the parameter values are determined from the respective algorithms and tabulated.

For Brain MRI image, the Dice coefficient is equal to 0.60 in Bernard, 0.62 for Chan & Vese, and 0.63 for Lankton, which is maximum. However, this approach requires maximum computation time for convergence (6.81 s). The PSNR value is equal to 7.16 in Bernard, 7.56 for Chan & Vese and 7.72 is maximum for Lankton. Hausdorff coefficient is equal to 16.12 in Bernard, 16.03 for Chan & Vese and 17.09 for Lankton which is maximum. MSSD value is 58.44 for Bernard, 54.59 for Chan & Vese and 86.18 for Lankton. Among all these three method Lankton has the maximum values and it gives the best performance.

4 Conclusion

Within this study, in the situation of image segmentation, we defined the efficiency of various level-set algorithms. This research was carried out using the tool-based program from MATLAB, which allows you to achieve the final segmenting images in six specific level algorithms. In terms of Dice, computation length, SPNR, Hausdorff distance and MSSD, the parametric values are applied to six algorithms.

References

1. Farmer ME, Jain AK (2005) A wrapper-based approach to image segmentation and classification. IEEE Trans J Mag Image Process 14(12):2060–2072
2. Logeswari T, Karnan M (2010) An improved implementation of brain tumor detection using segmentation based on soft computing. In: Second International Conference on Communication Software and Networks, ICCSN 2010, pp 147–151
3. Saha BN (2012) Quick detection of brain tumors and edemas: a bounding box method using symmetry. Comput Med Imaging Graph 36(2):95–107
4. Kumar A, Shaik F (2015) Image processing in diabetic related causes. Springer-Verlag Singapur Publishers (Springer Briefs in Applied Sciences and Technology-Forensics and Medical Bio-informatics), ISBN:978-981-287-623-2
5. Cuadra MB, Pollo C, Bardera A, Cuisenaire O, Villemure J, Thiran P (2004) Atlas based segmentation of pathological MR brain images using a model of lesion growth. IEEE Trans Med Imag 23(10):1301–1313
6. Moon N, Bullitt E, Leemput KV, Gerig G (2002) Model based brain and tumor segmentation. In: ICPR Quebec, pp 528–531
7. Khotanlou H, Colliot O, Atif J, Bloch I (2009) 3D brain tumor segmentation in MRI using fuzzy classification, symmetry analysis and spatially constrained deformable models. Fuzzy Sets Syst 160:1457–1473
8. Wang Z, Hu Q, Loe K, Aziz A, Nowinski WL (2004) Rapid and automatic detection of brain tumors in MR images. In: Proceedings of SPIE, Bellingham, WA, vol 5369, pp 602–612
9. Mancas M, Gosselin B, Macq B (2005) Fast and automatic tumoral area localization using symmetry. In: Proceedings of IEEE ICASSP Conference, Philadelphia, Pensylvania, USA
10. Lau PY, Ozawa S (2004) PCB: a predictive system for classifying multimodel brain tumor images in an image guided medical diagnosis model. In: Proceedings 12th International Conference on Intelligent System for Molecular Biology, Glasgow, UK
11. Lau PY, Ozawa S (2004) A region- and image-based predictive classification system for brain tumor detection. In: Proceedings of Symposium on Biomedical Engineering, Hokkaido, Japan, pp 72–102

Medical Imaging Analysis of Anomalies in Diabetic Nephropathy

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Abstract In diabetic patients, diabetic nephropathy is thought to be the leading end-stage renal disease. Proteinuria (excretion of excess protein in the urine) slowly improves diabetic nephropathy. A non-invasive imaging algorithm is desperately required to identify anomalies early in order to provide faster and improved care. As pre-processing and segmentation approaches the proposed algorithm uses enhancement. Equalization of histograms increases the global image contrast. Another version of histogram equalization computes multiple histograms, each corresponding to a separate section of the image and using them to redistribute and lighten the image value. CLAHE histogram equalization is an improvement of the previous method that works on specific regions of the image called titles rather than the whole image, and another technique, called dilation-based morphological reconstruction, is often used for preprocessing. Here Otsu thresholding is used as a post-processing tool that is used for automatic thresholding of images. This method is carried out on the R2018b and above version of MATLAB computing language.

Keywords Image enhancement · Diabetic nephropathy · Image segmentation · Histogram · Space

1 Introduction

Diabetes affects the ability of the body to produce or use insulin, a hormone required to regulate blood glucose properly. Diabetics must also control their own blood sugar levels by food injections and insulin injections. The main point in controlling blood sugar is precisely calculating blood sugar levels [1]. Nonetheless,

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_44

the recognition that diabetic patients have a medical condition from an additional insult called diabetic nephropathy is increasing. Diabetic nephropathy (DN), also referred to as diabetic kidney disease, signifies patients with kidney function loss continuing type 1 or type 2 diabetes mellitus. Diabetic nephropathy (DM) affects 5–10% of the world's population and is growing increasingly in the younger generation, including adults and babies. On a technical note image processing is used to remove essential features from the images, from which it is possible to obtain a better understanding of the scene for human viewers [2]. Biological vision system is one of the world's most essential means of human discovery, making complex activities easier for comprehension to improve [3]. Though costly, medical imaging is easy to perform due to non-invasive nature. In science, scientific computing is central to the production of mathematical models and quantitative analyzes to obtain results.

In order to obtain fruitful results with study, color spaces are considered in conjunction with image segmentation. A Lab color space is a color-opposite space based on nonlinearly compressed CIE XYZ color space coordinates with dimensions L for lightness and a and b for the color-opposite dimensions [4]. Therefore, the monograms Lab are to some extent imprecise in themselves. The color spaces are purpose-related but are different in implementation. Both YUV space and LAB space reflect colors relative to a reference white point, which is a common description of what is called white light, defined in terms of XYZ space, and typically created on the grayest light that a given system may produce. A metric of interest in color science is the difference or the distance between two colours [5]. It enables people to measure a notion otherwise defined with adjectives, to the detriment of everyone whose effort is serious to color. Public descriptions let usage of the Euclidean distance within a color space independent of the unit. The resulting images from these color spaces are fed to various methods of image segmentation like clustering. The methods are used by means such as SDD (Slope Differential Distribution), Otsu, FCM (Fuzzy C Means), EM (Expectation Maximization), and K-means.

2 Image Segmentation Methods Utilized

Nowadays the segmentation of images is one of the essential medical techniques where it is used to isolate or area of interest from the context. But the arrays of numbers in the computer3 represent medical images in their raw form, with the number showing the values of the related physical quantities that display distinction between various types of body parts. The segmentation findings make it possible to analyze the shape, identify volume shifts and make a detailed plan for the treatment of radiation therapy. Image segmentation, the partitioning of image data into similar fragments or regions, represents a significant step in a variety of image processing and recognition approaches. It can be achieved using a number of different techniques like, thresholding or increasing area.

The slope difference distribution (SDD) is determined from the one-dimensional curve and allows derivatives to be found which do not exist in the original curve. Calculating the threshold point is not only robust to logically isolate the curve but also robust to measure the middle of each part of the separated curve. SDD was used in the segmentation of images and meets both traditional and state-of-the-art methods of image segmentation. SDD is also very useful when measuring pattern recognition and object detection functions [6]. The Otsu technique is known as one of the most widely used thresholding techniques for images. The Otsu method makes use of the image histogram to give the image a threshold. It divides the image into two separate groups of gray levels and assigns a threshold to the image where there is minimal difference between those two levels [7]. Clustering algorithm Fuzzy c-means (FCM) is one of the most widely used unsupervised clustering techniques in the medical imaging field. Medical image segmentation refers to a segmentation from medical images of known anatomical structures. Fuzzy logic is a multi-evaluated logic derived from the theory of fuzzy set [8].

The EM (expectation-maximization) algorithm is an iterative method for estimating estimates of the ultimate likelihood when the results are incomplete. Expectation Maximization (EM) is one of the most common algorithms used in an unsupervised environment for the density estimation of data points. This algorithm is a common tool that simplifies difficult problems with the maximum likelihood [9]. It has two steps; in E-step, we quantify expectations and in M-step, the last step is maximized and iteration EM-steps proceed until convergence occurs. The EM algorithm is used to investigate the parameter which achieves the highest probability. As this is a likelihood procedure it uses the probability. The algorithm's stop criterion is either a maximum number of iterations to reduce the calculation time, or a smaller error. K-means algorithm is easier and faster statistical than the hierarchical clustering [10]. And this can function with a large number of variables as well. Yet for different number of cluster numbers it produces different cluster result. The key finding in these procedures is to find a better way to de-link Diabetes Mellitus by proper diagnosis to its related condition.

3 Methodology

The Otsu system, named after Nobuyuki Otsu, is used in image processing to perform automatic thresholding of images. The algorithm, in the simplest form, returns a single threshold of intensity that divides pixels into two groups, foreground and background. This method is considered as an old and classical techniques which has inherent capabilities to extract the significant features from an image. This threshold is calculated by reducing variance in intra-class severity, or by maximizing variance inter-class equivalently b. Here two forms of color spaces Lab and YUV are utilized along with the image segmentation procedures to obtain the results which can be helpful in assessing the depth of the issue. The picture from the Electron Microscopy which is considered to be Nikon's open source repository

is taken as the data file. In this algorithm the shot of Glomerular Cell is considered for experimentation and investigation. The pictures are usually RGB-based. So, using the MATLAB program, the RGB images are processed and the images undergo multiple algorithms to get a better output. The RGB image is initially transformed to a grey scale to prevent complicated calculations.

Algorithm:

1. Image is acquired from medical image data base.
2. The process of color mapping into gray, dividing into three sub channels
3. Initialization of the lab space
4. Display the results with respect to a and b channel
5. Initialization of YUV space
6. Display the results with respect to U and V channel

Flow Chart:

(See Fig. 1).

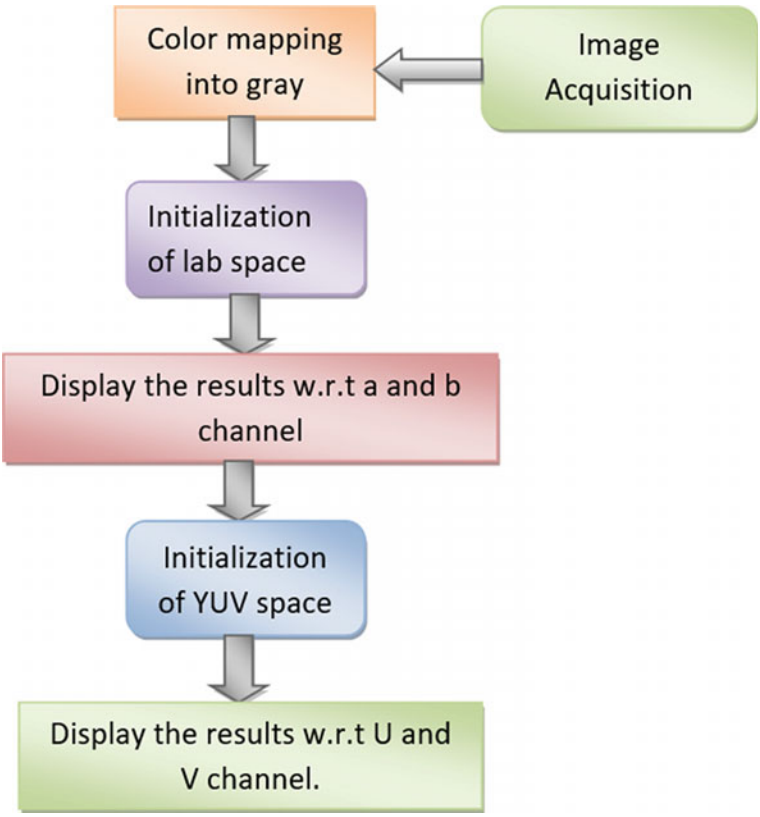

Fig. 1 Flow chart of proposed methodology

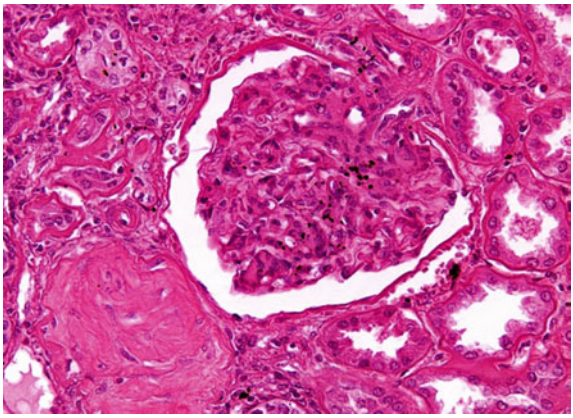

Fig. 2 Original input image

4 Experimental Investigation

The picture at the input Fig. 2 Represents pink hyaline material shape nodules in glomerular capillary loop regions in the glomerulus. This is due to a marked increase of the mesangial matrix resulting from damage due to non-enzymatic protein glycosylation. This is one form of chronic kidney disease with, over time, loss of renal function.

This input image in lab space considered for further process in YUV space, in this connection the image is color mapped to gray scale. Further the resulted image is processed through LAB space and YUV space using thresholding procedures such as SDD (Slope difference distribution), Otsu, FCM (Fuzzy C Means), EM and K means.

The output images for respective thresholding values are displayed for LAB space shown in Figs. 3, 4, 5, 6, 7.

The SDD thresholded output image as shown in Fig. 3 displays the entire pink zone into the white and the left dark part which is the healthy part in glomerulus in dark zone.

The output image for respective thresholding are displayed for LAB space as shown in Figs. 4 which is a Otsu thresholding method where it is clearly observe that the dark part represents the healthy cells.

The EM and FCM lab spaces as shown in the Figs. 5 and 6 where it is observed that the dark zone is the healthy part and the white zone is the damaged part. The k-means thresholded image is displays the damaged cells in yellow color and the healthy on dark color as shown in Fig. 7.

In a similar fashion the results in YUV space can also be analyzed. Here the analysis is similar to the above i.e. healthy zone is represented in dark and damaged zone of cells in white in all the thresholding methods.

Fig. 3 SDD resulted image

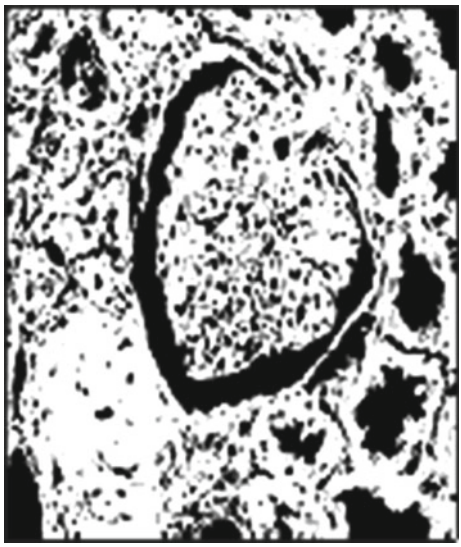

Fig. 4 Otsu resulted image

In Figs. 8 and 10 which are SDD thresholded and EM thresholded respectively, it can be observed that most of the regions which are in pink in original image are clustered into white which is the damaged part.

The thresholded results i.e. Fig. 9 for Otsu, Fig. 10 for EM, Fig. 11 for FCM, represent only the highlighted pink regions as white clusters and the remaining into dark clusters which is the healthier part of the glomerulus. Here K-means result is not so significant as it represents only darker image.

Fig. 5 EM resulted image

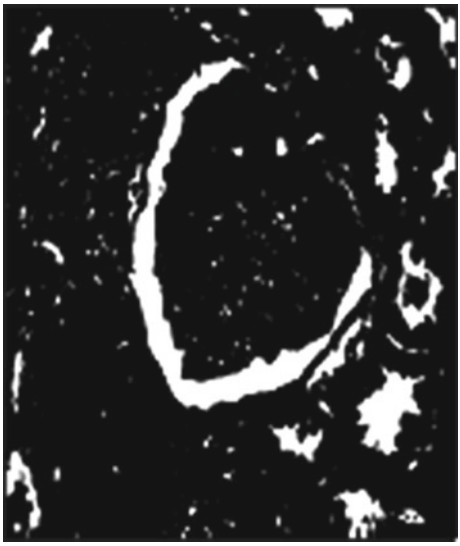

Fig. 6 FCM resulted image

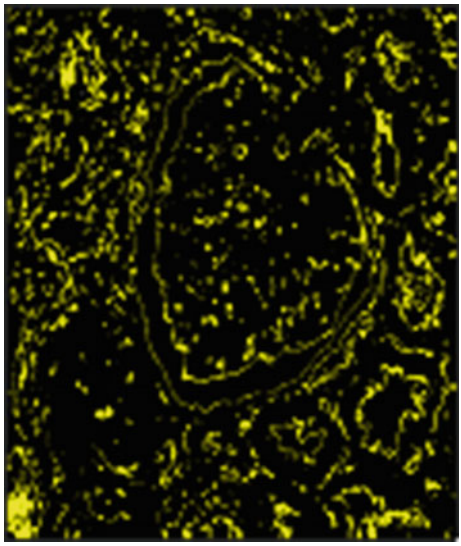

Fig. 7 K-means resulted image in lab space

Fig. 8 SDD resulted image in YUV space

Thus, it is obvious that YUV space is more effective in segmenting the clusters for damaged and healthier parts of the cells easily.

Fig. 9 EM resulted image in YUV space

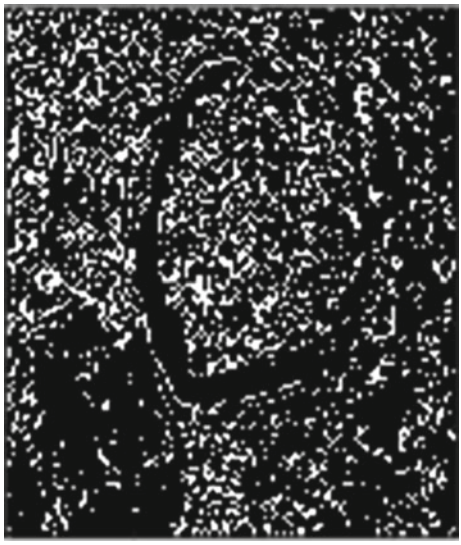

Fig. 10 Otsu resulted image in YUV space

Fig. 11 FCM resulted image in YUV space

5 Conclusion

Computer-assisted segmentation is a crucial step in identifying use in computer-assisted diagnosis, clinical trials, and preparation of therapies. In these procedures, the main and significant outcome is to find a better way to isolate Diabetes Mellitus from its associated disorder by proper diagnosis and following appropriate clinical and medical restrictions. The ultimate goal of the color spaces in combination with image segmentation methods is to provide an obvious process flow to obtain meaningful results which can aid in assessment of the problem. In order for medical practitioners to use this technique in order for earlier phenomenon to be detected, other preprocessing methods combined with the applicable post-processing approach can provide findings from future innovations. These diagrams will be used in communities to inform a common understanding of the problem.

References

1. Kaur J, et al (2009) Non invasive blood glucose measurement using optical method: feasibility study and design issues. In: Proceedings of International Conference on Optics and Photonics CSIO-2009, Chandigarh, India, 30 October–1 November 2009
2. Mohan V, Sandeep S et al (2007) Epidemiology of type 2 diabetes: Indian scenario. Ind J Med Res 125:217–230
3. Ravindraiah R, Shaik F (2010) Detection of exudates in diabetic retinopathy images. In: Proceedings of National conference on Future Challenges and Building Intelligent Techniques in Electrical and Electronics Engineering‖ (NCEEE 2010), Chennai, India, pp 363–368

4. Shaik F, Sharma AK, Ahmed SM (2016) Detection and analysis of diabetic myonecrosis using an improved hybrid image processing model. In: IEEE International Conference on Advances in Electrical, Electronics, Information, Communication and Bioinformatics-2016 at Prathyusha Institute of Technology & Management, 27–28th February 2016
5. Peres FA, et al (2010) Automatic segmentation of digital images applied in cardiac medical images. In: Proceedings of IEEE -PACHE, Conference, Workshops, and Exhibits Cooperation, Lima, PERU, 15–19 March 2010
6. Intajag S, et al (2009) Retinal image enhancement in multi-mode histogram. In: 2009 Proceedings of World Congress on Computer Science and Information Engineering, vol 4, pp 745–749
7. Kumar A, Shaik F (2015) Image processing in diabetic related causes. Springer-Verlag Singapur Publishers (Springer Briefs in Applied Sciences and Technology-Forensics and Medical Bio-informatics). (ISBN: 978-981-287-623-2)
8. Shaik F, Sharma AK, Ahmed SM, Gunjan VK, Naik C (2016) An improved model for analysis of Diabetic Retinopathy related imagery. Ind J Sci Technol 9:44 ISSN: 0974-6846
9. Askew DA et al (2012) Diabetic retinopathy screening and monitoring of early stage disease in general practice: design and methods. Contemp Clin Trials 33(5):969–975
10. Shaik F, Sharma AK, Ahmed SM (2016) Hybrid model for analysis of abnormalities in diabetic cardiomyopathy and diabetic retinopathy related images. Springer Plus J 5(1):1–17 ISSN: 2193-1801

Development of Hybrid Pre-coding Technique for Mimo Systems Based on Kalman Filter

C. H. Najaraju, G. Chandana, B. Manoj Kumar, and C. Kishore Kumar

Abstract Channel contact with millimeter wave is a crucial enabler to addressing bandwidth shortage of potential 5G networks. In order to overcome the higher route failure, millimeter wave communications throughout the 60 GHz range requires massive antennas clusters at the sender and recipient nodes to obtain signal amplification benefits. Analog approaches could not employ the power of evolutionary income. In addition, band pass filters with maybe vibrating strings processes can be electronically regulated, thereby reducing the likelihood of sophisticated processes and culminating in poor results. Hybrid systems are exciting nominee approaches which transcend their drawbacks of shaping mere virtual or analog beams, because they combine all methods' advantages. Through utilizing multiple concurrent beam transfers, hybrid systems growing bandwidth learning relative to analog-only systems.

Analog signal amplification will obtain a only a spectral efficiency of around 3 bps/Hz at 20 dB, and being under the similar circumstances our suggested hybrid analog/digital signal amplification gets 10 bps/Hz. We are proposing an incremental Kalman derived multi-user hybrid approach that reduces the error here between nodes (BS) transmitted declaration of independence as well as the cell station (MS) approximate information obtained. The system includes a specially constructed error model, followed by a two-step process to first measure the pre-coding/mixing matrix of RF and instead models the pre-coding of the digital firmware at the BS.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_45

Keywords Kalman filter · Hybrid beam forming · Millimeter wave · Massive MIMO

1 Introduction

Network interaction with such a millimeter wave (mm Wave) is a key facilitator in upcoming 5G networks for addressing frequency shortage. Due to the small frequencies accessible throughout the sub-6 GHz band, traditional cellular and Ethernet-based solutions can never be optimized to satisfy these ever-growing requirements of network densification information and evolving technologies for data centres and portable devices. While novel approaches have been proposed, including the opportunistic use of authorized spectrum, these methods are often subject to frequent interruptions and are limited by the channel bandwidth provided in licensed bands, such as TV bands. Within the newly opened adjacent area of unlicensed spectrum within the band contact range of 57–71 GHz millimeter wave (mm Wave) is an ability to reach gigabit-per-second data speeds. Moreover, standardizations such as the IEEE 802.11ad that exists in these bands require short-distance lines of communication out to 2 GHz long.

1.1 Objective

To obtain improvement in terms of spectral efficiency by using kalman based hybrid pre-coding/combining. When applied to a multi user situation it is a promising solution. By using this approach we can achieve high efficiency in spectral terms. Existing methods are often not suitable for mm wave communication, since it requires huge antenna arrays at both the sender and the recipient terminals to overcome the high path loss.

1.2 Need and Importance

Due to the restricted spectrum in the sub-6 GHz band, conventional mobile and Ethernet-based solutions cannot be expanded to meet these ever-increasing demands of the effects of channel rapid transit. Hybrid directional antennas usually combine high-dimensional analog phase shifters and power amplifiers with low-dimensional digital signal processing devices in fifth-generation (5G) wireless networks, mm Wave massive multi-input (MIMO) communications.

The need for this proposed approach is the rather-increasing demand for the wireless transmission network, which relies heavily on spectral efficiency (SE). Currently all modulation schemes work inside the 300 MHz to 3 GHz band.

Therefore, the core principle of 5G wireless devices lies in following mm Wave high frequency band ranging from 3 GHz to 300 GHz.

The value of this approach is by the use of hybrid beam forming technology to reduce the cost and power usage associated with the reliable design dream 5G. On the other hand, the multiple-input-multiple-output (MIMO) technology, the use of numerous transmitter (TX) and receiver (RX) antennas, is seen as one of the exciting ways to increase spectral performance [6].

2 Literature

The authors proposed "Transmits Selection of Antennas & Analog Beam Shaping to Small-Resolution Band pass filters in mm Wave MISO Devices." The placement of a combined transmitting antennas & an analogous beam of a poor low resolution PS configuration are considered in this report to maximize the spectrum performance of a dual input single output mm wave network [1].

The research team has focused on "Technology for 5G Wireless Services." The aim of the upcoming 4G telecom telecommunications providers is not only to reach greater overall capacity but to also support users with strong service quality (QoS) specifications, such as smooth usability, extremely-low latency (e.g. Responsive Internet) & high efficiency. It is also essential to somehow develop a frequency performance, energy performance and bit expense [2].

The author and his team provided "An Examination of MIMO Millimeter Wave Applications Machine learning Techniques." The mm Wave band provides greater frequency transmission networks than those currently found in consumer wireless applications. This article provides a description of the difficulties of photonics in mm Wave networks, concentrating on those presented by using MIMO contact at longer wavelengths of the transmitter [3].

The concept of "Large-scale electrode architectures including prototype electric and computer frequency hopping a 5G mm wave" reports the optimum drawings of variant modulation schemes designs are discussed, of M (its sum of activated telescopes in base station) based for N (the volume of transmitters) of dynamic echo cancellation mechanisms [4].

The authors suggested 'What would 5G be?' However, 5G would involve a conceptual shift, including incredibly elevated spectrum ranges to wide band widths, massive base unit and infrastructure densities, and unprecedented amplifier numbers. This would still be strongly comprehensive, though, unlike in the past four millennia: linking the latest 5G air and satellite network to LTE & Wi-Fi to deliver robust heavy-speed connectivity and smooth user interface [5].

3 Proposed Method

We are proposing a multi-user beam forming technique, based on hybrid pre-coding using kalman filter, for millimeter wave massive MIMO systems. Analog solutions cannot employ the control of adaptive gain. In addition, phase shifters with only quantized phases can be digitally controlled, thus the probability of improved development and the resultant lack of performance is reduced. Hybrid schemes are innovative candidate strategies that overcome the constraints of creating pure digital or analog beams, as they incorporate the benefits of both strategies.

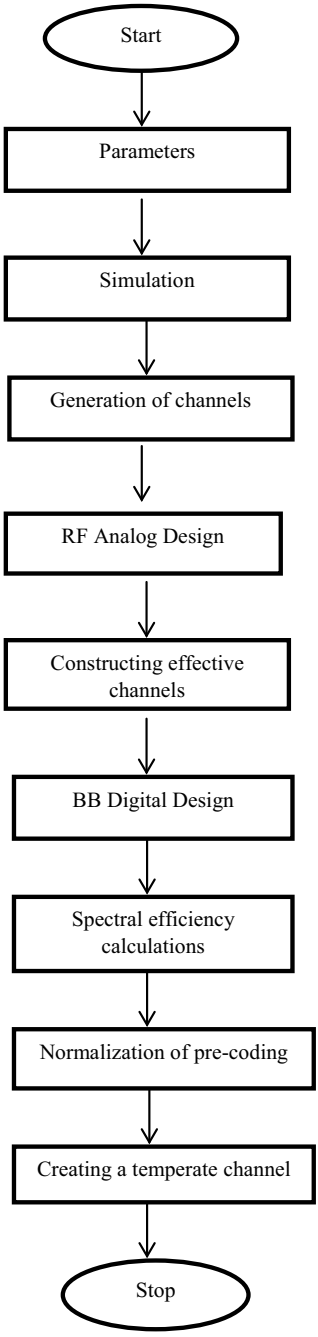
In this the proposed work in terms of statistical parameters such as SNR and spectral efficiency is compared with existing techniques.

4 Methodology

4.1 Algorithm

Step: 1- Start
Step: 2- System and Channel parameters
Step: 3- Simulation
Step: 4- Generate user channels
Step: 5- RF Analog design
Step: 6- Construct effective channels
Step: 7- BB Digital design
Step: 8- Normalization of pre-coding
Step: 9- Spectral efficiency
Step: 10- Creating a temperate channel
Step: 11- End

4.2 Flowchart



5 Results and Analysis

In this work, an algorithm for hybrid pre-coding based on kalman filtering, for millimeter wave is proposed. In the initial stage, the channel parameters and system parameters are defined and the entire simulation depends on number of user channels and transmitting antennas.

Here, for investigation the user channels, n = 4 and n = 6 with transmitting antennas 64, 81, 100 are considered.

In Fig. 1 the output result is generated for 4 user channels and 64 transmitting antennas which yields a spectral efficiency of 8.6 bps/Hz.

In Fig. 2 the output result is generated for 4 user channels and 81 transmitting antennas which yields a spectral efficiency of 8.8 bps/Hz.

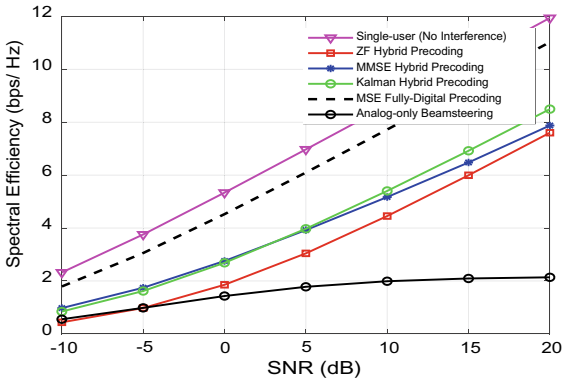


Fig. 1 For n = 4, TX antenna-64

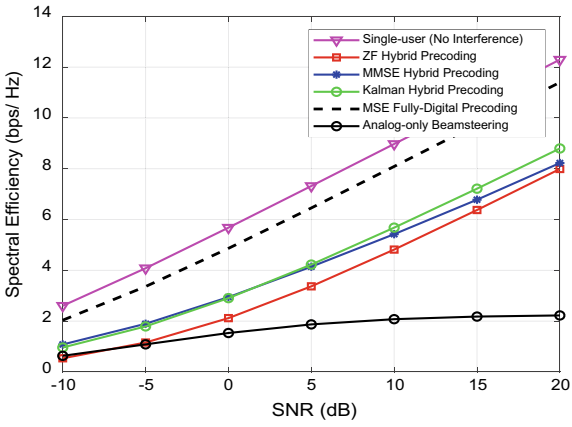


Fig. 2 For n = 4, TX antenna-81

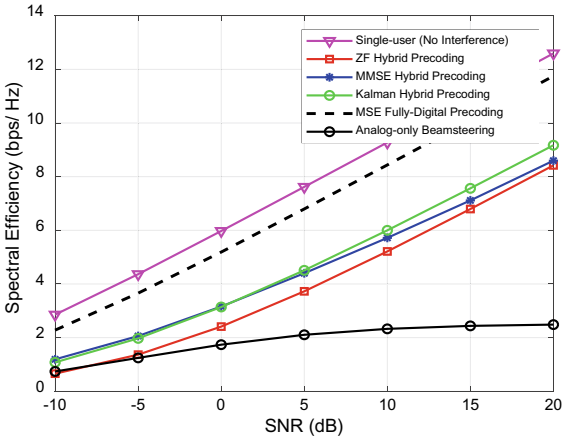


Fig. 3 For n = 4, TX antenna-100

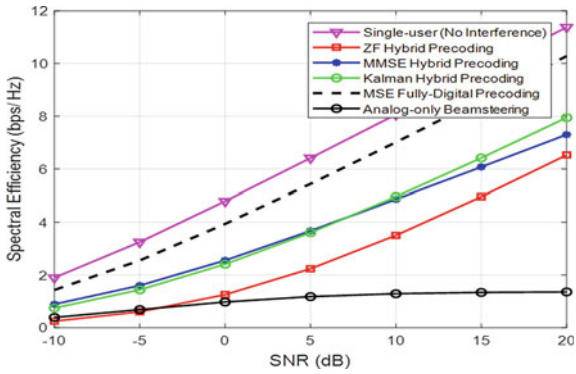


Fig. 4 For n = 6, TX antenna-64

In Fig. 3 the output result is generated for 4 user channels and 100 transmitting antennas which yields a spectral efficiency of 8.8 bps/Hz.

In Fig. 4 the output result is generated for 6 user channels and 64 transmitting antennas which yields a spectral efficiency of 8 bps/Hz.

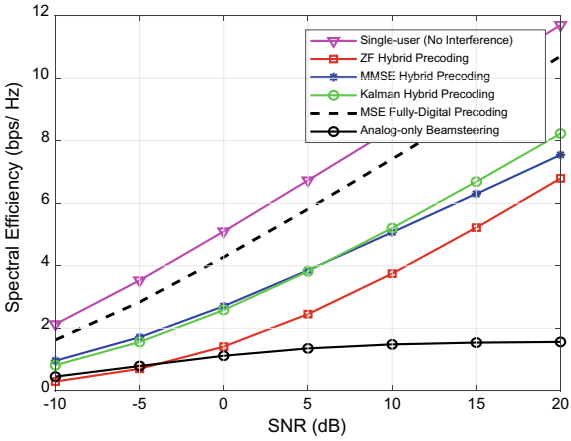


Fig. 5 For n = 6, TX antenna-81

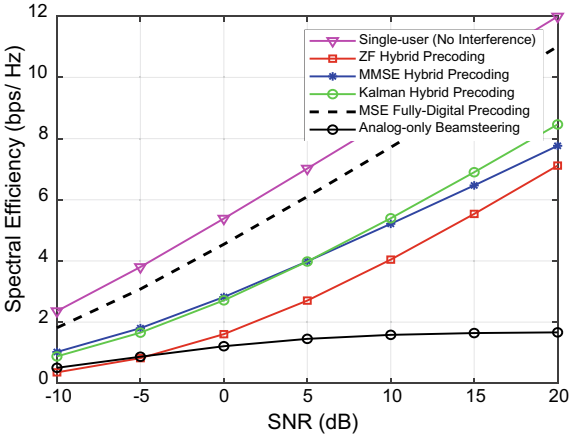


Fig. 6 For n = 6, TX antenna-100

In Fig. 5 the output result is generated for 6 user channels and 81 transmitting antennas which yields a spectral efficiency of 8.2 bps/Hz.

In Fig. 6 the output result is generated for 6 user channels and 100 transmitting antennas which yields a spectral efficiency of 8.6 bps/Hz.

From the above plots as shown in Figs. 1 to 6 which are drawn between SNR and spectral efficiency. It is obvious that proposed method yields an optimal solution, whereas previous methods either have values nearer to zero/null or high values which are involved with interference.

Table 1 For n = 4

S. No	Number of users	Number of TX antennas	Spectral efficiency
1	4	64	8.6
2	4	81	8.8
3	4	100	9.2

Table 2 For n = 6

S. No	Number of users	Number of TX antennas	Spectral efficiency
1	6	64	8
2	6	81	8.2
3	6	100	8.6

These comments can be supported with following tables (Tables 1 and 2).

From the two tables it is clear that, the spectral efficiency increases as the number of transmitting antennas increases.

6 Conclusion

We therefore proposed a multi-user beam forming technique for mm Wave massive MIMO systems based on a Kalman formulation and a hybrid pre-coding designed to reduce the uncertainty between the generated and predicted data.

Simulation results show that the approach proposed offers an optimal solution, while previous methods either have values closer to zero/null or high interfering values.

References

1. Wang Z, Li M, Tian X, Liu Q (2017) Iterative hybrid precoder and combiner design for mmwave multiuser mimo systems. IEEE Commun Lett 21(7):1581–1584
2. Molisch AF, Ratnam VV, Han S, Li Z, Nguyen SLH, Li L, Haneda K (2017) Massive mimo hybrid beamforming: a review. IEEE Commun Mag 55(9):134–141
3. Nguyen DHN, Le LB, Le-Ngoc T (2016) Precoding hybrid mmse for mmwave multiuser mimo systems. In: 2016 IEEE International Communications Conference (ICC), May 2016, pp 1–6
4. Alkhateeb A, Heath RW, Leus G (2015) Achievable rates of hybrid precoding multiuser millimeter wave systems. In: 2015 IEEE International Conference on Communication Workshop (ICCW), June 2015, pp 1232–1237

5. Smith PJ, Shafi M, Neil PC, Dmochowski A (2014) On the convergence of massive mimo systems. In: IEEE International Communications Conference (ICC) 2014, June 2014, pp 5191–5196
6. Rappaport TS, Sun S, Mayzus R, Zhao H, Azar Y, Wang K, Wong GN, Schulz JK, Samimi M, Gutierrez F (2013) Millimeter wave mobile communications for 5g cellular: it'll work!. IEEE 1:335–349

Enhancement of Cerebral and Retinal Vascular Structures Using Hessian Based Filters

Fahimuddin Shaik, J. Chittemma, S. Mohammed Islam, B. Laksminath Reddy, and S. Damodhar Reddy

Abstract A large vascular disorders such as stenosis, aneurysm and malformations, which involve different anatomical locations, are detected and handled through a set of techniques for imaging them. The need to diagnose and manage vascular disorders early has now contributed to the creation of numerous techniques in vascular imaging. Image manipulation plays an significant part of medicine's study of photographs from different methods for the treatment of eyes. The goal of the novel method for enhancing visualization by using hessian-based filters is to highlight the secret vessels, to improve angiographies as well as the possible pathological locations. The pictures found come from the computed tomography and retinal data. The goal of the novel method for enhancing visualization by using hessian-based filters is to highlight the secret vessels, to improve angiographies as well as the possible pathological locations. The pictures found come from the computed tomography and retinal data. The novel upgrading feature suggested has many applications such as retinal vasculatures, neck, lung and fundus, but only retinal and cerebral vasculatures are taken into account.

Index terms Digital image processing

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_46

1 Introduction

Now for a few days the need to diagnose vascular disorders at an early stage and manage them has led to different strategies for vascular imaging. Stenosis, aneurysms, embolism, defects and remodeling can involve vascular pathologies. Vascular diseases can affect a number of body parts counting the brain, hepatic, heart, pulmonary, retinal, etc. Throughout medical image production, photographs produced through different imaging methods play a prominent function. Improve the picture is considered one of medical picture processing's most significant technologies, as it boost the image quality and allow the image more processed and viewed [1]. The aim of the proposed German filters is to display expanded or rounded structures centered on Hessian own values.

The main cause of handicap and mortality in developed countries was vascular diseases. For the diagnosis and treatment of such diseases an accurate and thorough examination is important. Vascular structure imaging is an essential method for diagnosing and managing vascular disorders. Image-assisted devices reduce the amount of time the clinician needs to test the picture while often more accurately and more effectively detect vascular pathologies [2]. Picture processing should only include the identification and focus on pathology sites or vascular segmentation and quantification. However, such research is not that successful for vascular structural intensities, due to non-uniform disparity spread across a vascular system throughout imaging. Although the ideally spaced contrast bolus the not be distributed across the entire networks when examining a broad vascular network, because shifts in blood flow related to the laminar flow will disrupt the distribution of the contrast agent and thus enhance the non-uniformity inside the vessels. Filters for the improvement of vascular systems are widely used to eliminate these undesired differences in angiographic pictures and to block image vibration [3].

The key goals of the proposed task of enhancement are to illuminate possible locations for pathology by highlighting secret vasculature regions and to enhance visualization. In order to improve angiographic images using Hessian-based filters, we suggest a new enhancement feature, in which the shortcomings of previous implementations may be removed by evaluating the image parameters [4]. The ratio of own values eliminates unnecessary data like additive noise. Robust and weak standards of your own. In earlier workshops, a significant range of enhancement features, such as New, Frangi, Sato, Zhou, had been used, but the tests were less successful mostly because of a complex and eroded answer in bends and a weak response in the aneurysm test [5].

2 Literature Review

Digital image storage and management is the retrieval of pictures. It is widely used for different applications in biomedicine. The main cause of handicap and mortality in developed countries was vascular diseases. For the diagnosis and treatment of such diseases an accurate and thorough examination is important. Vascular structure imaging is an effective method to detect and cure vascular diseases [6].

Based on image recognition, computer-aided systems decrease the time a clinician spends analyzing the image, while also diagnosing vascular pathologies faster and more reliably. Picture processing should only include the identification and focus on pathology sites or vascular segmentation and quantification. However, such research is not that successful for vascular structural intensities due to non-uniform vessels [7].

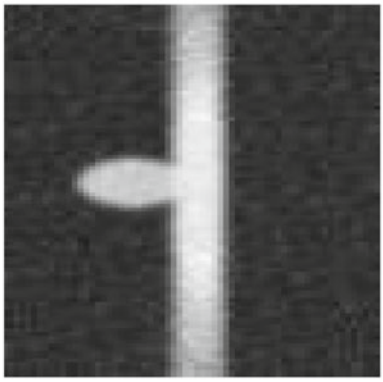
Although the ideally spaced contrast bolus the not be distributed across the entire networks when examining a broad vascular network, because shifts in blood flow related to the laminar flow will disrupt the distribution of the contrast agent and thus enhance the non-uniformity inside the vessels. Filters for the improvement of vascular systems are widely used to eliminate these undesired differences in angiographic pictures and to block image vibration [8].

Stenosis, aneurysms, embolisms, malformations and reconstruction can involve vascular pathologies. In the medical processing, vascular pathologies can impact a wide variety of anatomical areas, including those in the cerebral, hepatic, cardiac, pulmonary or peripheral or retinal areas [9]. Improving photographs is recognized as one of the a good number of vital applications in therapeutic image processing since it improves image quality and allows the picture appropriate for further study and viewing [10]. The purpose of the proposed German filters is to signify extended or circular frameworks centered on Hessian own values [11]. There are majorly five steps involved in the proposed enhancement functions. They are

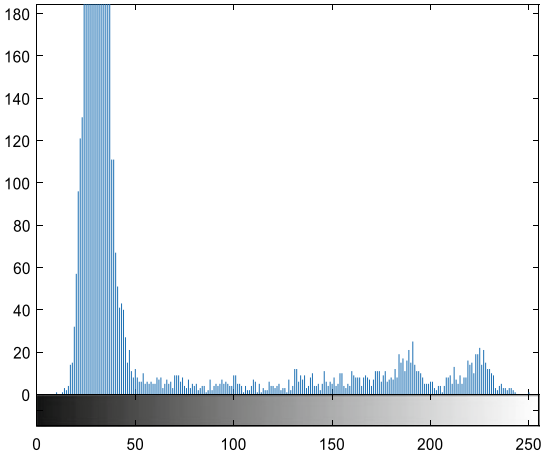
Step1:Load input image obtained from CT (Computed Tomography) scan.
Step2:For 2D image calculate the percentile of the input image.
Step3:For 3D image rotate volume for visualization by calculating percentile and then command permute is applied on the input image to rearrange dimensions of an N-dimensional array.
Step4:Compute enhancement for two different tau values.
Step5:Display result.

Fig. 1 **(a)**:-Input image **(b)**:-Histogram of input image

Analysis for blobness for 2 dimensional image:-



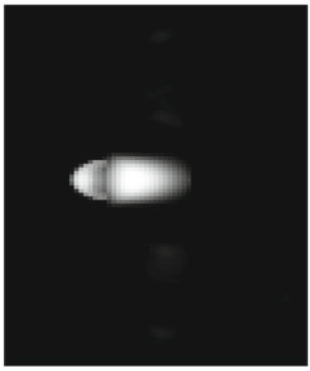
(a)



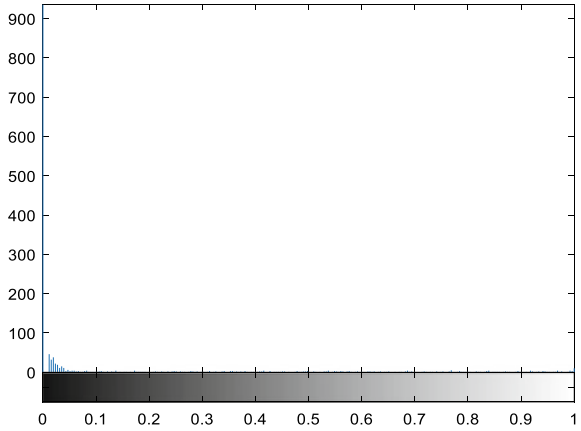
(b)

3 Results and Analysis

The representation of the CT (Computed Tomography) scan displayed in Fig. 1(a) is obtained, and the histogram of the representation of the sample is seen in Fig. 1 (b). The picture is supplied with the planned latest feature enhancement. The tau is



(a)



(b)

Fig. 2 **(a)**:-Output image (tau = 1) **(b)**:-Histogram of output image (tau = 1)

an update and the display picture for tau = 1 in Fig. 2(a) and the histogram in Fig. 2 is seen (b). Figure 2(a) displays the production image to tau = 0.5 and Fig. 2(a) displays the histogram (Fig. 3).

The gray data value is scattered around the gray picture from the histogram of the above chart, while the white picture value is grouped and condensed into the

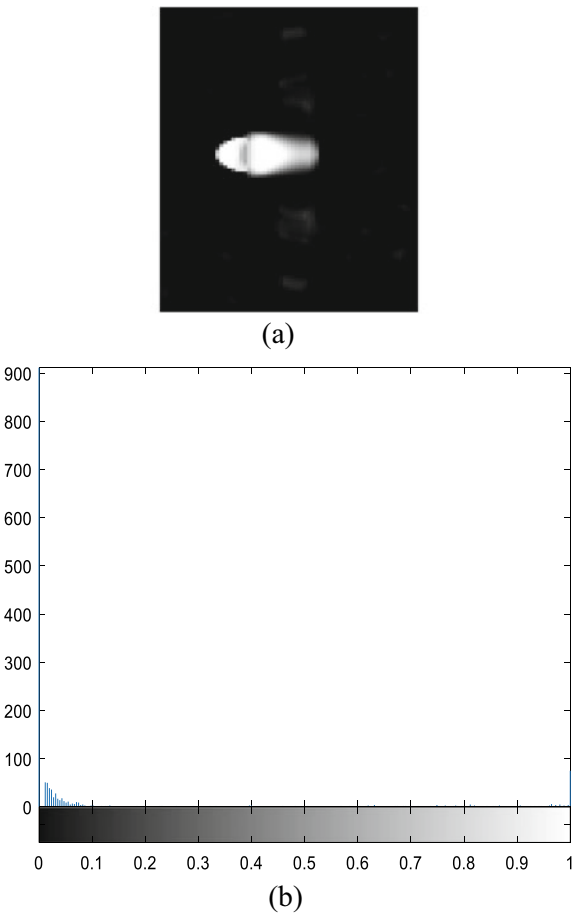


Fig. 3 **(a)**:-Output image (tau = 0.5) **(b)**:-Histogram of output image (tau = 0.5)

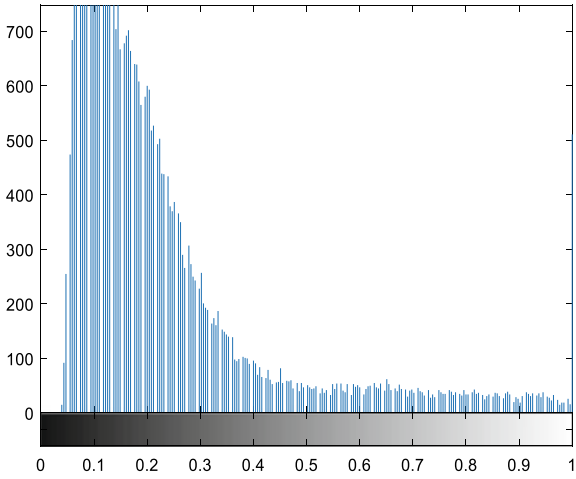
middle of the white picture and the number of pixels is smaller in the histogram of the output pictures.

The representation of the CT (Computed Tomography) scan displayed in Fig. 4 (a) is obtained, and the histogram of the representation of the sample is seen in Fig. 4(b). The picture is supplied with the planned latest feature enhancement. The tau is an update parameter and the tau = 1 reference value is seen in Fig. 5(a) and in Fig. 5(b) the histogram. Figure 5(a) displays the production image to tau = 0.5 and Fig. 5(b) displays the histogram.

Fig. 4 **(a)**:-Input image **(b)**:-Histogram of input image

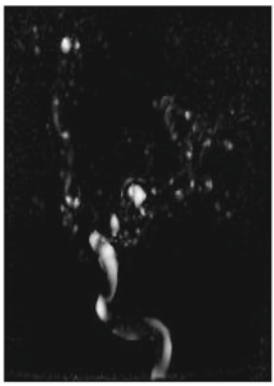
Analysis of blobness of 3 dimensional image :-

(a)

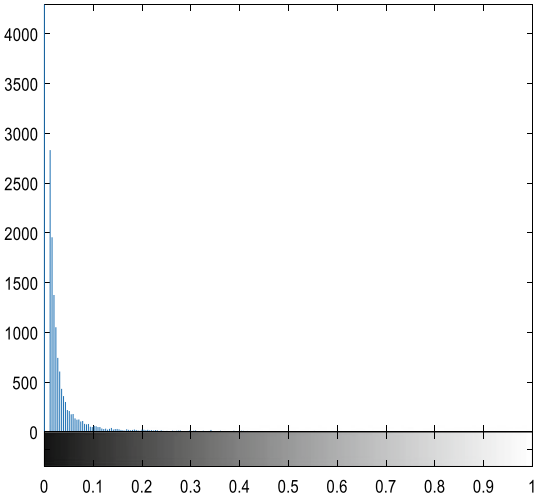


(b)

This can be seen from the histogram of the input map above, the gray scale values of the data are distributed across the gray scale, while the blue scale values are grouped and concentrated at the middle of the blue scale in the output image.



(a)



(b)

Fig. 5 **(a)**:-Output image (tau = 0.75) **(b)**:-Histogram of output image (tau = 0.75)

A CT (Computed Tomography) scan provides an input figure shown in Fig. 6 (a), and a photographic histogram in Fig. 6(b). The image of the input is given with the new upgrade function. The tau is a parameter for increasing tau = 1; the

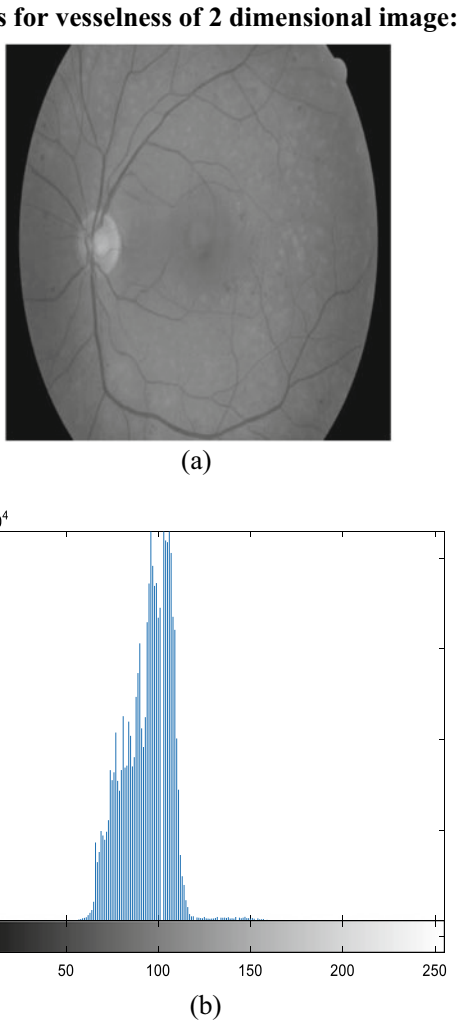
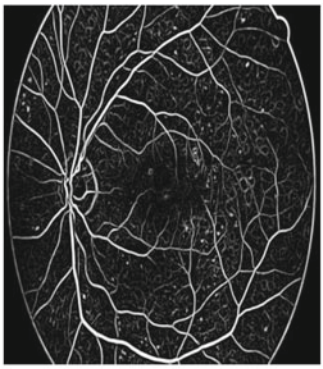


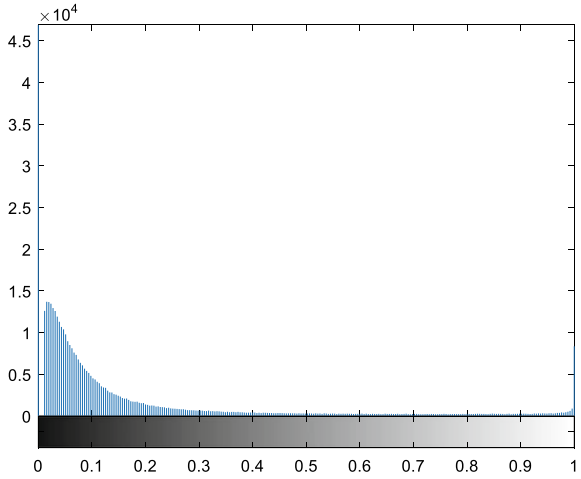
Fig. 6 **(a)**:-Input image (tau = 0.75) **(b)**:-Histogram of input image

performance is shown in Fig. 5(a) and in Fig. 5(b) the histogram is shown. In Fig. 5 (a), and histograms in Fig. 5(b), the reference value of tau = 0.5 occurs (Fig. 8).

As it can be observed from histogram of the above input picture, the gray scale values of the input are combined, while the gray level standards of the output image are scattered around the gray scale and the number of pixels is smaller.



(a)



(b)

Fig. 7 **(a)**:-Output image (tau = 0.75) **(b)**-Histogram of output image (tau = 0.75)

A CT scan (Computed Tomography) provides the input picture seen in Fig. 9(a) and the input picture histogram is seen in Fig. 6(b). The photo of the input is inserted into the new functionality proposed. The tau is a parameter change, with the picture production for tau = 1 seen in Fig. 7(a) and in Fig. 7(b). The tau = 0.5 production is seen in Fig. 7(a) and in Fig. 7(b) in the histogram (Fig. 10).

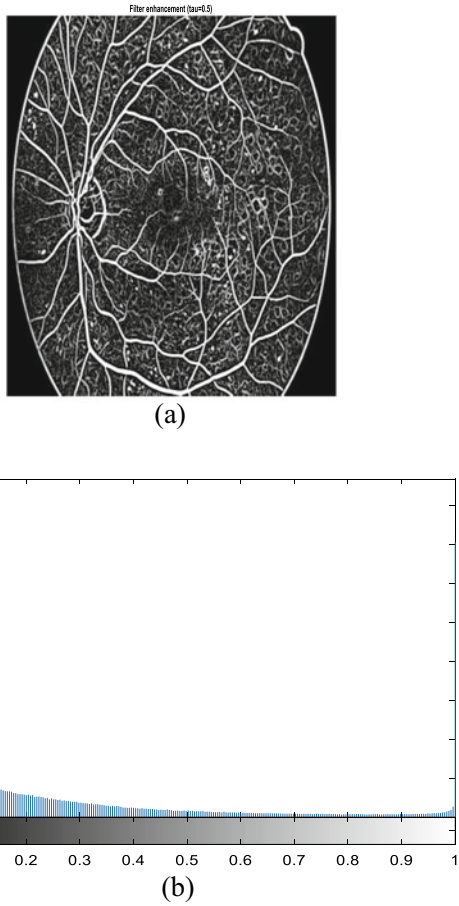
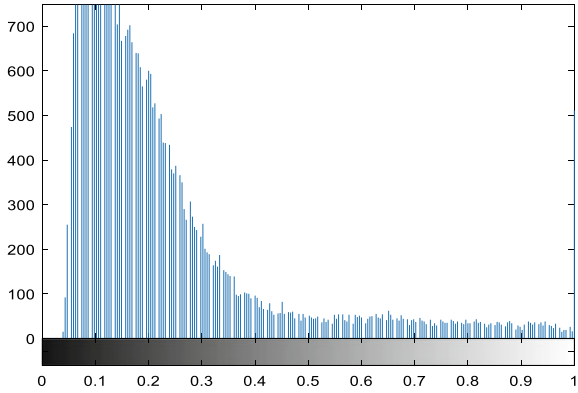


Fig. 8 **(a)**:-Output image (tau = 0.5) **(b)**:-Histogram of output image (tau = 0.5)

As from the histogram of the above reference image, the gray scale values of the input are scattered over the gray scale, while the gray range values of the output image are combined into the histogram and the amount of pixels in the output picture is larger than that of the input image.

Analysis for vesselness of 3 dimensional image :-

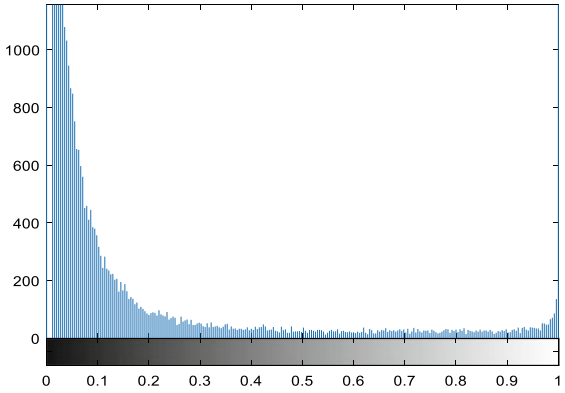
(a)



(b)

Fig. 9 **(a)**:-Input image **(b)**:-Histogram of input image

(a)



(b)

Fig. 10 **(a)**:-Output image (tau = 0.75) **(b)**:-Output image and its histogram (tau = 0.75)

4 Conclusion

The suggested strategy of improving cortical and retinal vascular systems enhances retinal and brain vascular systems and make the aneurysm noticeable. It examines and analyzes current approaches. There is a distinction between the positives and disadvantages of the system. Ultimately, the experiment contributes to the development of a modern algorithm combining ideas from various techniques of image processing. This research has established a jerman filter based on hessian matrix. Survey and review of current approaches. Software weaknesses and faints in contrast to each other, and the experiment will potentially contribute to the development of a new algorithm that incorporates concepts from established image processing technologies The vasculitis mechanisms are improved such that the aneurysm becomes obvious evident.

The efficacy and usefulness of the suggested technique have been seen in comparison to the related subjectivity, utilizing histogram diagrams, in experimental studies for large datasets. A few new datasets may be checked, analyzed and measured in the future for improved outcomes.

References

1. Villablanca JP, Jahan R et al (2002) Detection and characterization of very small cerebral aneurysms by using 2D and 3D helical CT angiography. Am J Neuroradiol 23(7):1187–1198
2. van Rooij W, Sprengers M, de Gast A, Peluso J, Sluzewski M (2008) 3d rotational angiography: the new gold standard in the detection of additional intracranial aneurysms. Am J Neuroradiol 29(5):976–979
3. White PM, Wardlaw JM, Easton V (2000) Can noninvasive imaging accurately depict intracranial aneurysms? a systematic review. Radiology 217(2):361–370
4. Sailer AMH, Grutters JP, Wildberger JE, Hofman PA, Wilmink JT, van Zwam WH (2013) Cost-effectiveness of CTA, MRA and DSA in patients with non-traumatic subarachnoid haemorrhage. Insights Imaging 4(4):499–507
5. Abramoff M, Garvin M, Sonka M (2010) Retinal imaging and image analysis. IEEE Rev Biomed Eng 3:169–208
6. Shahzad R, Kirili H, Metz C, Tang H, Schaap M, Vliet LV, Niessen W, Walsum TV (2013) Automatic segmentation, detection and quantification of coronary artery stenoses on CTA. Int J Cardiovasc Imaging 29(8):1847–1859
7. Hentschke CM, Beuing O, Paukisch H, Scherlach C, Skalej M, Tnnies KD (2014) A system to detect cerebral aneurysms in multimodality angiographic data sets. Med Phys 41(9):091904
8. Gopichand M, Madapudi RK, Rao AA (2012) Change requests artifacts to assess impact on structural design of SDLC phases. Int J Comput Appl 54(18):21–26 ISSN 0975-8887
9. Lesage D, Angelini ED, Bloch I, Funka-Lea G (2009) A review of 3D vessel lumen segmentation techniques: Models, features and extraction schemes. Med Image Anal 13 (6):819–845
10. Agam G, Armato SG, Wu C (2005) Vessel tree reconstruction in thoracic CT scans with application to nodule detection. IEEE Trans Med Imag 24(4):486–499
11. Wiemker R, Klinder T, Bergtholdt M, Meetz K, Carlsen IC, Buelow T (2013) A radial structure tensor and its use for shape-encoding medical visualization of tubular and nodular structures. IEEE Trans Vis Comput Graph 19(3):353–366

Throughput Comparison of Majority Logic Decoder/Detector with Other Decoders Used in Communication Systems

J. Chinna Babu and N. Mallikharjuna Rao

Abstract The Low Density Parity Check (LDPC) codes are linear block codes, which are Shannon Limit codes. These codes are attained least error floors of data bits for data transfer applications used in communication systems. However, the proposed LDPC codes are more beneficial than Turbo codes because of reduction in the decoding complexity and detection of the errors in less cycle time. This results the reduction of decoding time, low decoding latency and as well as least error floors in communication, when the transmitted data contains multiple error bits. This paper is proposed to represent the majority logic decoding/detecting of LDPC codes. This paper proposes the Generation of Generator and Parity Check matrices for both Binary and Non-Binary LDPC Codes. Here, the proposed Majority Logic Decoder/Detector (MLDD) is Hard decision decrypting scheme and it uses majority logic decoding based on the data transmission and reception in communication channel. This paper also elaborates the effective implementation of encoding and decoding of LDPC Codes.

Keywords LDPC codes · Turbo codes · Coding theory · Communication · Signal processing

1 Introduction

1.1 Low Density Parity Check (LDPC) Codes

Low density parity check (LDPC) codes are superior type of error detecting and correcting codes, which are famous for their **less** complexity of the decoding Process and speed of operation. Many techniques have been designed for the

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_47

construction of LDPC codes, so that they can approach the channel capacity for efficient transmission proving the Shannon's theorem. The rapid progress in this area of coding theory has laid a strong interest in adopting LDPC codes in fields such as satellite based digital video broadcasting, optical communications, data storage, third generation mobile telephony etc. [1–4].

1.2 Representation of LDPC Codes

As the title represents, the projected LDPC codes are the superior type of least decoding complexity block codes with various sizes of parity-check matrices containing less number of non-zero entries. This sparse matrix is often generated by random process, based on the some strict constraints. LDPC codes are distinct as null space of the Generator matrix (G) with the structural properties. Each and every row specified as 'ρ' number of ones. Each and every column specified as 'γ' number of ones. The common numbers of 1's among any two neighbourhood columns are designated by 'λ' and it should not superior than one. Both 'ρ' and 'γ' are slightly small enough, associated to the size of the code pattern and quantity of rows in Generator matrix (G) [5–7].

Subsequently 'ρ' and 'γ' are minor, and the generator matrix G has less density of ones and it is a sparse generator matrix. Henceforward, this generated code matrix stated by G is known as LDPC code. From this resultant generator matrix, we can derive H matrix. Depending on thinness of H-matrix the decoding complexity may increase or decrease linearly according with the length of the code and minimum distance. LDPC codes are also like other block codes and other linear block codes can be represented by constructing sparse matrix but that is not practical. However the sparse H-matrix is constructed first for designing of LDPC codes and then generator matrix is determined for the code pattern. The key transformation among LDPC code patterns and traditional chunk code patterns is the way the code patterns are decrypted. Traditional block code patterns are commonly decoded using ML (Majority Logic) for similar decrypting procedures [8]. Hence they are usually small and intended algebraically, so that the assignment is not composite. However the proposed LDPC codes are decrypted using iterative process and a pictorial illustration of their parity-check matrix H. Generally, LDPC codes are represented by two forms: Matrix representation, graphical representation [9–11].

Matrix representation:

$$H = \begin{bmatrix} 0 & 1 & 1 & 1 & 1 & 0 & 1 & 1 \\ 1 & 1 & 1 & 0 & 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 & 1 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 1 & 1 & 1 & 0 \end{bmatrix}$$

The presented matrix size is mentioned as 8 × 4, which contains n-variable nodes and k-check nodes. In this weight of the each row is 6 and column weight is 3 defined respectively. Whereas n represents the total block length and k represents the quantity of message bits and $n - k$ parity bits are added to the each code word of size contains $(n.k)$. The H-matrix becomes one only when the joint exists among the feasible nodes and check nodes for all the elements of n^{th} column and the k^{th} row of a graph. Such graph contains of n (i.e., n = 8) variable nodes and k (i.e., k = 4) check nodes [12–15].

1.3 Shannon's Theorem

To achieve consistent transmission of information over the given communication channel, the data broadcasting rate should not go beyond the capacity of the channel, which is proved by Shannon [16]. Tanner graph is represented in Fig. 1 which can also be shown in matrix representation as depicted before this graph with dimensions n × m for a (8, 4) code. The tanner graph is itself a two dimensional representation of H-matrix, where c-nodes (f_0, f_1, f_2, f_3) are called Check nodes or constraint nodes and v-nodes (c_0–c_7) are called feasible nodes. Check node f_i is connected to feasible node c_j if the element h_{ij} of parity matrix (H) is a one.

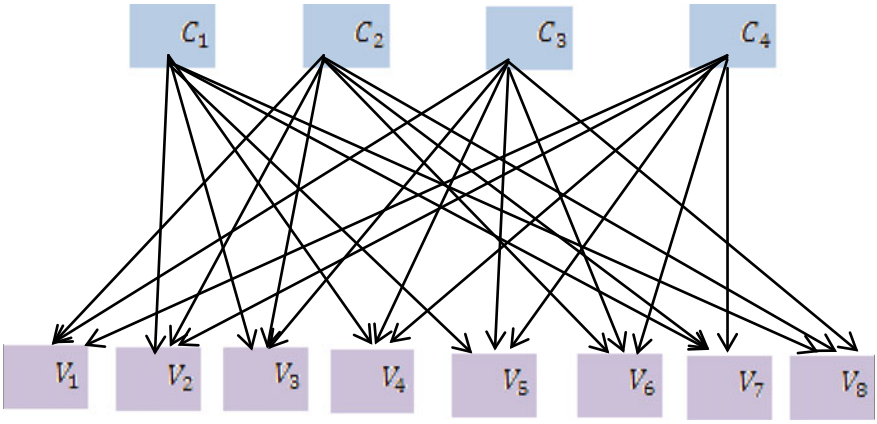

Fig. 1 Tanner graph representation of H-matrix

2 Construction of LDPC Codes

The $H_{M\times N}$ parity check matrix is defined as (n, k), where n is total code pattern length, K indicates actual bits of data pattern information and (n-k) is said to be number of parity bits. The generated code pattern is valid, if the code pattern fulfils the expression $c.H^T = 0$. The Code pattern can be generated from the expression $c = m.G$. The parity and generator matrices are mutually exclusive; they are obtained one from the other. The reorganization of the H-matrix results the Generator matrix. It can be obtained by interchanging row and columns. $H_{sys} = [I_m| G_{m\times k}]$. Rearrange the methodical parity check matrix (H_{sys}) as $G = [P^T_{k\times m}| I_k]$. The matrices G and H holds true, if $G.H^T = 0$.

2.1 Operational Procedure for the Determination of Generator and Parity Check Matrices for Binary LDPC Codes

1. Calculate the primitive polynomial
2. Calculate the degree terms
3. Galois addition and Galois multiplication
4. Calculate the originator polynomial G(x)
5. Determination Generator and parity check matrices, one from other.

For the better understanding of the procedure, here let us consider a binary code of length (7, 4).

Step$_1$: Scheming of Primeval polynomial

*Let us deliberate the odd quantities from 1 to 16
1, 3, 5, 7, 9, 11, 13, 15
*Write the odd numbers in binary form
1-0001, 3-0011, 5-0101, 7-0111, 9-1001,
11-1011, 13-1101, 15-1111
*Concatenate 1 as MSB bit
1-10001; 3-10011; 5-10101; 7-10111, 9-11001, 11-11011, 13-11101, 15-11111
*Now reverse the bits which are obtained after concatenation.
1-10001; 3-11001; 5-10101; 7-11101, 9-10011, 11-11011, 13-10111, 15-11111
*Now associate the appended bits with the inverted bits
1-10001-10001, 3-10011-11001, 5-10101-10101, 7-10111-11101, 9-11001-10011
11-11011-11011, 13-11101-10111, 15-11111-11111
*If both bit streams are equal ignore them, otherwise note the numbers.
3-10011-11001, 7-10111-11101, 9-11001-10011, 13-11101-10111
*For the primeval polynomial choice the least value of left over.

$$11001 \rightarrow x^4 + x^3 + 1$$

*Primitive polynomial $P(x) = x^4 + x^3 + x + 1$

Step$_2$: Calculation of Degree terms

While calculating the degree term value, if the value exceeds the 16, then Ex-or it with the primitive polynomial $(x4 + x3 + x + 1)$,

p(x) = 11001.

α^0 = 0001,
α^1 = 0010 = 2,
α^2 = 0100 = 4,
α^3 = 1000 = 8,
α^4 = 10000^11001 = 01001,
α^5 = 10010^11001 = 01011,
α^6 = 10110^11001 = 01111,
α^7 = 11110^11001 = 00111,
α^8 = 01110,
α^9 = 11100^11001 = 00101,
α^{10} = 01010,
α^{11} = 10100^11001 = 01101,
α^{12} = 11010^11001 = 00011,
α^{13} = 00110,
α^{14} = 01100,
α^{15} = 11000^11001 = 00001

Step$_3$: Galois Addition and Multiplication

Galois Addition:

The addition of two operands, which are having n and (n + 1) bits respectively are added, then the resultant data has n number of bits.

Galois Multiplication:

The multiplication of two operands, which are having n and (n + 1) bits respectively are multiplied, then the resultant data has n number of bits.

×	$\alpha^0$1	$\alpha^1$2	$\alpha^2$4	$\alpha^3$3	$\alpha^4$6	$\alpha^5$7	$\alpha^6$5
$\alpha^0$1	α^0	α^1	α^2	α^3	α^4	α^5	α^6
$\alpha^1$2	α^1	α^2	α^3	α^4	α^5	α^6	α^0
$\alpha^2$4	α^2	α^3	α^4	α^5	α^6	α^0	α^1
$\alpha^3$3	α^3	α^4	α^5	α^6	α^0	α^1	α^2
$\alpha^4$6	α^4	α^5	α^6	α^0	α^1	α^2	α^3
$\alpha^5$7	α^5	α^6	α^0	α^1	α^2	α^3	α^4
$\alpha^6$5	α^6	α^0	α^1	α^2	α^3	α^4	α^5

Step4: Generator polynomial Calculation

*The normalized method of originator polynomial G(x) is given by

$$G(x) = (x - \alpha 0)(x - \alpha 1)$$

$$(x - \alpha 2).\ldots.\ldots.\ldots.\ldots.\ldots.\ldots.\ldots.\ldots...$$

$$\left(x - \alpha^{n-k-1}\right)$$

where n, k = 16, 8 therefore

$$G(x) = (x - \alpha 0)(x - \alpha 1)(x - \alpha 2)(x - \alpha 3)(x - \alpha 4)(x - \alpha 5)(x - \alpha 6)(x - \alpha 7)$$

*By solving above equation the result is

$$G(x) = x7 + x6 + x5 + x4 + x3 + x2 + x + 1 \rightarrow (1\ 1\ 1\ 1\ 1\ 1\ 1\ 1)$$

Step$_5$: Construction of parity check matrix

$$\mathrm{H} = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 \end{pmatrix}$$

The first column is obtained by lettering the bits after LSB to MSB of α^0 = 1 = 0001 and in the next step downshift the data in column 1 to obtain column 2 and so on. If the '1' appears as last bit in the column then for the next shift it should be Ex-ored with the shifted data with G(x) to obtain that column, otherwise data is shifted left/down. Here the last bit in column 11 is '1' hence it is shifted down and is then Ex-or with G(x) = [1 1 1 1 1 1 1 1] to obtain data in column 12. This is the procedure to obtain H-matrix for binary LDPC codes. It can produce the code pattern input, by reproducing message 'm' with originator matrix 'G', $\boldsymbol{c} = \boldsymbol{m}.\boldsymbol{G}$.

$$\mathrm{G} = \begin{pmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 1 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

Let us assume and study an 8-bit data message m = [1 0 0 1 0 1 0 0], this data message code pattern is encoded by reproducing it with generator matrix i.e., then the resultant code word for encoding is C = m.G

$$\begin{pmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 1 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

C = [1 0 0 1 1 0 1 0 1 0 0 1 0 1 0 0], then the resultant code pattern is said to be legal, if it fulfills the pattern calculation is $z = CH^T = 0$, where data size can be assumed as (12, 6). It represents total number of bits and messages for data transmission among transmitter and receiver.

The rest of the paper is detailed as follows. In Sect. 2.2, decoding of LDPC codes is reviewed and discussed. In Sect. 3, simulation process and results analysis is presented and Sect. 4 concludes the work with a summation. This is the procedure to obtain H-matrix for binary LDPC codes.

2.2 *Operational Procedure for Determination of Parity Check Matrix for Non-binary LDPC Codes*

Let us deliberate the length of non-binary codes of dimensions (12, 6), In this regard, it is too complex to determine the (12, 6) parity check matrix. To obtain the (12, 6) matrix, it can use the 2:1 ratio of (12, 6) matrix and it can be represented by two (6, 3) matrices.

Step1: Determination of primitive polynomial

Find the odd numbers from 1 to 6 i.e., 1, 3, 5 in binary notation and concatenate 1 as MSB bit.

Now reverse the concatenate bits.

1001-1001, 1011-1101, 1101-1011 if equal ignore them else take minimum term as primitive polynomial.

Hence, 1011 is min term and the primitive polynomial as $P(x) = X3 + X + 1$.

Step2: Determination of degree terms: To calculate the degree terms, shift the bit pattern to left side. Then the resultant bit pattern exceeds the value 6 then do the EX-OR operation with the above mentioned polynomial.

$\alpha^0 = 001 = 1$

$\alpha^1 = 010 = 2$

$\alpha^2 = 100 = 4$

α^3 = 1000^1011 = 011
α^4 = 110 ==> Exceeded 6 ==> 0
α^5 = 1100^1011 ==> 0111^1011 => 100 => 4

Matrix representation of (12, 6):

Degree terms are used to generate the matrix is as shown below, by taking the data bits in terms of rows into columns from LSB to MSB.

$$\begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 \end{bmatrix}$$

The matrix shown above is considered as (w_r, k) where w_r = 2, two is weight of the row and k = 3, three is number of rows in the above matrix. Finally, the matrix can be obtained by re-arranging the columns in the (2, 5), (3, 4), (1, 6) order (Fig. 2).

Parity matrix of (6, 3) code can be written as

$$H = \begin{bmatrix} 0 & 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 \end{bmatrix}$$

From (6, 3) Matrix, The required (12, 6) Matrix (H) can be represented as

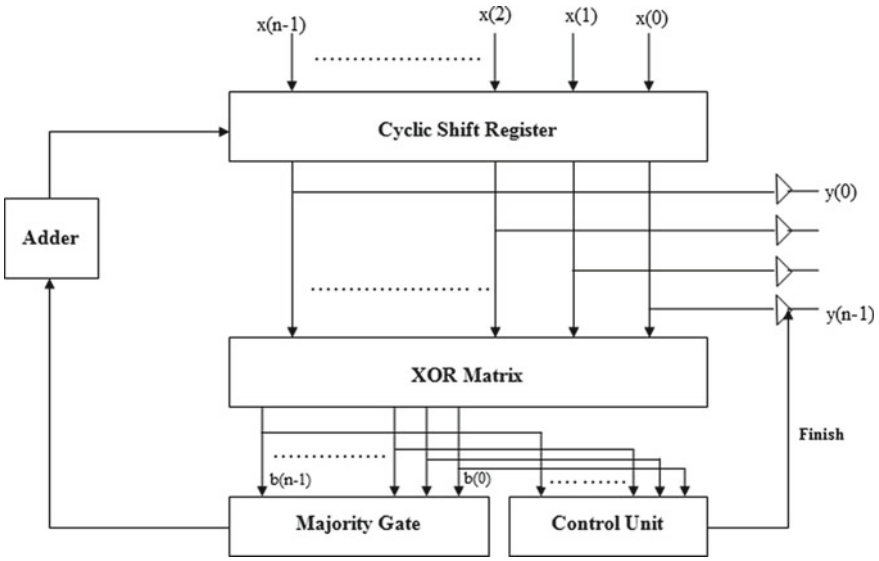

Fig. 2 Block diagram of MLDD decoder

$$H = \begin{bmatrix} M1(x) & M1sC(x) \\ M1RsC(x) & M1RC(x) \end{bmatrix}$$

Here, M1(x) indicates matrix for (6, 3) code. M1 sC(x) gives Shift row from down and column from last to middle and middle to last. M1RsC(x) can be shown as Shift column. M1RC(x) gives change last column to middle and middle row to last column. In (12, 6) code, 12 feasible nodes and given by the columns and rows are indicated by 6 check nodes. Therefore, Final H-Matrix is given by

$$\left[\begin{array}{cccccc|cccccc} 0 & 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 1 & 0 \\ \hline 0 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \end{array}\right]$$

2.3 Decoding of LDPC Codes Using MLDD

Procedure for redundant matrix:

Consider the H-Matrix for (15, 7) code

$$H = \begin{bmatrix} h0 \\ h1 \\ h2 \\ h3 \\ h4 \\ h5 \\ h6 \\ h7 \end{bmatrix} = \left[\begin{array}{cccccccc|cccccccc} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 & 1 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 1 \end{array}\right]$$

Step 1: By doing the XOR operation for the combinations of (1, 5), (0, 2, 6) we get the maximum reduced values as ‘4’, so 4th row is eliminated.

Step 2: Similarly by doing XOR operation for (4, 3), (6, 1), (2, 5) and (1, 2), (3, 0) we get the reduced value ‘7’ and ‘3’ respectively, so we should keep 3rd and 7th rows constant.

Step 3: From step1 we add row1 and row5; and row0, row2 and row6.

The reduced matrix is

$$\begin{bmatrix} w1 \\ w2 \\ w3 \\ w4 \end{bmatrix} = \begin{bmatrix} h3 \\ h1+h5 \\ h0+h2+h6 \\ h7 \end{bmatrix} = \begin{bmatrix} 0001000000011010 \\ 0100010000000011 \\ 1010001000000001 \\ 0000000110100001 \end{bmatrix}$$

Majority logic decoder steps

Step1: Store the data in the shift register

Step2: Check equations are computed from the reduced matrix as shown below:

$$W1 = c3 \oplus c11 \oplus c12 \oplus c14$$

$$W2 = c1 \oplus c5 \oplus c13 \oplus c14$$

$$W3 = c0 \oplus c2 \oplus c6 \oplus c14$$

$$W4 = c7 \oplus c8 \oplus c10 \oplus c14$$

Step3: The inputs W1, W2, W3 and W4 are given to the 4 XOR gates and the result is obtained.

Step4: The finalized equations from sums are then accelerated to the mainstream entrance for assessing its exactness, if the received data contains more ones than zeros, which means that the present data bit underneath decrypting process is incorrect; else the data bit under decoding is correct.

Step5: If the result is wrong, then the C14 bit is toggled, then the content of register is rotated.

Step6: This process can be repeated until the all code pattern bits have been processed.

Ex: Consider the code word

C0 C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14

0 1 1 1 0 1 0 1 1 1 1 1 1 0 1 1

By using the above check equations,

$$W1 = 1 \oplus 1 \oplus 0 \oplus 1 = 1,$$

$$W2 = 1 \oplus 1 \oplus 1 \oplus 1 = 0,$$

$$W3 = 0 \oplus 1 \oplus 0 \oplus 1 = 0,\ W4 = 1 \oplus 1 \oplus 1 \oplus 1 = 0$$

The numbers of 1's are less than 0's. So the output of majority gate is 0. Then the content of register is rotated and the code pattern is given as 1 0 1 1 1 0 1 0 1 1 1 1 1 0 1. This procedure is same up to 15 cycles. After 15th cycle the content of shift register is corrected code pattern. The procedure for 15 cycles is shown in below Table 1. For checking the code word that is obtained, the same procedure is followed which shown in Table 2.

Table 1 Shift operations of MLDD algorithm with error

C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	W1	W2	W3	W4	MG out	SB
0	1	1	1	0	1	0	1	1	1	1	1	0	1	1	1	0	0	0	0	1
1	0	1	1	1	0	1	0	1	1	1	1	1	0	1	0	1	0	1	0	1
1	1	0	1	1	1	0	1	0	1	1	1	1	1	0	1	1	1	0	1	1
1	1	1	0	1	1	1	0	1	0	1	1	1	1	1	1	0	0	1	0	1
1	1	1	1	0	1	1	1	0	1	0	1	1	1	1	0	0	0	0	0	1
1	1	1	1	1	0	1	1	1	0	1	0	1	1	1	1	1	0	0	0	1
1	1	1	1	1	1	0	1	1	1	0	1	0	1	1	1	0	1	1	1	0
0	1	1	1	1	1	1	0	1	1	1	0	1	0	1	1	1	1	1	1	0
0	0	1	1	1	1	1	1	0	1	1	1	0	1	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1	1	0	1	1	1	0	1	0	0	0	0	0	1
1	0	0	0	1	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0
0	1	0	0	0	1	1	1	1	1	1	0	1	1	1	0	0	0	0	0	1
1	0	1	0	0	0	1	1	1	1	1	1	0	1	1	0	0	0	0	0	1
1	1	0	1	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	1
1	1	1	0	1	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0
0	1	1	1	0	1	0	0	0	1	1	1	1	1	1	–	–	–	–	–	–

Table 2 Shift operations of MLDD Algorithm Without error

C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	W1	W2	W3	W4	MG out	SB
0	1	1	1	0	1	0	0	0	1	1	1	1	1	1	0	0	0	0	0	1
1	0	1	1	1	0	1	0	0	0	1	1	1	1	1	0	0	0	0	0	1
1	1	0	1	1	1	0	1	0	0	0	1	1	1	1	0	0	0	0	0	1
1	1	1	0	1	1	1	0	1	0	0	0	1	1	1	0	0	0	0	0	1
1	1	1	1	0	1	1	1	0	1	0	0	0	1	1	0	0	0	0	0	1
1	1	1	1	1	0	1	1	1	0	1	0	0	0	1	0	0	0	0	0	1
1	1	1	1	1	1	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0
0	1	1	1	1	1	1	0	1	1	1	0	1	0	0	0	0	0	0	0	0
0	0	1	1	1	1	1	1	0	1	1	1	0	1	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1	1	0	1	1	1	0	1	0	0	0	0	0	1
1	0	0	0	1	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0
0	1	0	0	0	1	1	1	1	1	1	0	1	1	1	0	0	0	0	0	1
1	0	1	0	0	0	1	1	1	1	1	1	0	1	1	0	0	0	0	0	1
1	1	0	1	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	1
1	1	1	0	1	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0
0	1	1	1	0	1	0	0	0	1	1	1	1	1	1	0	0	0	0	0	1

Table 1 shows the number of cycles the code had been rotated until the correct code word is obtained. Table 2 shows the verification of the obtained corrected code word. The above table represents C0 to C14 are Code pattern bits from 0 to 14. W1 to W14 are the values of reduced check equations. Where MG out is the Majority gate output considering W1 to W4. If W1 to W4 values are all zeros, then the Majority gate output is zero. If W1 to W3 Values are 1s and W4 is 0, then the majority gate output is 1. Here SB indicates shifted bit from cycle to other. In Table 2 also C0–C14 are Code pattern bits from 0 to 14. W1 to W14 are the values of reduced check equations.

In Table 2 the corrected code pattern can be obtained after 15 clock cycle iterations. In MLDD Decoder reduced check equations are taken from the parity check matrix of the given Code. By following the decoding steps of MLDD algorithm, the decoded code word is correct code pattern which was transmitted at the transmitter end (Fig. 3).

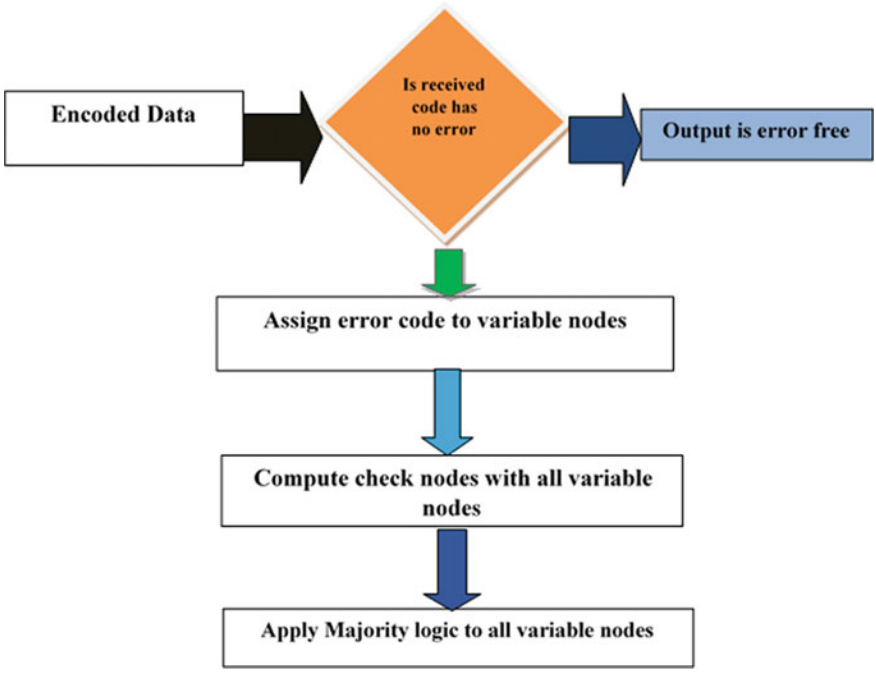

Fig. 3 Flow graph of MLDD decoding process

3 Result Analysis

In the proposed Majority Logic Decoder/Detector method, the speed can be increased by comparing with One-step MLD and the required power consumption is less in proposed algorithm of MLDD method when compared to One-step MLD. In conventional MLD method, the operational delay is proportional to size of the code pattern i.e., if the length of the code is 15 bits, then it needs 15 clock cycles. Similarly, the required numbers of cycles to read IOBs are also high. On the other hand, for the proposed MLDD the required delay is only depends on the error rate of the data transmitted [17–21]. In this section MLDD is compared with other existing decoding algorithms such as Belief propagation decoder, Sequential peeling decoder, Parallel peeling decoder and Self reliability based weighted bit flipping decoder and Soft bit flipping algorithms.

In this section, It discussed methodology and simulation results of decoding algorithms are presented. The proposed research study, MLDD utilization or complexity and power consumption. The following three metrics are used to measure the decoding latency. The simulation values are obtained from Xilinx Synthesis report and SPARTAN 3e. The resultant values are tabulated in Table 3

The performance metric latency is computed using Eq. (1).

$$Latency = CC * CP \tag{1}$$

$$where\ CC = Total\ number\ of\ Clock\ Cycles\ to\ obtain\ output$$

$$CP = Minimum\ required\ Clock\ Period$$

The total number of clock cycles referred to as CC is computed from Eq. (2).

$$CC = \frac{Time\ period\ needed\ for\ decoding\ the\ output}{Time\ period\ Interval} \tag{2}$$

this is evident from the Tables 4, 5 and Fig. 4; the proposed MLDD took moderate latency compared to SBF, SPD and took high latency compared to BPD, PPD, and SRWSBF to produce decoded data. The proposed research study, MLDD decoding

Table 3 Comparison of one –step MLD and MLDD algorithms [22]

Cycles at which the output is obtained after error detection process				
Method	IOBs	Error detection (no. of cycles)	With error (no. of cycles)	Without error (no. of cycles)
One-step MLD Algorithm	2	N	N + 2	N + 2
MLDD Algorithm	2	3	3 + 2=5	N + 5 (e.g. N = 15 + 5)

Table 4 Simulation parameters versus decoding algorithm

Parameters	Algorithms					
	SBF	BPD	SPD	PPD	MLDD	SRWSBF
Minimum clock period (in ns)	29.61	23.64	24.34	21.38	26.49	22.23
Total required cycles to obtain output	36	37	39	41	34	35
Time interval (in ns)	200	200	200	200	200	200

Table 5 Latency performance metric over decoding algorithms

Performance metric	Algorithms					
	SBF	BPD	SPD	PPD	MLDD	SRWSBF
Latency (ns)	1065.96	874.68	949.26	876.58	900.66	778.00

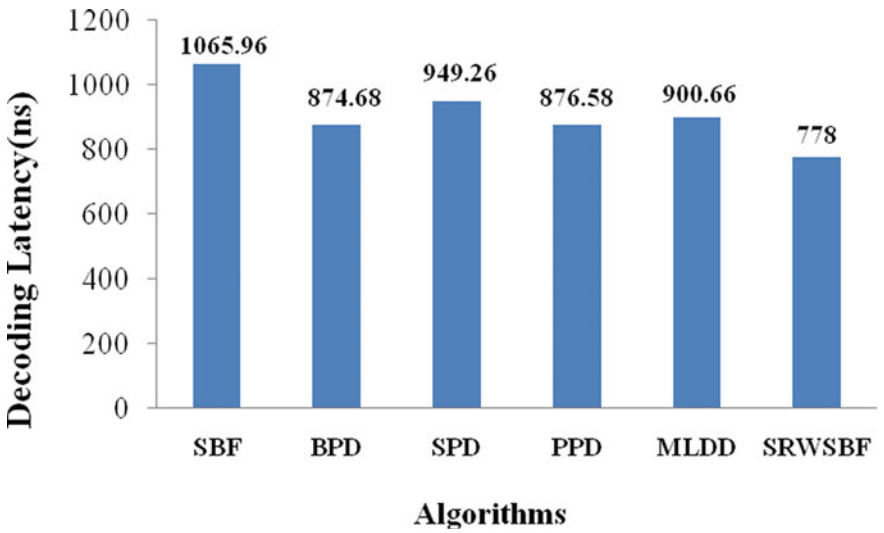

Fig. 4 Decoding latency comparison over various algorithms

algorithm has taken 900.66 ns time to decoding the data transmission over a communication channel comparing with other decoding algorithms.

4 Conclusion

The LDPC codes have the near Shannon limit performance and the creation of the correspondence check media is clarified in this paper for the both binary and non-binary LDPC codes. Decoding of LDPC codes is also explained in this paper using MLDD algorithm. This MLDD decoding scheme was hard decision decoding scheme and producing less decoding complexity and higher coding rates compared to other conventional algorithms like one step MLD and other Bit Flipping algorithms. The method MLDD detects five error bits and consumes less area of the majority gate. The simulation results shows that, MLDD algorithm consumes less area and high speed performance for error detection and correction. By comparing with One-step MLD, MLDD gives high speed of operation with reduction in execution time, less area and high throughput. Future work includes extending the theoretical analysis to the cases of eight to 12 bit flips. More generally, determining the required number of iterations to detect errors affecting a given number of bits seems to be an interesting problem. In future, this proposed algorithm can be extended to high bit rate, which will give good trade-offs among time of the decoding process and capability of the error detection. Finally it is concluded that MLDD decoder having moderate decoding latency compared to conventional decoding algorithms.

References

1. Gallager RG (1962) Low density parity check codes. IRE Trans Inf Theory IT-8:21–28
2. MacKay DJC, Neal RM (1996) Near Shannon limit performance of low density parity check codes. Electron Lett 32(18):1645–1646
3. MacKay DJC (1997) Good error correcting codes based on very sparse matrices. IEEE Trans Inf Theory 45(2)
4. Davey MC, MacKay DJC (1998) Low density parity check codes over GF (q). IEEE Commun Lett 2(6)
5. MacKay DJC (1998) Gallager codes that are better than turbo codes. In: Proceedings of the 36th Allerton conference on communication, control, and computing
6. Kou Y, Lin S, Fossorier M (1999) Low density parity check code based on finite geometries: a rediscovery and more. IEEE Trans Inf Theory
7. Richarson T, Urbanke R (1999) Design of provably good low density parity check codes. IEEE Trans Inf Theory
8. Mao Y, Banihasherni A, Landolsi M (2000) Comparison between low-density parity-check codes and turbo product codes for delay and complexity sensitive applications. In: Proceedings of the 20th biennial symposium on communication, pp 151–153
9. Reviriego P, Maestro JA, Flanagan MF (2013) Error detection in majority logic decoding of Euclidean geometry low density parity check (EGLDPC) codes. IEEE Trans Very Large Scale Integr (VLSI) Syst 21(1):156–159
10. Chinna Babu J, Chinnapu Reddy C, Giri Prasad MN (2016) Comparison of technologies for the implementation of SBF decoder for geometric LDPC codes. INDJST J 9:30
11. Chinna Babu J (2017) VLSI implementation of decoding algorithms for EG-LDPC codes. Procedia Comput Sci 115(3):143–150

12. Giri Prasad MN, Chinnapu Reddy C, Chinna Babu J (2017) Generation and decoding of non-binary LDPC codes using MSA decoding algorithm. Lecture notes in electrical engineering, vol 434, pp 583–591, September 2017
13. Sha J, Gao M, Zhang Z, Li L (2006) Self reliability based weighted bit-flipping decoding for low-density parity-check codes. In: 5th WSEAS international conference on instrumentation, April 2006
14. Chen J, Dholakia A, Eleftheriou E, Fossorier MPC, Hu X-Y (2005) Reduced- complexity decoding of LDPC codes. IEEE Trans Commun 53(8):1288–1299
15. Palanki R, Fossorier MPC, Yedidia JS (2007) Iterative decoding of multiple-step majority logic decodable codes. IEEE Trans Commun 55(6):1099–1102
16. Kudekar S, Richardson T, Urbanke R (2013) Spatially coupled ensembles universally achieve capacity under belief propagation. IEEE Trans Inf Theory 59(12):7761–7813
17. Kumar S, Young AJ, Macris N, Pfister HD (2014) Threshold saturation for spatially coupled LDPC and LDGM codes on BMS channels. IEEE Trans Inf Theory 60(12):7389–7415
18. Chinna Babu J, Chinnapu Reddy C, Giri Prasad MN (2017) Comparison of various decoding algorithms for EG-low density parity check codes. In: Konkani A, Bera R, Paul S (eds) Advances in systems, control and automation, vol 442. Lecture notes in electrical engineering. Springer, Singapore, pp 605–613
19. Liu S, Reviriego P, Maestro JA (2012) Efficient majority logic fault detection with difference-set codes for memory applications. IEEE Trans Very Large Scale Integr (VLSI) Syst 20(1):148–156
20. Ganepola VS, Carrasco RA, Wassell IJ, Le Goff S (2008) Performance study of non-binary LDPC codes over GF (q)
21. Chinna Babu J, Prathyusha S, Usha Sree V (2014) Simulation and synthesis of majority logic decoder/detector for EG-LDPC codes. Int J Comput Appl 104(8):32–35
22. Chinna Babu J, Prathyusha S (2014) Hard decision and soft decoding algorithms of LDPC and comparison of LDPC with turbo codes, RS codes and BCH codes. In: IRF international conference, 27th July 2014

A Review on OTA with Low Power and Low Noise Techniques for Medical Applications

J. Chinna Babu and A Thrilokanatha Reddy

Abstract Wearable Electrocardiography (ECG) sensors are most commonly used in monitoring a patient heart condition to detect cardiovascular diseases like heart failure and cardiac arrhythmia and many more. The amplifier that records noise, power and linearity performance in an ECG sensor is the crucial part. In the existing systems, different approaches are proposed for optimization in power and noise. However, the OTA is implemented by using various techniques that can mainly either reduce the power consumption or have lower Noise Efficiency Factors (NEF). In the proposed paper, different research works are observed and studied and hence results are compared between the works and discussed here.

Keywords Patient heart rate · Monitoring · Amplifier · Noise efficiency · Optimization

1 Introduction

Analog IC design will always exist because we are living in time where Analog Design plays a prominent role. To interface Analog designs and Digital designs, Analog-to-Digital converters (ADCs) and Digital-to-Analog converters (DACs) are required. CMOS analog design is considered to be an art which mainly depends on knowledge and perception. Meanwhile, more precise device models are too perplexing, and are non-responsive to hand evaluation [1]. In addition to that, there is no such selective systematic procedure that an engineer can be followed for designing an analog block, which can even be a fundamental block such as Operational Transconductance Amplifier (OTA) which shows that a designer should rely on simulation tools, more practice, and perception for any design to

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_48

work. As well as in need of significant design time and costly tool licenses for simulating designs.

1.1 OTA Specifications

A transconductor is used to convert an input voltage into an output current. For an OTA, the output current is directly proportional to the difference between the input voltages they receive. The transconductance amplifier can be specified for amplifying or for integrating either currents or voltages. The input-output (I/O) characteristic for an OTA is for a given maximum output current [2]. The width of the linear region of OTAs is in inverse proportion to the magnitude of the transconductance; the transconductance will be lower for larger linear region. In an OTA, the input and output resistance should be very high. Due to infinite input impedance maximum transfer of the source voltage occurs at the input side of the OTA (Fig. 1).

1.2 Basic Operation

The output current is determined as follows for an OTA, in which output current is a linear function of the differential input voltage and is given as:

$$\text{Iout} = (\text{Vin+} - \text{Vin–}).\ \text{Gm} \tag{1}$$

Where V_{in+} is the non-inverting input voltage, V_{in-} is the inverting input voltage and transconductance of an amplifier is given by G_m.

The output voltage of an amplifier is the product of output current and load resistance and is calculated using the followed equation.

$$\text{Vout} = \text{Iout}.\ \text{Rload} \tag{2}$$

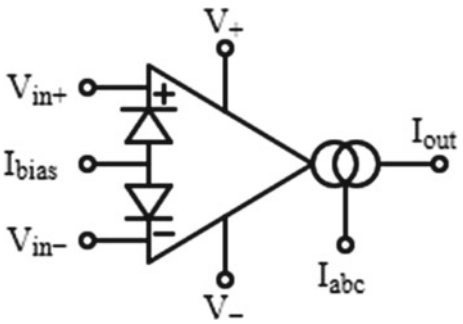

Fig. 1 Basic Operational Transconductance Amplifier (OTA)

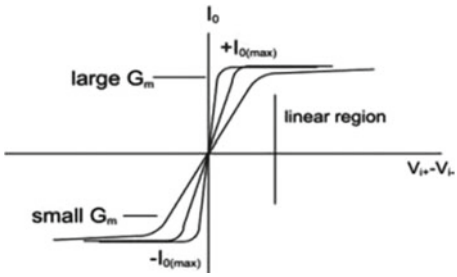

Fig. 2 Input-output characteristics of an OTA

Basically, for any amplifier the transconductance is usually controlled by an input current which is denoted as I_{abc} ("I_{abc} -Amplifier bias current"). The transconductance of an amplifier is directly proportional to this current (I_{abc}). This important feature in the amplifier makes it useful for electronic control of amplifier gain, etc.

1.3 Input-Output Characteristics

For an OTA, the characteristics of the input-output are shown in Fig. 2. For a given maximum output current, the width of the linear OTAs region is inversely proportional to the magnitude of the transconductance; if the linear region is greater, then the transconductance will be smaller. In an OTA, the resistance to input and output must be large [3]. Impedance of infinite input allows complete transition of the supply voltage to the OTA input.

2 Literature Survey

The details of various Low Noise or Low powered Operational Transconductance Amplifiers are explained below in the following survey with their merits and demerits associated in them accordingly and the results are compared simultaneously.

2.1 A Low-Voltage Chopper-Stabilized Amplifier for Fetal ECG Monitoring with a 1.41 Power Efficiency Factor

Author: Shuang Song, Michael Rooijakkers, Pieter Harpe, Chiara Rabotti, Massimo Mischi, Arthur H. M. van Roermund, and Eugenio Cantatore.

Year: 2015

Abstract: The paper introduced a chopper-stabilized low-voltage current-reuse frontend amplifier for fetal ECG monitoring. The amplifier proposed here will allow measuring individual noise adjustment in each channel, reducing overall power consumption while meeting all requirements of the application. The topology of low-voltage current-reuse will use power optimization in both the current and the voltage domains, exploiting multiple voltages of supply (0.3, 0.6 and 1.2 V). The power management circuitry, which provides the various supply voltages, is designed for high efficiency (peak charge-pump efficiency = 90%). Together with its power management circuitry the low-voltage amplifier is implemented in a typical 0.18 μm CMOS method and is experimentally characterized. The amplifier core achieves a good factor of noise efficiency (NEF = 1.74) and a factor of power efficiency (PEF = 1.74). Experiments show that the amplifier core can deliver a noise level of 0.34 μVrms in a 0.7 to 182 Hz band with a power consumption of 1.17 μW. Along with its power management circuitry, the amplifier consumes 1056 μW reaching a PEF of 1.41. The amplifier is also tested using pre-recorded fetal ECG and adult ECG tests [3].

2.1.1 Introduction

Pregnancies involving higher risk nowadays are becoming increasingly prevalent where women prefer to have children at older ages [5]. More than 10% of the pregnancies in modern days are severely complicated, resulting in perinatal morbidity and mortality. The fetal electrocardiogram (fECG) recordings will allow the measurement of fetal heart-beat, which is useful in fetal health monitoring. Observing, for example, the uterine contractions produces fetal heart response that are obtained from non-harmful Electrohysterogram (EHG) measurements, which is the widely used process to identify fetal distress. State-of-the-art fetal monitoring systems are vastly when compared with a smart mobile phone. To boost user-friendliness and see to that fetal monitoring outcomes are accessible to society, this proposed topic addresses a wearable patch like device that incorporates a coin battery, electrodes and electronics, as shown in Fig. 3. In such a wearable system, ultra-low power consumption is crucial for enabling miniature battery size and extending operating life. To understand this, we consider an example, when used for a 1.4 V zinc-air button battery with 620 mAh capacity will last up to three months. Apparently, the biomedical monitoring systems normally involves a frontend amplifier, a radio to send raw information and a multiplexed ADC.

During this case radio controls the power consumption. Bur recent technological advances will use on-body signal processing to read before transmission of the physiological information, thereby RF transmission power values reduces to minute level that achieves a lower power consumption. Therefore, three amplification

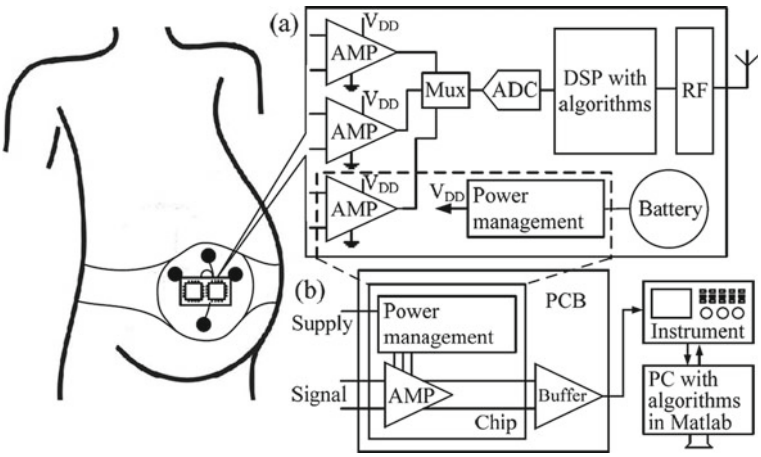

Fig. 3 The machine design with test board and the experimental configuration of the frontend amplifier chip

channels in our system are employed. Firstly, a DSP that implements the algorithms for fetal monitoring. Secondly, a power management circuitry block and finally a radio to transmit information as shown in Fig. 3. In this scenario, the power consumption of the system is generally regulated by the signal processing power within the DSP block, whereas most of the rest is used by the frontend amplifier. Therefore, the analog circuitry power optimization shall focus mainly on the frontend amplifier.

Two approaches for fECG monitoring amplifiers to achieve state-of-the-art NEF are presented in this proposed paper, the first is a stacked multichannel current-reuse amplifier and the second is a chopper-stabilized low-voltage current-reuse frontend amplifier. Figure 3, illustrates an outline of the frontend amplifier chip that includes a circuitry for power management and a low-voltage amplifier. Measurement results show that the low-voltage amplifier absorbs 1.17 μW within the core, thus achieving a 1.74 NEF and a 1.05 PEF for low-noise configuration. All algorithms used for signal processing in this proposed work has been implemented with the help of MATLAB ® tool simulated on a PC.

2.1.2 Monitoring System for Fetal Electrocardiography

The fECG amplitude mainly depends on inter-electrode distance, fetal age, and measurement orientation with respect to the fetal heart movement. During the last 3 months of pregnancy, when the fetus is usually head-down, the fECG recording is typically present in one of the three shown in Fig. 4, having signal to noise ratio (SNR). The electrodes that describe the three bipolar fECG measuring directions are illustrated with dark lines in the figure, and are separated with 16 cm of distance.

Additional ground electrode is used to connect the body to reduce contact with the power line. This setup of 5-electrodes is often embedded in a convenient patch so that it offers standard fECG amplitudes estimated between 3 and 20 μV so that EHG recordings can also be made possible.

The described fECG monitoring algorithm actually contains three steps: peak detection of material ECG (mECG), accurate estimation/removal of mECG, and peak detection of fECG, as defined with dark lines in Fig. 4. The algorithm's computational complexity is generally predominated by mECG waveform estimation. In the dynamic mECG template every wave produced in the first step is matched with the time stamps. The residual maternal portion after mECG removal is minimized in this method, thus allowing accurate extraction of fECG but this is computationally complex. In this algorithm QRS- waves are simply blanked in the mECG when peak detection is done, as shown in Fig. 4 with lines that are dotted, leaving a subset of fECG peaks to calculate the amplitude of fECG. Only 10% of the computational power required is used by this simple algorithm.

2.1.3 Circuit for Power Management

The circuit for power management will perform all on chip voltage conversions necessary for both the proposed amplifier and the DC servo loop as well.

The main aim of the design is to maximize the power efficiency. The circuitry, as shown in Fig. 5, has three LDOs and two step- down charging pumps (CP1,2). One of the three supply voltages for the frontend amplifier will be produced, and one for the DC-servo amplifier. For sufficient dropout voltage in the LDOs a minimum input supply voltage of 1.4 V is enabled.

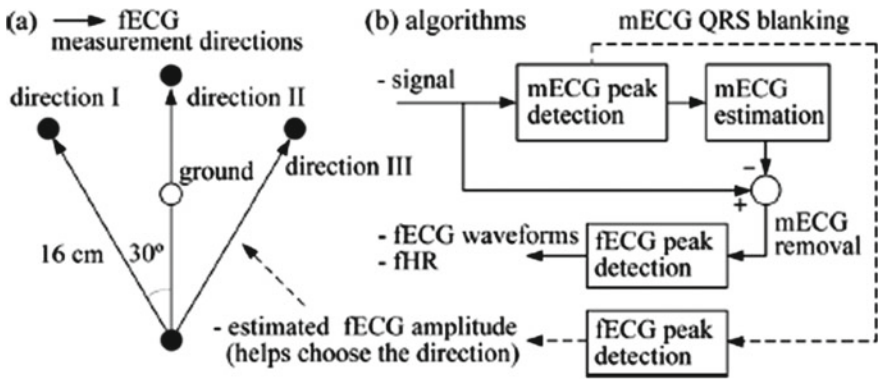

Fig. 4 Electrode grid arrangement for measuring fECG and combination of algorithms used for measuring fECG

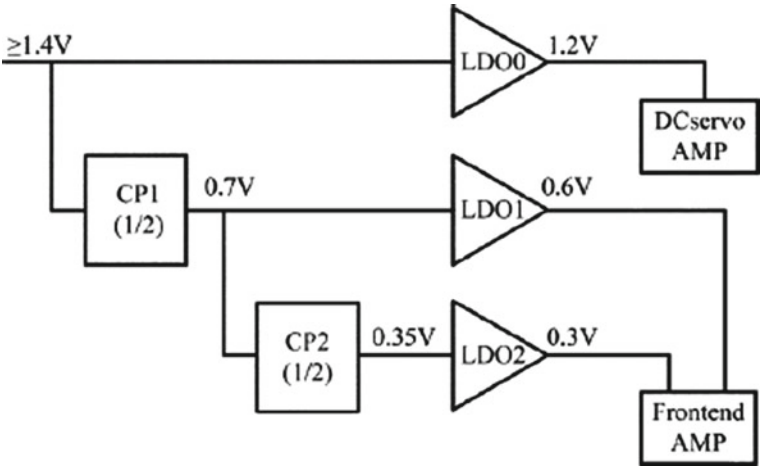

Fig. 5 Power management circuit

2.1.4 Results

This paper that is presented has a circuit gain of 33 dB, with 1.74 as noise efficiency factor (NEF) for a frequency ranging between 0.7 and 182 Hz with both the marginal values inclusively. By including Power management circuitry, the power consumptions reduced to 1.56 μW while the power consumption falls down to 1.17 μW excluding it. The total Harmonic Distortion for the circuit is 1.5%, and the circuit also offers Noise Tuning effectively.

2.1.5 Conclusion

In this paper presented, a low-voltage chopper-stabilized amplifier with CMOS technology of 0.18 μm. The low-voltage amplifier allows each channel to independently adjust the noise level. Therefore, a fetal ECG system is obtained with a lower power consumption.

2.2 An Injectable 64 nW ECG Mixed-Signal SoC in 65 nm for Arrhythmia Monitoring

Author: Po Chen, Dongsuk Jeon, Yoonmyung Lee, Yejoong Kim, Zhiyoong Foo, Inhee Lee, Nicholas B. Langhals, Grant Kruger, Hakan Oral, Omer Berenfeld, Zhengya Zhang, David Blaauw, and Dennis Sylvester.

Year: 2015.

Abstract: Asyringe-implantable electrocardiography (ECG) monitoring system is proposed. The analog front-end (AFE) noise optimization and circuit techniques require 31 nA current consumption while at the digital back-end a minimum energy computing approach reduces digital energy consumption by 40% When successfully detecting atrial fibrillation arrhythmia and memorizing the abnormal waveform in experiments using an ECG simulator which are conducted on a live sheep and an isolated sheep's heart with the proposed SoC in 65 nm CMOS technology that consumes a power of 65 nW [6].

2.2.1 Introduction

Electrocardiography (ECG) is nothing more than recording the heart's electrical activity and taking note of diagnostic information, and studying many heart disorders. Arrhythmia is one of the most serious cardiac illness. Referring to the 2010 National Institute of Health report, about 2.7 million people suffered with atrial fibrillation (AF), which is the most commonly seen kind of arrhythmia, and the number of people affected continues to rise over time. A person affected with AF, ECG waveform shows the normal-shaped peaks that relate to the ventricles, but are observed at an irregular rhythm where those peaks correspond to the atrial activity that is either in abnormal shape and/or size, observed at rapid irregular and/or continuous rates. So, AF can be observed when the abnormalities of rate and form are controlled on the ECG. Nonetheless, arrhythmia can rarely occur with each event lasting only a few seconds. Consequently, long-term and critical observation in arrhythmia studies and care is essential for determining the frequency and abnormality.

Body wearable ECG monitoring system is a commonly used technique or solution while observing for longer durations. There may be two or more than two patches in contact with the skin and connected through a wearable device on the body for continuous ECG monitoring and storing the information. Nonetheless, when tracking arrhythmia using this technique there are some disadvantages. Firstly, when using a body-wearable device, a patient's day-to-day life can be severely affected. Secondly, a contact is made physically across the patches and the skin to induce impedance changes caused by the body movements, resulting a drift in the low frequency baseline across the output voltage, declining or decreasing the quality of the signal and even causing amplifier to overrun. Thirdly, signals generated using those instruments will be sensitive to external noise sources like a 60 Hz noise from power lines.

2.2.2 Implementation of Analog Front End (AFE)

The AFE block diagram at the top level is shown in Fig. 6. In particular, the AFE comprises three key blocks: a variable-gain amplifier (VGA), a low-noise instrumentation amplifier (LNA), and a successive analog-to-digital converter approximation register (SAR ADC).

In order to decrease the power consumed, AFE's voltage source should be set at 0.6 V, and all the other building blocks rather than the ADC's clocked comparator are optimized for high current output and low power in the subthreshold system. If the supply voltage is low, the final output signal will undergo non-linearity, especially in the amplifier phase. Based on the results obtained from simulation, the final detection of arrhythmia is not affected by non-linearity with <3.5% of total harmonic distortion. Therefore, to stabilize system performance and power consumption, the non-linearity design goal for the AFE amplifier is limited to 3%. As seen in the above top-level diagram of the AFE, i.e. Figure 6, the two amplifiers used in series where each of them produces high gain and low noise. The primary amplifier will focus mainly on low noise, whereas the secondary amplifier allows a tunable gain. High impedance is produced by the tissue electrode where the input amplifier demands very high impedance of input. As standard requirement by an ECG amplifier, the design goals of the CMRR and PSRR are set higher than average (80 dB).

The target impedance is set to be greater than 10 MΩ for sufficient signal amplitude and the target gain is set at 72 dB and the design can be tuned to give enough gain for amplifying the peak-to-peak signal of 1 mV amplitude to the rail-to-rail output and the dynamic range that can be tuned. As the minimum standard set by capacitive input, the amplifier also aims to take care of dc offset up for the electrodes to 300 mV. The capacitive feedback circuit, which is a fixed gain, produces a gain of 40 dB, and a parallel-resistive-feedback circuit creates a

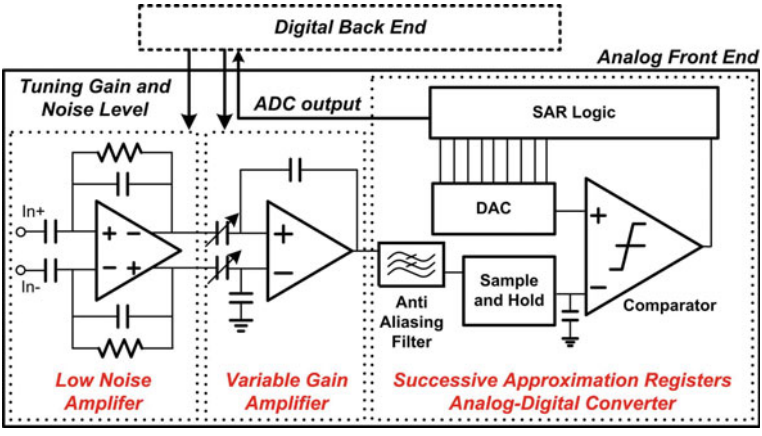

Fig. 6 Top level analog front-end block diagram

high-pass corner which can filter out the low-frequency signal drift and dc offset. For producing a <0.5 Hz ultralow high-pass corner, a pseudo-resistor is used with appropriate chip space.

2.2.3 Minimum Energy Computation

If the source voltage decreases then both the dynamic power and leakage power decreases. When the device clock is slowed, the energy of leakage will increase for each cycle Increase in the energy loss will therefore offset the dynamic energy savings and thereby increase total electricity. Despite the fact that, in order to obtain this faster clock frequency, a higher operating voltage is needed, the leakage energy for each computation is greatly reduced, achieving the minimum possible energy consumption. With this technique, the voltage supply increases by 50 mV compared to the source voltage while saving energy by 40%.

2.2.4 Results

This method purely concentrates on reducing the power consumption. By using a 65 nm CMOS technology, with a nominal Supply voltage of 0.6 V along with tradeoffs between power and noise by using analog to digital design co-optimization technique, power consumption is variably brought down to 64 nW resulting in 40% energy savings. The frequency of operation at which this method proposed is 250 Hz with high Gain of range 51–96 dB and 2.64 as its noise efficiency factor (NEF).

2.2.5 Conclusion

The research proposed in this paper has a syringe-implantable ultralow-power for long-term analysis and for detection of Arrhythmia using SoC electrocardiography (ECG) sensor made using 65 nm CMOS technology. In this method, exchange between power and noise using analog-digital co-optimization technique, as well as using several other amplifier methods, asynchronous SAR logic, and low energy digital computation to achieve 64 nW of power consumption.

2.3 A Fully Reconfigurable Low-Noise Biopotential Sensing Amplifier with 1.96 Noise Efficiency Factor

Author: Tzu-Yun Wang, Min-Rui Lai, Christopher M. Twigg, and Sheng-Yu Peng.

Year: 2014.

Abstract: This paper proposes a completely reconfigurable biopotential sensing amplifier which uses a floating-gate transistor [4]. Use complementary differential pairs together with the current-reuse method, the new amplifier's theoretical limit for the noise efficiency factor (NEF) will be less than 1.5. Without any extra power consumption, the floating-gate transistor is used for programming the amplifier's low frequency cutoff corner for implementing the common-mode feedback. A prototype proof chip concept was designed and manufactured in a 0.35 µm CMOS process with a silicone area of 0.17 mm^2. By using a 2.5 V source voltage, the measured mid-band gain is 40.7 dB, and the measured input-referred noise is 2.8 µm · $V_{rms.}$ The chip we considered has underwent tests with multiple configurations, in addition bandwidth of the amplifier is programmed to 100 Hz, 1 and 10 kHz. In these bandwidth settings, the calculated noise efficiency factors are 1.96, 2.01 and 2.25 respectively which are the best reported numbers till date. Rejection of supply and rejection of common-mode is calculated above 70 dB When configuring the bandwidth to 10 kHz, 60 dB is the dynamic range measured at 1 kHz with a total harmonic distortion (THD) which is less than 0.1%. The proposed amplifier also shows signals from the different parts of the human being by capturing electroencephalography (EEG), electrocardiography (ECG), electrooculography (EOG) and electromyography (EMG).

2.3.1 Introduction

Outstanding advances have made in wearable and implantable tools that are used to capture physiological signals and are groundbreaking in a range of biomedical applications, such as health monitoring, disease detection, brain stimulation therapies and neural prostheses. Having a small form factor is important for those sensing devices, and the power consumption should be low when tracking chronic diseases. The power dissipation should be low especially for the implantable devices and avoid excess heat flux damage to the tissue. Since the amplifiers used in sensing actually dominate the noise performance and the power factors for the front-end recording, significant analysis is focused on designing such crucial circuit block.

Amplifiers used for neural recording must have the most demanding criteria as power and area limitations and stringent. To remove the weak intercellular neural signals that are having amplitude about tens of micro-volts, it is important to provide a high gain to the amplifier with low electric noise. The importance of Noise Efficiency Factor (NEF) that is considered should be small when designing the amplifiers used in neural sensing. To counteract the saturating amplifier outputs on the electrode surface, the wandering DC offset from the binding and unbinding reactions is very important to discard. Alternatively, to avoid the aliasing, a wide

dynamic range with high linearity is needed. In addition to neural signals, there are other forms of biopotential signals that can be used for medical diagnosis and monitoring of human activity that can be detected using skin-implanted electrodes such as electrocardiography (ECG), Electromyogram (EMG), electroencephalography (EEG) and electrooculography (EOG). Similar biopotential signals have different frequency characteristics and different amplitudes, based upon their physiological activity. In addition, under the limitations of power and location, reconfigurability and programmability are generally advantageous for dealing with the mismatch issues in analog integrated circuits and process variations. Therefore, in many of the biomedical applications programmable sensing control circuits are being adopted. The amplifier mentioned is as shown in Fig. 7, followed by an analog array for signal processing that is incorporated into a highly power-efficient, reconfigurable computing platform. This amplifier's noise efficiency factor (NEF) was tested using the configurable bandwidth such as 100 Hz, 1, 10 kHz.

2.3.2 Bio-Potential Amplifiers

The instrumentation amplifiers are commonly used in applications for biopotential recording because they have high input impedance, simple gain and offset adjustments via resistors. Therefore, for biomedical implantable applications the noise and power consumption in this method is too high. To achieve low power consumption and noise of less than 3 μVrms, the proposed capacitive feedback amplifier may be combined with microelectrode arrays. The theoretical limit for an OTA's working Noise Efficiency Factor (NEF) is around 2.9. For neural sensing applications, the capacitive feedback approach that uses the capacitors to set the gain and reject the DC offset has become the leading topology.

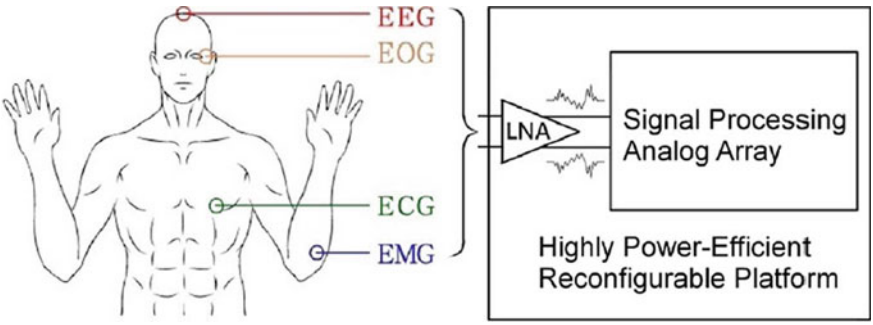

Fig. 7 The Scheme of the proposed amplifier using highly power-efficient reconfigurable computation platform

2.3.3 Results

This paper presented makes use of a 0.35 µm CMOS technology with a supply voltage of 2.5 µV which is ultralow voltage than the regular supply voltages that are used for any analog circuits. Under this operation the power considerably decreased to 82.5 nW with linearity in the circuit ranging over an area of 0.17 mm^2. The Noise Efficiency Factor (NEF) is 1.96 for the proposed methodology with 40.7 dB as gain for a bandwidth of 100 Hz. In this proposed paper the bandwidths considered are for 0.1, 10, 100 Hz and for 1 kHz.

2.3.4 Conclusions

A biopotential amplifier is proposed in this paper which is a completely reconfigurable sensing amplifier which measures an input-referred noise of 2.8 µ · Vrms. The amplifier that is presented can produce best efficiency with tradeoffs between power and noise obtaining a gain of 40.7 dB. The noise efficiency factor (NEF) measured for a 100 Hz bandwidth configuration will be 1.96 with overall circuit power consumption of 82.5 nW with area occupancy of 0.17 mm^2.

3 Comparison of the Various Factors for the Above Proposed Works

With inference from the above proposed papers, we hereby conclude that OTA implemented here considering different methodologies thereby achieving desired results for power and noise efficient medical applications. In the second work we considered i.e., in 2.2, with the use of 65 nm CMOS technology the power consumption efficiently reduced by 40% compared to the previous work that is from 1.17 µW to 64 nW. Simultaneously, while considering the noise efficiency factor that has increased a little from 1.74 to 1.96 and also with an increase in gain from 33 to 40.7 dB. The attributes in various papers are configured to be either advantageous or disadvantageous. But depending on the technology and various requirements according to the user, appropriate models can be selected for further study and research (Table 1).

Table 1 Comparison of the various works with common attributes

Title of the paper	A low-voltage chopper-stabilized amplifier for fetal ECG monitoring with a 1.41 power efficiency factor	An injectable 64 nW ECG mixed-signal SoC in 65 nm for arrhythmia monitoring	A fully reconfigurable low-noise biopotential sensing amplifier with 1.96 noise efficiency factor
Year	2015	2015	2014
Technology (CMOS)	0.18 μm	65 nm	0.35 μm
Supply voltage	0.6 V	0.6 V	0.25 V
Gain (in dB)	33	51–96	40.7
Total Harmonic Distortion (THD)	1.5%	2.87%	1%
Bandwidth (in Hz)	0.7–182	250	0.4–100
Noise Efficiency Factor (NEF)	1.74	2.64	1.96
Power	1.17 μW	64 nW	82.5 nW

References

1. Zhang J, Zhang H (2018) A low-noise, low-power amplifier with current-reused OTA for ECG recordings. IEEE Trans Biomed Circuits Syst 12:700–708
2. Sabry MN, Omran H (2018) Systematic design and optimization of operational transconductance amplifier using gm/ID design methodology. Microelectron J 75:87–96
3. Song S, Rooijakkers M (2015) A low-voltage chopper-stabilized amplifier for fetal ECG monitoring with a 1.41 power efficiency factor. IEEE Trans Biomed Circuits Syst 9:237–247
4. Wang T-Y, Lai M-R (2014) A fully reconfigurable low-noise biopotential sensing amplifier with 1.96 noise efficiency factor. IEEE Trans Biomed Circuits Syst 22:411
5. Gopichand M, Madapudi RK, Rao AA (2012) Change requests artifacts to assess impact on structural design of SDLC phases. Int J Comput Appl (0975 – 8887) 54(18):21–26
6. Chen Y-P, Jeon D (2015) An injectable 64 nW ECG mixed-signal SoC in 65 nm for arrhythmia monitoring. IEEE J Solid-State Circuits 50:375–390

The LTE Indoor and Outdoor Performance Evaluation Using OFDM

K. Riyazuddin, S. Nazeer Hussain, O. Homa Kesav, and S. Javeed Basha

Abstract In the present technology the rapid expand of wireless data digital communications call for wireless structures which can be reliable and feature an excessive spectral performance. Orthogonal Frequency Division Multiplexing (OFDM) has been diagnosed for its proper overall performance to achieve excessive statistics prices. Fast Fourier Transforms (FFT) has been used to provide the orthogonal sub-carriers. Due to the drawbacks of OFDM-FFT primarily based gadget consisting of high height-to-common ratio (PAR) and synchronization and plenty of other works have replaced the Fourier rework part via wavelet transform. In this paper, a suitable method for the OFDM system and the proper usage of FFT is provided. This system shows a superior overall performance with traditional OFDM-FFT systems through an Additive White Gaussian Noise (AWGN) channel. Bit error rate (BER) defines the overall performance of the device as a characteristic of signal to Noise Ratio (SNR). Here in this work OFDM is evaluated using LTE. LTE stands for long term evolution. The LTE performance is evaluated in indoor and outdoor applications. Moreover, the proposed gadget gives nearly an excellent reconstruction for the input signal inside the presence of Gaussian noise. This work concentrates on reduction of errors and improving the SNR by using some of the digital modulation techniques such as Phase Shift Keying, Quadrature Amplitude Modulation and the Fourier transforms.

Keywords OFDM · SNR · FFT · Bit error rate · Sample error rate

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_49

1 Introduction

OFDM stands for orthogonal frequency division multiplexing which is a type of encoding virtual records at more than one carrier frequencies. For wideband digital communique OFDM has evolved in popular scheme, whether or not wireless data or over copper wires, utilized in programs like virtual television and audio broadcasting, DSL broadband net get entry to, Wi-Fi, and fourth generation cellular communique. To carry information a massive range of carefully spaced orthogonal subcarriers are used on numerous parallel statistics streams or channels. OFDM is nothing but transmission of more signals at a time parallel such that bandwidth will be decreases and data rate is very fast when compare to other techniques.

Orthogonality principle plays a vital role in OFDM system which is responsible for overlapping of subcarriers without any interference. It can be studied in both time and frequency domains. Two signals are said to be orthogonal in time domain if the area under the product of two signals is zero.

OFDM system will be effective means of communication if this orthogonality of carrier signals is maintained properly [1]. Modulation is the process of mapping the data onto the carrier signal amplitude or phase. Transmitting a baseband signal over a long distance is highly impossible due to loss of signal strength.

Hence a carrier signal is used to carry the data over longer distances by mapping the data onto amplitude, phase or frequency of the carrier signal. In general sinusoidal signals are used as carriers. Digital modulation provides advantage over analog modulation in terms of noise immunity, multiplexing, security, error detection and correction etc.

In digital modulation schemes, m-ary signalling is an important technique which can provide high data rates by transmitting group of bits on a single carrier signal. If m = 2, it is known as binary signalling. Binary phase shift keying (BPSK) is a specimen of binary signalling. Quadrature phase shift keying (QPSK) is an illustration of m-ary signalling where m = 4. Here quadrature carrier multiplexing is done i.e., two carrier signals with same carrier frequency but different phase are used.

2 Implementation of OFDM System

To generate OFDM signal, very first thing is the relationship between the subcarriers, which must be maintained orthogonal [2]. Hence to generate OFDM firstly it is necessary to choose the spectrum required, modulation scheme used and also the input data. A simple OFDM generation and reception is shown in Fig. 1.

The OFDM system model consists of transmitter section and receiver section.

The transmitter accepts the input signal then modulation is done and the modulated signal is given to serial to parallel converter which converts data into parallel form. The signal is then subjected to IFFT for processing. The processed data is

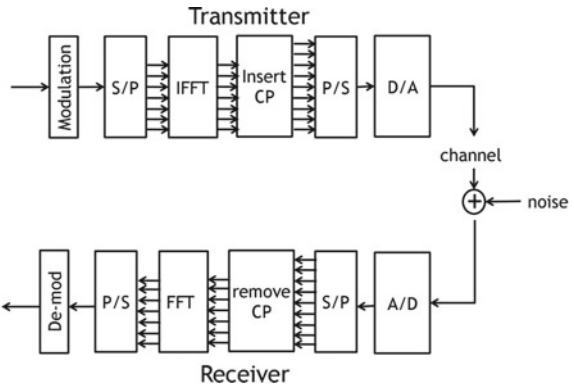

Fig. 1 Basic OFDM system model

added with cyclic prefix and is then converted into serial form using parallel to serial converter and then applied to digital to analog converter [3].

The receiver section converts the data using analog to digital converter, then the data is passed through serial to parallel converter then removal of cyclic prefix is done and is applied to FFT for processing. Thee data then converted into parallel form using serial to parallel converter. The converted data is finally demodulated.

The unique merits of OFDM [4] are:

Faster: The processing complexity of OFDM, Higher: It transmit information in parallel on overlapped subcarriers but orthogonal to each other, over the channel. Hence bandwidth efficiency and data rate are comparatively higher than the traditional single carrier transmission. The impulse noise is reduced by parallel transmission.

2.1 FFT and IFFT Operation in OFDM System

A fast Fourier transform (FFT) is a calculation to process discrete Fourier change. A Fourier change over's opportunity area signal data into recurrence space. Subsequently, FFT is broadly utilized as a part of DSP method and in numerous applications, for example, correspondence. FFT has been depicted as most vital numerical calculation.

FFT is one of the simple operations in the field of computerized flag and picture preparing. Utilizing FFT is irreplaceable as a part of most flag preparing application. In this work we propose to utilize proficient augmentation procedure to lessen the fractional item which is happened in customary duplication system along these lines the FFT and converse quick Fourier change (IFFT) with effective duplication and with expanded rate is utilized for OFDM Modulator and Demodulator squares [5].

In numerous applications rapid and productive augmentation is sought. For this reason routine multicarrier strategy are normally picked, yet this outcomes in lower range effectiveness. Along these lines, the standards of OFDM are utilized.

This proposed work will be handling square of an OFDM framework, which are connected to FFT and IFFT.

2.2 OFDM Transmission-IEEE 802.11A Specification

The symbol duration $T = 3.2\,\mu s$. The used subcarriers are $\frac{\pm k}{T} = \pm 312.5\,kHz$, $\pm 625\,kHz\ldots$ and so on.

Total 64 sub-carriers having indices $k = [-32\ldots+31]$, are available within the bandwidth of 20 MHz.

But only 52 subcarriers with indices from $[-26\ldots-1 \quad +1\ldots+26]$ are used for conveying data a_1 to a_{52}.

The remaining subcarriers are used as the pilot carriers to estimate the channel or to send the control signals. The simulation plot for 802.11a OFDM transmission spectrum and Spectrum of an OFDM transmission (with 20% Guard Band) are shown in Figs. 2 and 3 respectively

The Fig. 2 shows OFDM spectrum of transmission in which frequency is represented on x-axis and power spectral density on y-axis.

The Fig. 3 shows OFDM spectrum of transmission in which frequency is represented on x-axis and power spectral density on y-axis with 20% guard band [6].

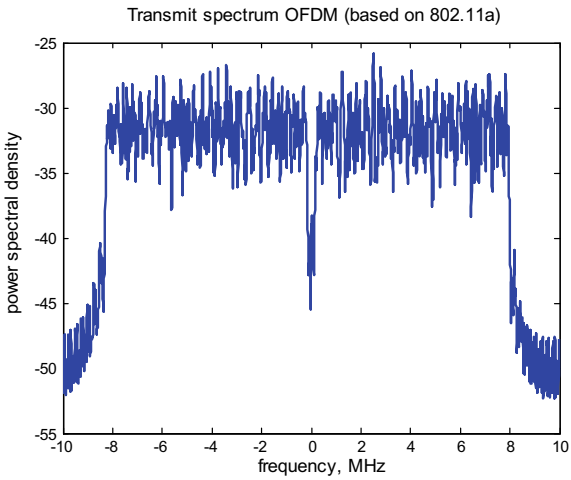

Fig. 2 802.11a OFDM transmission spectrum

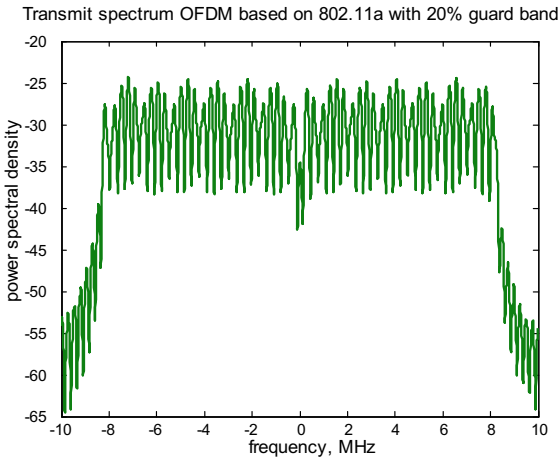

Fig. 3 Spectrum of an OFDM transmission (with 20% guard band)

2.3 Long Term Evolution

The Long Term Evolution (LTE) system uses OFDM as the downlink core because of its robustness to radio channel dispersion without having extremely complex receivers [7]. This is particularly useful because the receivers have to be mobile stations, and can be made at a lower cost with better battery consumption. LTE uses SC-FDMA which is Single Carrier – Frequency Division Multiplexing Access [8] on the uplink, so we will focus on the downlink.

3 Methodology

In this work we have used the basic digital modulation techniques like Phase shift keying (PSK), Quadrature amplitude modulation (QAM). The Fourier transform in addition to its inverse transform were used by the OFDM system [9, 10]. The performance of the system is analyzed on the basis of Bit error rate as well as Signal to noise ratio. MATLAB is used for simulation.

4 Simulation Results

4.1 Indoor Performance Simulation Results

The Fig. 4 shows indoor performance simulation result of SNR versus SER for a 16-PSK in which Signal to noise ratio is represented on x-axis and Symbol error rate on y-axis.

The Fig. 5 shows indoor performance simulation result of SNR versus SER in for a 16-QAM in which Signal to noise ratio is represented on x-axis and Symbol error rate on y-axis.

The Fig. 6 shows indoor performance simulation result of SNR versus SER for a 32-PSK in which Signal to noise ratio is represented on x-axis and Symbol error rate on y-axis.

The Fig. 7 shows indoor performance simulation result of SNR versus SER for a 32-QAM in which Signal to noise ratio is represented on x-axis and Symbol error rate on y-axis.

The Fig. 8 shows indoor performance simulation result of SNR versus SER for a 64-PSK in which Signal to noise ratio is represented on x-axis and Symbol error rate on y-axis.

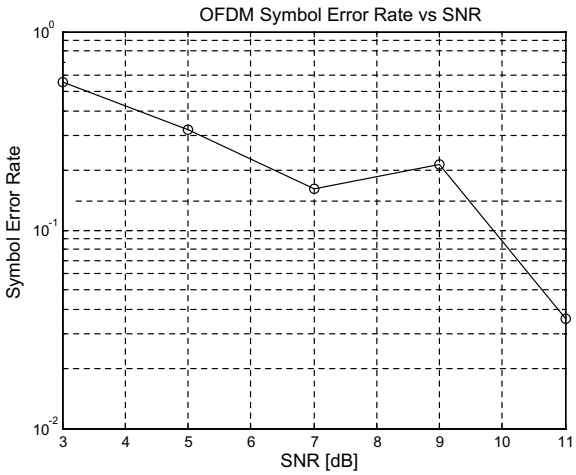

Fig. 4 SNR vs SER plot for 16-PSK

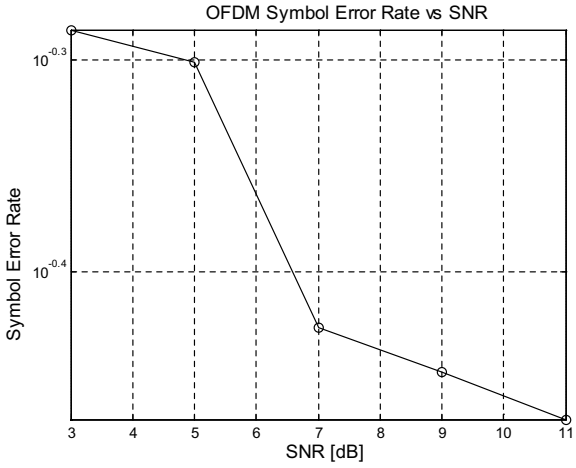

Fig. 5 SNR vs SER plot for 16-QAM

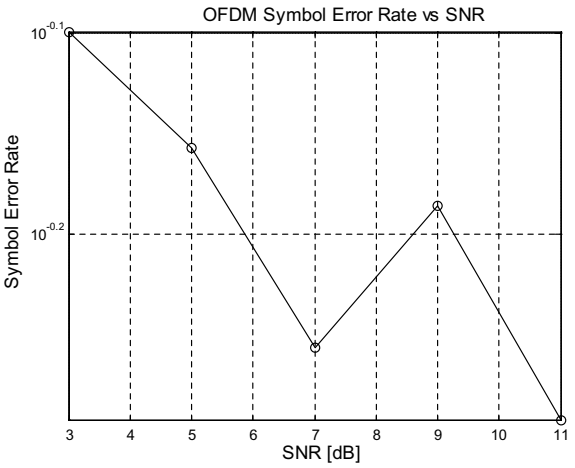

Fig. 6 SNR vs SER plot for 32-PSK

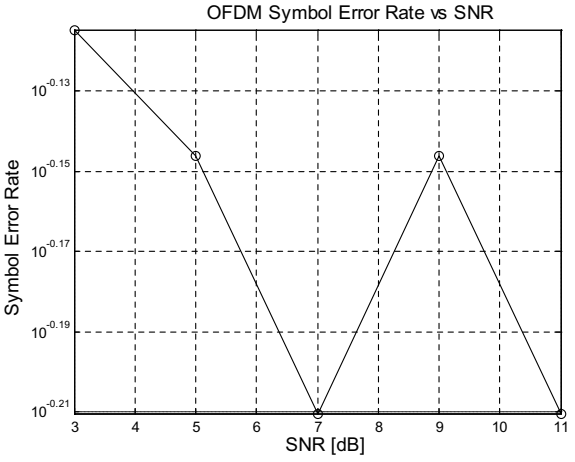

Fig. 7 SNR vs SER plot for 32-QAM

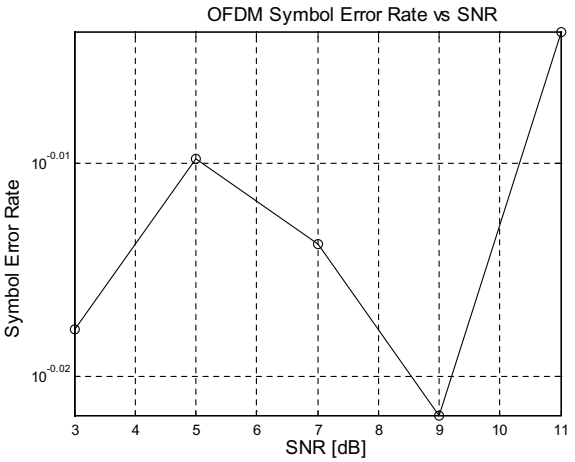

Fig. 8 SNR vs SER plot for 64-PSK

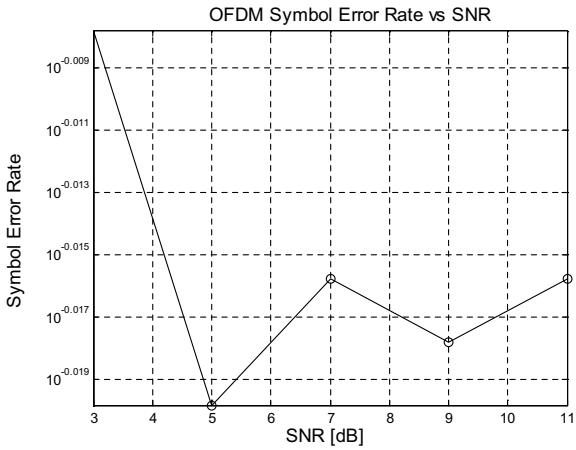

Fig. 9 SNR vs SER plot for 64-QAM

The Fig. 9 shows indoor performance simulation result of SNR versus SER for a 64-QAM in which Signal to noise ratio is represented on x-axis and Symbol error rate on y-axis.

4.2 Outdoor Performance Simulation Results

The Fig. 10 shows outdoor performance simulation result of SNR versus SER for a 16-PSK in which Signal to noise ratio is represented on x-axis and Symbol error rate on y-axis.

The Fig. 11 shows outdoor performance simulation result SNR versus SER for a 16-QAM in which Signal to noise ratio is represented on x-axis and Symbol error rate on y-axis.

The Fig. 12 shows outdoor performance simulation result SNR versus SER for a 32-PSK in which Signal to noise ratio is represented on x-axis and Symbol error rate on y-axis.

The Fig. 13 shows outdoor performance simulation result SNR versus SER for a 32-QAM in which Signal to noise ratio is represented on x-axis and Symbol error rate on y-axis.

The Fig. 14 shows outdoor performance simulation result SNR versus SER for a 64-PSK in which Signal to noise ratio is represented on x-axis and Symbol error rate on y-axis.

The Fig. 15 shows outdoor performance simulation result SNR versus SER for a 64-QAM in which Signal to noise ratio is represented on x-axis and Symbol error rate on y-axis.

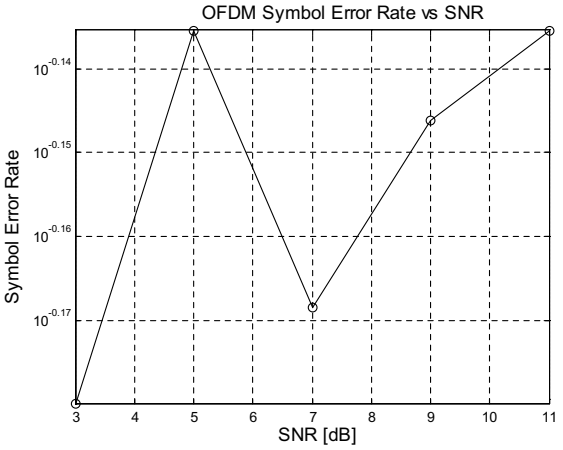

Fig. 10 SNR vs SER plot for 16-PSK

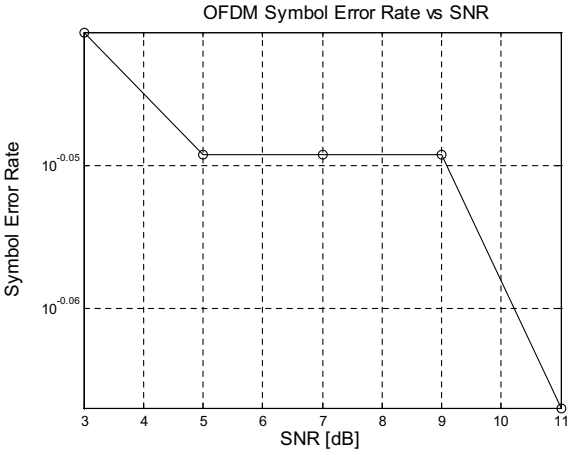

Fig. 11 SNR vs SER plot for 16-QAM

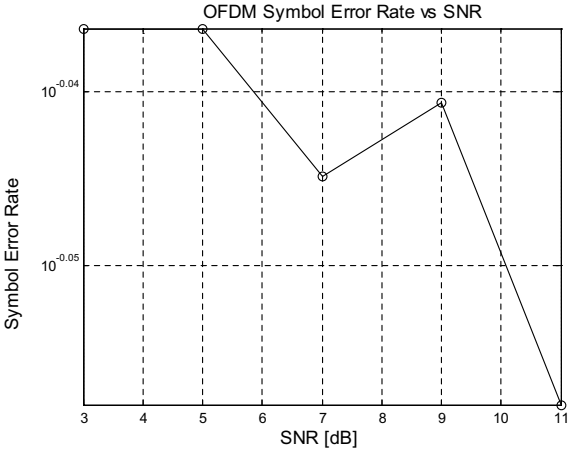

Fig. 12 SNR vs SER plot for 32-PSK

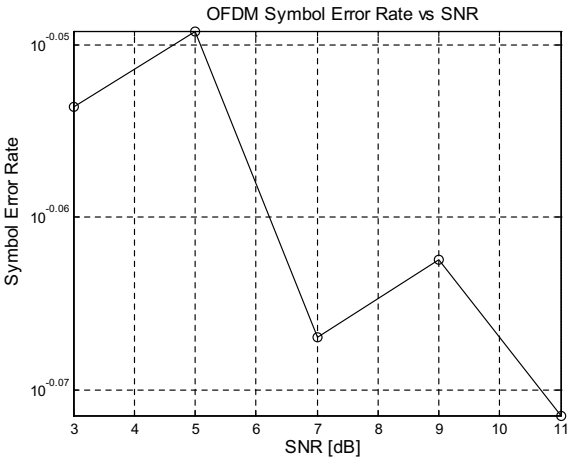

Fig. 13 SNR vs SER plot for 32-QAM

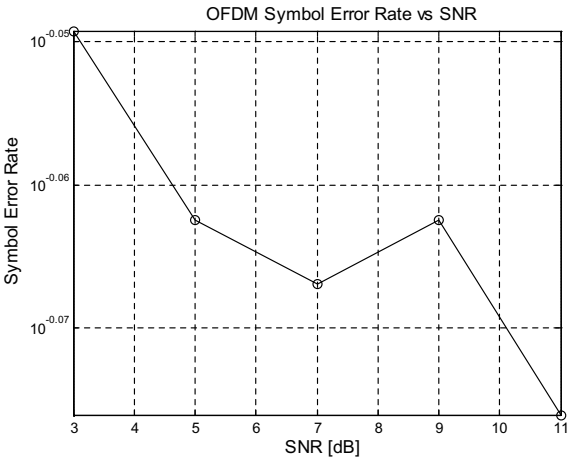

Fig. 14 SNR vs SER plot for 64-PSK

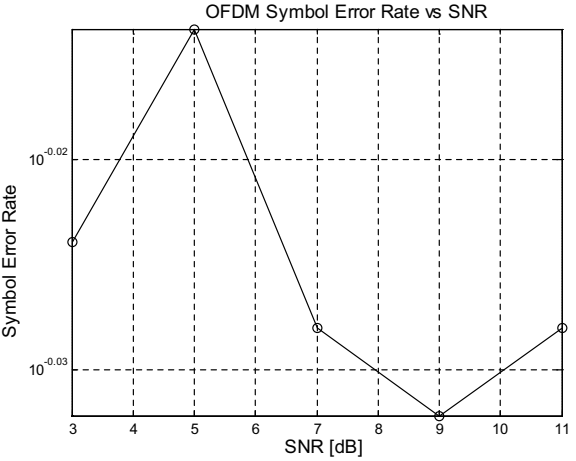

Fig. 15 SNR vs SER plot for 64-QAM

5 Conclusion and Future Scope

In this work we have evaluated the performance of LTE both in indoor as well as outdoor situations using OFDM and the performance is measured in-terms of SNR and SER. The SNR Vs SER plots are plotted using the two digital modulation techniques PSK and QAM. The performance can be further increased by using some other techniques.

References

1. Jeon WG, Chang K, Cho YS (1999) An equalization technique for orthogonal frequency-division multiplexing systems in time-variant multipath channels. IEEE Trans Commun 47(1):27–32
2. Johnson SG Links to FFT-related Resources. http://www.fftw.org/links.html
3. Nguyen VD, Kuchenbecker HP (2002) Intercarrier and intersymbol interference analysis of OFDM systems on time-invariant channels. In: Proceedings of the IEEE international symposium on personal, indoor and mobile radio communications, IEEE PIMRC 2002, Lisbon, Portugal, pp 1482–1487, September 2002
4. Coulson AJ (2006) Bit error rate performance of OFDM in narrowband interference with excision filtering. IEEE Trans Wireless Commun 5(9):2484–2492
5. Sankarpillai (blogspot). www.dsplog.com
6. Nannepaga B, Lalitha NV, Sailaja (2013) BER comparison of Rauleigh fading & AWGN channel using MIMO SFBC CI-OFDM system. Int J Adv Eng Sci Technol (IJAEST) 7 (1):143–150
7. Elangovan K, Priyadarsini PLK (2010) Performance enhancement technique for OFDM using channel estimation technique. Int J Eng Sci Technol 2(8):3483–3493
8. Morrison R, Cimini L, Wilson S (2001) On the use of a cyclic extension in OFDM. In: Proceedings of the 54th IEEE vehicular technology conference, vol 2, pp 664–668
9. Bell Krenik C, Hindelang T, Kambourov I, Eder S (2008) Spectral efficiency assessment and radio performance comparison between LTE and WiMAX. In: IEEE 19th international symposium on personal, indoor and mobile radio communications – PIMR 2008, Cannes, 15–18 September 2008, pp 1–6. IEEE Press, New York. 2008.0 Broadband, Elsevier
10. Chow B, Yee M-L, Sauer M, Ng'Oma A, Tseng M-C, Yeh C-H (2009) Radio-over-fiber distributed antenna system for WiMAX bullet train field trial. In: Mobile WiMAX symposium, MWS 2009, 9–10 July 2009, pp 98–101. IEEE

Image Segmentation with Complex Artifacts and Correction of Bias

Fahimuddin Shaik, P. Pavithra, K. Swarupa Rani, and P. Sanjeevulu

Abstract ChanVese (CV) model ultimately solves many image segmentation issues based on area. Nevertheless, this procedure does not succeed when the given images of any particular application are skewed by means of the objects (outliers) and lighting bias which compensate the real contrast values. Within a single operational energy, the following two points are implemented in this research work, firstly a complex artifact class that prohibits strength outliers of skewing the image segmentation, and then within Retinex type of procedure, which disintegrate the concerned image into a piece-constant structural element and a smooth biased part. The parameters of CV-segmentation then function only on the design, and only in regions that are not recognized as objects. The process of Segmentation is considered as parametric process using a phase-field, effectively reducing threshold dynamics. The proposed method on a compilation of representative images from various modalities representing artifacts and/or bias are mentioned in this work. This method is considered useful where image distortion prevents conventional CV segmentation of activity and where artifacts and bias are of particular concern in the application area of medical imaging, for instance the magnetic resonance imaging (MRI) modality, where identification of lesions and correction of bias area is most preferred.

Keywords Image processing · Segmentation · Contour · Artifacts

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_50

1 Introduction

The segmentation of images is a fundamental issue in image processing and computer vision. The aim is to divide the image into regions within the given image that belong to distinct objects. Variational models and partial differential equations require several positive approaches to segmentation of images. These models are well designed to place constraints of regularity on the solutions. Image segmentation process is basically defined as the function which divides the image domain into homogeneous regions relating to individual segments or finding the contours describing the borders of those objects through duality. Image segmentation is most generally constructed as an issue of minimization, where the regions or their contours are optimized for particular segmentation criteria encoded in the functional objective. In most of the Image segmentation applications each part of an image is considered as object whether being a living thing or non-living one [1]. Fundamental image segmentation templates are edge-based segmentation reptiles or geodesic active contours (GAC) and region-based segmentation active contours no edges. The segmentation can also be easily explicitly categorized and use the level set method for GAC and CV and various effective optimisation schemes have been implemented [2].

The main issue of concern here are is of regional image segmentation, and in specific with the CV model improvements, Image segmentation affecting both visual objects and light bias functions with different parameters [3]. Illustrations of such type of images can be observed in the modality such as atomic force microscopy known to be as AFM procedure, in which these object defects are owed to both artifacts and image processing, in noise- and inhomogeneity-infrared imaging, and in methods of medical imaging include magnetic resonance imaging. Artifacts (and outliers) is not only nuisance in other applications but the actual object of interest, which are required to be removed or reduced by means of pre-processing procedures to avoid the distortion of the results [4]. The method CV concept originates from practical Mumford-Shah (MS). In this paper we introduced a new model that dynamically differentiates objects and rectifies shadows by segmentation. The main aim is to formulate an image segmentation model that would indirectly tackle object recognition and resolution of illumination bias within that same single variations model. Here an addition of a binary artifact mark X, which labels distant objects as artifacts is introduced, if they contravene the two-phase principle of constancy of the CV segmentation method [5].

In this research work the demonstration is carried out to show how this method relates accurately to statistical hypothesis testing; more specifically, If the Gaussian null-hypothesis of such a pixel failure by virtue of a z−score greater extreme than the stated threshold, it is marked as an artifact [6]. This threshold parameter therefore explicitly influences the level of statistical significance consistent with the classification of the items, or the predicted false-positive probability, respectively. This part of the procedure is referred as CV+X pattern in this research work. On the other side, we include a Retinex-like image decomposition to deal with the illumination bias. The process to disintegrate the reference image I into a part structure

S and a smooth bias B is induced, beginning with a basic additive image forming model, I = B +S. The part of the structure, as modeled by the CV-terms, is anticipated to be two-phase, piecewise constant [7]. This second version of the proposed procedures is referred as CV+B pattern in this research work. The combination of both parts results in image segmentation combined with the identification of dynamic objects and as expected, bias estimation. The resultant model with complete CV+XB yields the optimal results.

2 Literature Review

The segmentation of images was and is a common theme in the area of image processing and computer vision procedures. The process is difficult when the perfect function or algorithm to segment the image concerned of a particular application is completely not perceived in a precise and specific manner. The segmentation purpose of the image is to make the image representation more expressive and easier to understand. In other words, it divides the image domain into a variety of different regions, each of which has a consistent function, which differs from the others (intensity, colour, texture, etc.). The interpretation of a particular image is very much required in order to identify the type of method it has to carried out to attain the promising results which can be elucidated in both subjective and objective manner. A large number of methods together with variational image segmentation approaches have been projected to unravel the issue of the image segmentation procedures [1]. Various segmentation methods are categorized by the derivation of functional energy from a previous mathematical model and minimizations in all possible partitions of this functional energy. The Mumford – Shah variational model [2] is one of the most commonly discussed mathematical models capable of attaining the objective of image segmentation. In this procedure the characteristic functions of the algorithm are completely computed in a scientific way to avoid the errors that may lead to non-functioning of the future approaches. The shah-mumford function typically includes a fidelity phrase, regularisation of the model and regularisation of partitions.

Mumford – Shah model was commonly used in the processing of images [3–6]; but, when direct implementation is carried out, it is difficult to use computational methods to overcome [6]. It depicts that a perfect and specific pre-processing stage is required to avoid further problems that may arise in later stage of Image Processing. By means of the level-set method presented by the researchers such as Osher and Sethian [8], Sethian [9], Chan and Vese [3] principally unravelled a distinct case of the Mumford – Shah model in which the binary case of two regions was considered, and developed the commonly used model of “active edge-free contours”. The opening quotes does not have a corresponding closing quotes in the sentence “Mumford – Shah model in which the …”. Please insert the quotes in the appropriate position." –>. These methods purely depend on the active contour procedures where the boundaries of the image and also particular regions. In fact, the Chan-Vese model [3] pursues the anticipated segmentation as the best piece-by-piece continuous calculation to a particular object,

and is therefore also interpreted as a level-set implementation of the two-phase, consistent Mumford model for Shah [1]. This method has been most used one among the contour methods owing to its inherent characteristics. Following the Chan – Vese model, diverse type of active contour models were established and extensively implemented in different image processing applications based on the Mumford – Shah framework, with the level-set approaches [10].

3 Results and Analysis

Input image and contour of a initial segmentation are shown in Fig. 1(a). Bias in strength seriously affects the picture, so the classical CV model failures. Preferable portions of white matter are segmented under, while the lower regions are

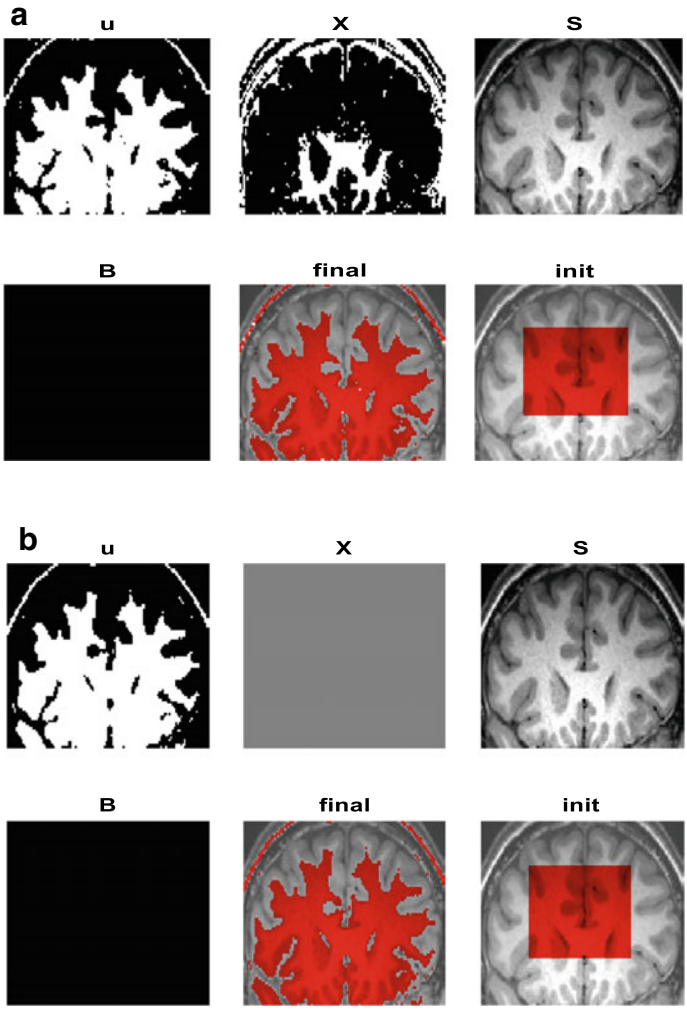

Fig. 1 **a** CV model **b** CV+X model **c** CV+B model **d** CV+XB model

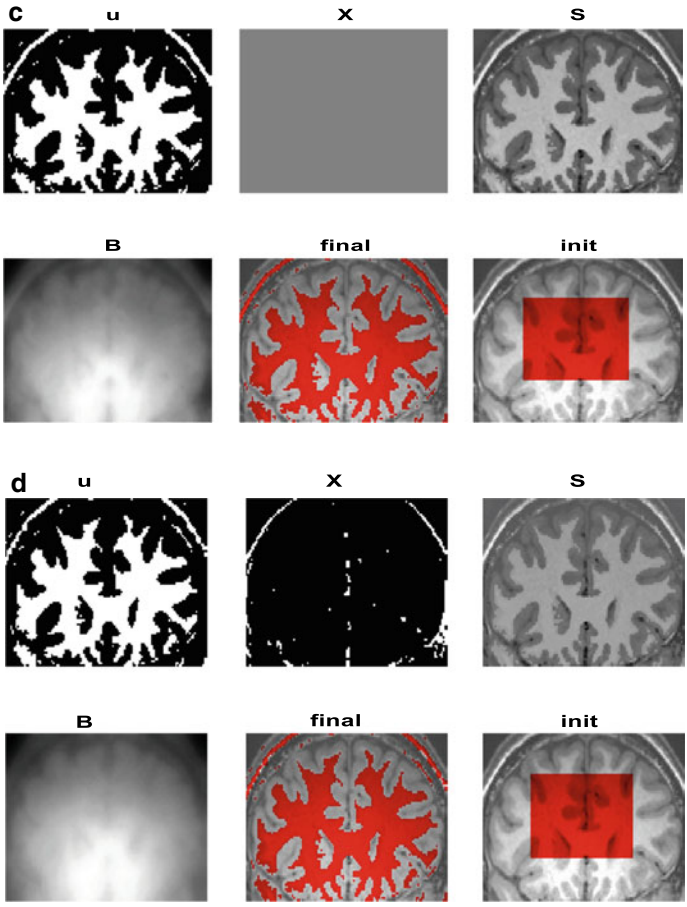

Fig. 1 (continued)

significantly over segmented. CV+X isn't very effective, right here. CV+B, on the other hand, solves the issue: the derived structure is now almost flat (basically two-phase parts of the brain are constant); whereas CV+XB marks outliers some anti-brain pixels and produces the correct performance.

An input image is represented as 'u' in Fig. 1(a) is consider for processing. The input image is first processed through CV model. The resulted images as shown as the final images in Fig. 1(a). The variations that take place in the input image can be observed clearly in a step by step process in Fig. 1(a). The highlighted part of the brain is shown in the image which is labelled as final.

Further the input image is processed through CV-Model along with binary artifacts label 'X', Which contains 'X' represented in Fig. 1(b) leads the output represented to final image CV+X as shown in Fig. 1(b).

Further the input image is processed through CV-Model along with smooth bias 'B' which contains 'B' represented in Fig. 1(c) leads to output represented to final image CV+B as shown in Fig. 1(c).

Further the input image is processed through CV-Model along with artifacts detection and bias estimation 'XB', Which contains 'XB' represented in Fig. 1(d) leads to output represented to final image CV+XB as shown in Fig. 1(d). By comparing all the four procedures of active contour methods involving CV model, it is obvious that exact contour can be observed from CV+XB model.

An input image is represented as 'u' in Fig. 2(a) is consider for processing. The input image is first processed through CV model. The resulted images as shown as the final images in Fig. 2(a).

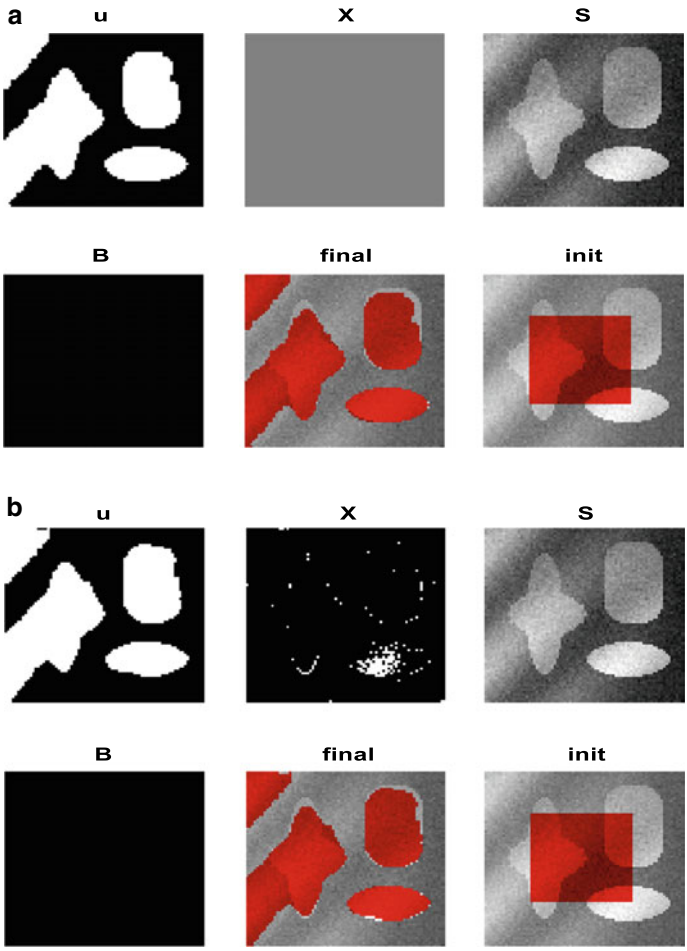

Fig. 2 **a** CV model **b** CV+X model **c** CV+B model **d** CV+XB model

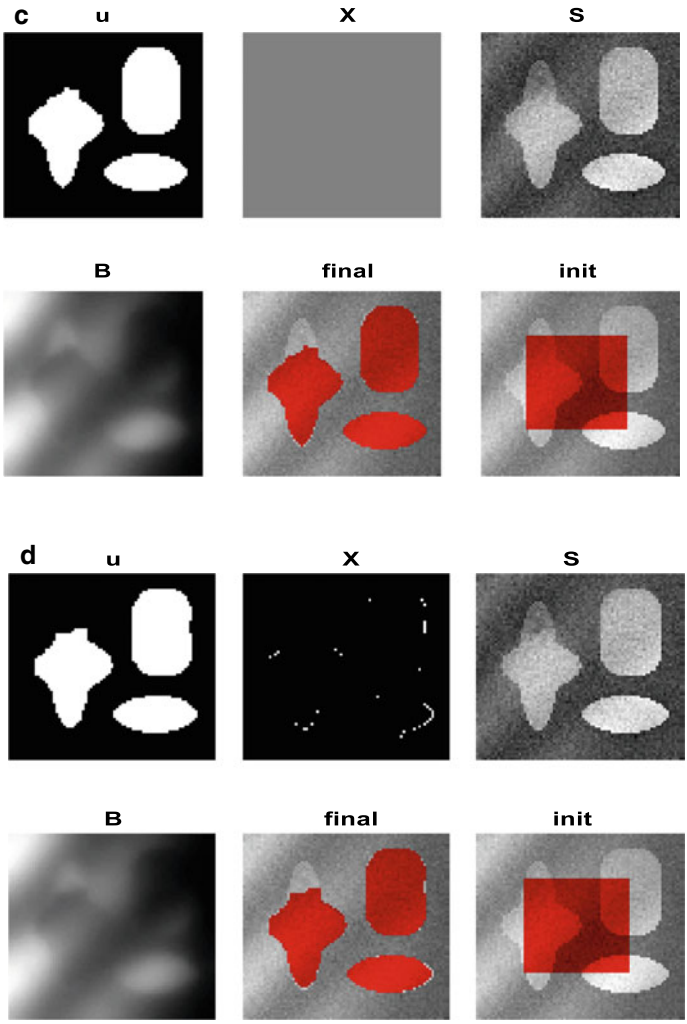

Fig. 2 (continued)

Further the input image is processed through CV-Model along with binary artifacts label 'X', Which contains 'X' represented in Fig. 2(b) leads the output represented to final image CV+X as shown in Fig. 2(b).

Further the input image is processed through CV-Model along with smooth bias 'B' which contains 'B' represented in Fig. 2(c) leads to output represented to final image CV+B as shown in Fig. 2(c).

Further the input image is processed through CV-Model along with artifacts detection and bias estimation 'XB', Which contains 'XB' represented in Fig. 2(d) leads to output represented to final image CV+XB as shown in Fig. 2(d). By comparing all the four procedures of active contour methods involving CV model, it is obvious that exact contour can be observed from CV+XB model.

4 Conclusion

In this research work a functional energy is introduced that explains joint region-based image segmentation, classification of dynamic artifacts, and estimation of bias fields. As compared to more error-prone sequential processing, the integration with in a single functional framework, these tasks require the simultaneous solution of the various problem aspects in a similar variational method. Nonetheless, joint optimization allows the few images employed in the model to be made full use of, while sequential processing will concentrate only on subsets of images at each time. From this work, in the comparison of all 4 active contour techniques with the CV model, it is evident that the exact contour of the CV+XB model can be observed.

References

1. Ayvaci A, Raptis M, Soatto S (2011) Sparse occlusion detection with optical flow. Int J Comput Vis 97:322–338
2. Bresson X, Chan TF (2007) Active contours based on Chambolle's mean curvature motion. In: 2007 IEEE international conference on image processing, vol 1. IEEE
3. Shaik F, Sharma AK, Ahmed SM (2016) Detection and analysis of diabetic myonecrosis using an improved hybrid image processing model. In: IEEE international conference on advances in electrical, electronics, information, communication and bioinformatics 2016 at Prathyusha Institute of Technology & Management, 27–28th February 2016. (ISBN 978-1-4673-9745-2)
4. Brox T, Cremers D (2008) On local region models and a statistical interpretation of the piecewise smooth Mumford-Shah functional. Int J Comput Vis 84:184–193
5. Caselles V, Kimmel R, Sapiro G (1997) Geodesic active contours. Int J Comput Vis 22:61–79
6. Gunjan VK, Shaik F, Kashyap A, Kumar A (2017) An interactive computer aided system for detection and analysis of pulmonary TB. Helix J 7(5):2129–2132. (ISSN 2319–5592)
7. Chan TF, Vese LA (2001) Active contours without edges. IEEE Trans Image Process 10:266–277
8. Chan T, Zhu W (2005) Level set based shape prior segmentation. In: CVPR 2005, vol 2, pp 1164–1170. IEEE
9. Shaik F, Jagadish V, Ravi Kishore M (2018) Level-set algorithm based system for segmentation of medical images. Int J Eng Tech 4(2). ISSN 2395–1303
10. Chan TF, Sandberg B, Vese LA (2000) Active contours without edges for vector-valued images. J Vis Commun Image Represent 11:130–141

Low Power Enhanced Leach Protocol to Extend WSN Lifespan

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Abstract WSN (Wireless Sensor Network) is characterized as a wireless sensor nodal network where one of the most challenging issues is the routing technique. Some of the critical issues with Wireless Sensor Networks is that the network sensor nodes have insufficient battery power. The battery power plays an important role in improving node lifespan. In Wireless Sensor Network, energy usage is among the most essential considerations for routing between various routing techniques. The best-known protocols are hierarchical routing protocols to reduce energy consumption. For application-specific type an enhanced protocol architecture for a Wireless Sensor Networks (WSN), a Low-Energy Adaptive Clustering Hierarchy (LEACH) was introduced. The proposed En-Leach protocol (Enhanced Leach) is an enhanced energy-efficient routing protocol that saves a large portion of the power of communication within the network. In do so, the proposed network topology chooses CH (Cluster Head) nodes from the higher residual energy of the sensor nodes, Further and a lesser range from the BS (base station). It then properly manages the SN (sensor nodes) and generates clusters to maximize the lifespan of the WSN and reduce the average energy dissipation per each sensor node.

Keywords Wireless sensor nodes · Sensor nodes · LEACH · Cluster head · Base station · En-LEACH

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_51

1 Introduction

WSN (Wireless Sensor Network) is a large gathering of SNs that senses the surroundings and transmits the information to base station. WSNs also refers to a group of spatially distributed and dedicated sensors for tracking and documenting the environmental physical condition and storing the data collected at a central location [1]. Wireless sensor network is used in various fields such as the military, environment, defence, home, and other commercial areas. The architecture of a sensor network is influenced by various factors such as fault tolerance, scalability, production costs, operating environment, transmission devices, and power consumption. The primary goal in designing the WSN routing protocol is to maximize network life by minimizing the energy consumption in the sensor nodes, as sensor nodes have limited power, memory, and computing [2]. SNs are usually battery powered and are distributed at random to work in inaccessible terrains. In such applications batteries cannot be recharged or replaced.

When a WSN is enabled, various steps are taken to create the required network infrastructure, such as the distribution of sensor nodes and the replication of data transmission, allowing the sensor node to conduct the applications normally. In particular, each node must discover which other nodes it can directly communicate with, and the communication must be ensured by its radio power [3].

2 Literature Survey

Beiranvand et al. studied a recent improvement of LEACH called I-LEACH, and suggested it. An upgrade was rendered by essentially considering these factors; node residual energy, base station size, and neighboring node number [4]. The node was known as a header node because it had maximum amount for three factors discussed i.e. Seem to have more residual energy than typical network energy, and provide more neighbors than that of usual neighbors for a networked node And that the node was less far from the BS than the normal distance from the base station to the average network node. Loss of energy efficiency including extension of network lifespan is observed [5]. The suggested routing algorithm is contrasted with previous algorithms e.g., DBS, LEACH-C and LEACH. Tests for simulation reveal the new routing method had increased WSN efficiency by at least 65%, decreases WSN energy consumption by 62%, it improves the packet ratio efficiency distributed as at minimum 56% relative to previous routing methods [6].

Ahlawat et al. released an updated leach protocol version called Modified VLEACH that aims to enhance network life. In the above article they in first thoroughly studied the traditional routing protocol-LEACH clustering and its inadequacies, and proposed better V-LEACH. The research to be undertaken on the assignment of vice cluster leader in improved V- protocol [7]. The vice cluster head is the alternate head which operates after the cluster head dies. The vice-cluster

member screening process focused on 3 factors i.e. small scale, low accumulated energy, and low energy content. The preferred approach would improve network resilience, while the head of a cluster will never die. When a cluster head expires it can be preceded by the cluster's role head [8]. After a number of checks, it was found that the new iteration of improved v-LEACH beats the previous version of the leach method by 49.37% of the network life.

3 Proposed Method

To reduce loss of energy and improvement through Wireless Sensor Networks energy efficiency, in this paper we suggest the enhancement of the Leach protocol by enhancing the CH nodes election strategy. The En-Leach protocol dealt with latent energy, range to BS, number of rounds in succession [9]. The factor indicating whether or not the remaining energy nodes were adequate to return the accumulated data to the base station where a node was not a CH.

Figure 1 illustrates the process of selecting clusters and creating clusters for the system proposed. First, this takes place in two stages in the initialization process. One is initializing the parameters of the network and establishing wireless sensor network [10]. Then, the $T(s_i)$ threshold is calculated in each round. Each node closer to the head of the cluster needs a unique number to be generated and then compared with $T(s_i)$. Unless the energy consumption is below or equal to $T(s_i)$, then the node is chosen as the cluster head [11]. Calculated distance to cluster head. The nodes whose distance is greater than to the base station than to the cluster head will not participate in the cluster creation process and will forward data directly to the base station.

The Cluster Head and cluster nodes radio network is closed until the transmission is reserved to reduce energy consumption. The CH radio network and nodes planning to send the data must be activated. Non-Cluster Head nodes send the data to the CH after the nodes have been triggered, while the CH receives those data and sends them to the Base Station. A single approach to data communication would increase node energy consumption, since the easiest way to transmit data is to reduce the distance between nodes [12]. So, we suggest a strategy providing a single hop, multihop and hybrid communication network to eliminate the distance [12].

In fact, the node nearest to the Base Station than the CH does not engage in the creation of a cluster to minimize energy consumption. Hence the specificity of the network is strengthened and the lifetime of the network is expanded [13]. The suggested protocol also compares energy consumption for single hop and multi hop communication modes of data transmission [14].

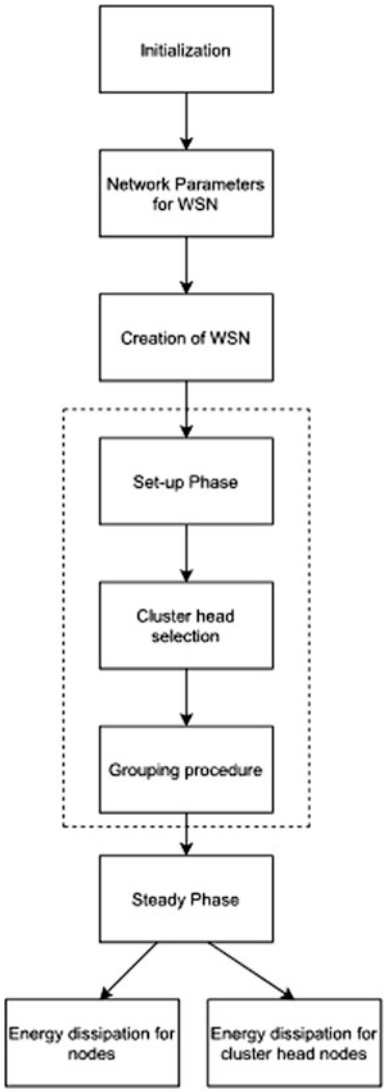


Fig. 1 Flow chart for En-Leach Protocol

4 Results and Analysis

In this work the Leach protocol is experimented based upon network establishment parameters such as number of nodes, sinks and various energy values depending upon clusters. These clusters are shown in Fig. 2.

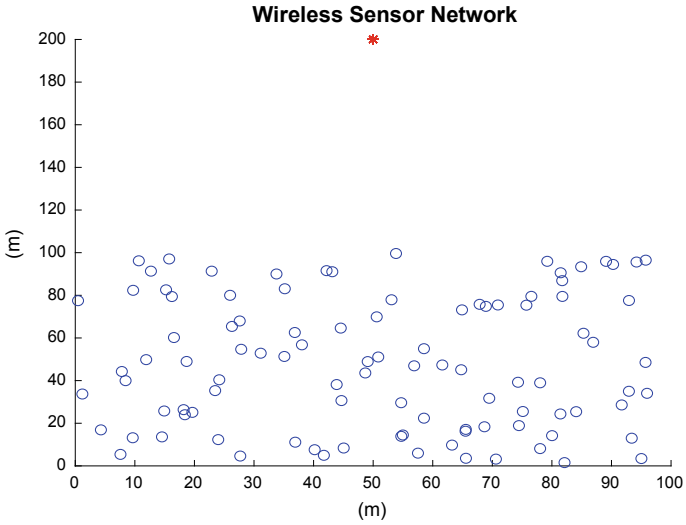


Fig. 2 Wireless sensor network

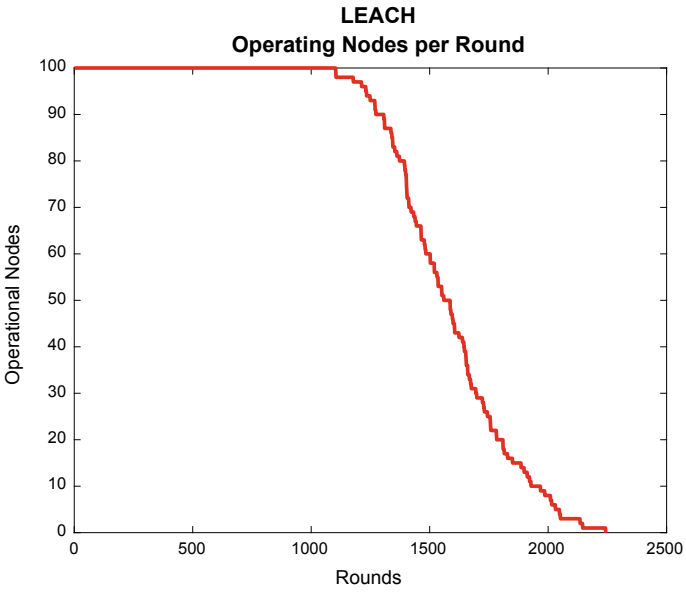


Fig. 3 Operating nodes per round

This leads to creation of wireless sensor network. Later set-up phase is initialized which displays the operating nodes per rounds as shown in Fig. 3 and operating nodes per transmission as shown in Fig. 4.

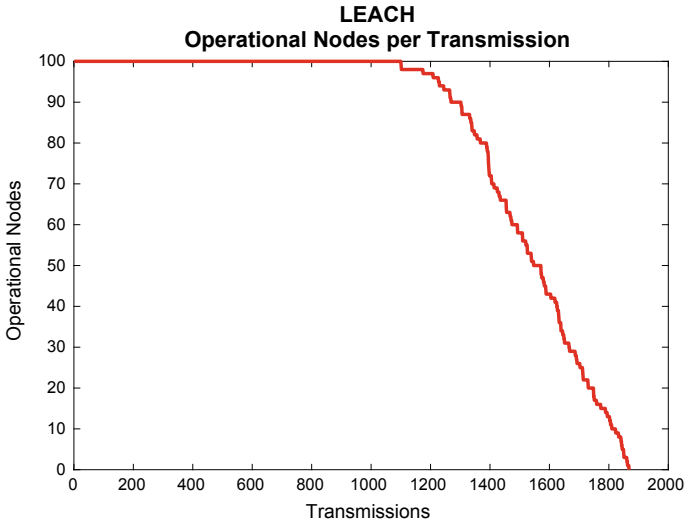


Fig. 4 Operating nodes per Transmission

From these two figures, it is obvious that operational nodes take a down leap as the number of nodes and transmission decreases.

Further a steady phase state is initiated after cluster head selection which indicates the energy consumption per transmission as shown in Fig. 5 and also the average energy consumed by a node per transmission is also verified in Fig. 6.

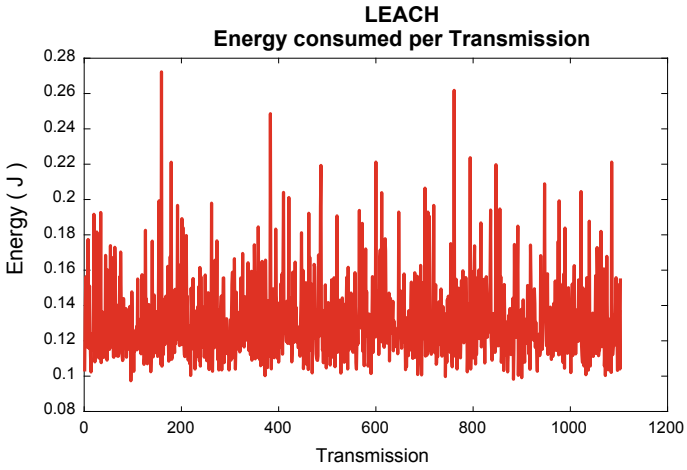


Fig. 5 Energy consumed per transmission

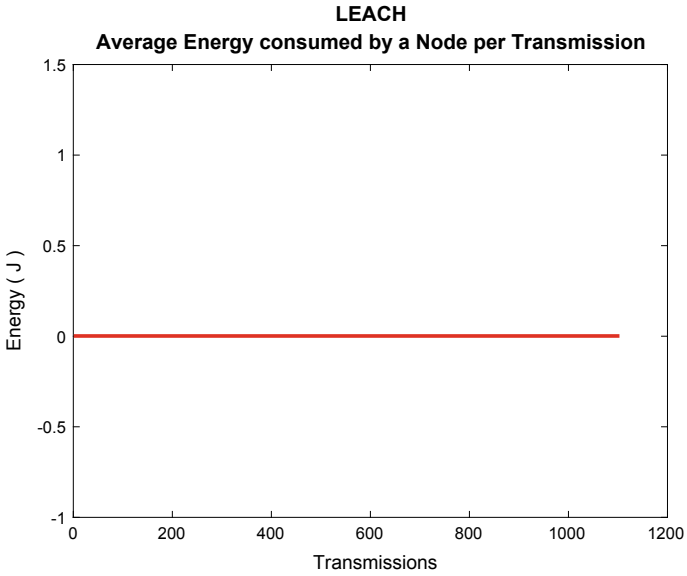
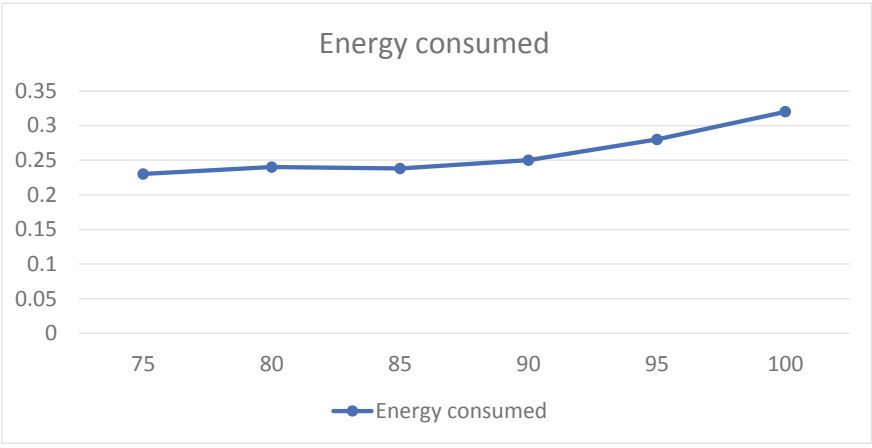


Fig. 6 Average energy consumed by a node per transmission

Table 1 No. of nodes vs Energy consumed

No. of nodes	Energy consumed
75	0.23
80	0.24
85	0.238
90	0.25
95	0.28
100	0.32



Graph for table 1. No. of Nodes vs Energy consumed

The energy consumption for different nodes is drawn and plotted in Table 1.

It is observed that as a number of nodes increases that there is a gradual increase in energy consumption but not in a sudden change.

5 Conclusion

The proposed protocol breaks the network into fixed number of clusters. The selections of CHs and next heads in advance are weighted by the remaining energy of sensor nodes and the centre of the cluster. Simulation results indicate that the proposed protocol effectively balances the energy consumption of the entire network, slow down the death rate of the sensor nodes and hence prolong the network lifetime efficiently. The next head eliminates the negotiation required to form node re-clustering. It is observed that first and last node dies quickly in LEACH shortening the lifetime. Because, in LEACH protocol the node re-clustering after every round is carried out by making fresh negotiation among the sensor nodes. This consumes a node energy. The next head selection concept increases energy conservation in En-Leach, which decreases the death rate of sensor nodes, resulting in longer lifetime of the network. In LEACH, CH node directly communicates with the BS, whereas in proposed protocol the CHs communicate with the BS using multi-hop communication. Direct communication consumes more energy and the nodes far away from BS dies quickly in LEACH.

References

1. Li XF, Xu LZ, Wang HB, Song J, Yang SX (2010) Sensors 10:5425–5442
2. Ma T, Hempel M, Peng D, Sharif H (2013) A survey of energy-efficient compression and communication techniques for multimedia in resource constrained systems. IEEE Commun Surv Tutor 15:963–972
3. Karimullah S, Vishnuvardhan D A review paper on optimization of placement and routing techniques at NC'e-TIMES # 1.0 IN2018, IJET ISSN: 2395-1303
4. Zhang D, Li G, Zheng K, Ming X, Pan Z (2014) An energy-balanced routing method based on forward-aware factor for wireless sensor networks. IEEE Trans Ind Inform 10:766–773
5. Sohn I, Lee J, Lee SH (2016) Low-energy adaptive clustering hierarchy using affinity propagation for wireless sensor networks. IEEE Commun Lett 20:558–561
6. Shafiuddin S, Riyazuddin YMd, Karimullah S, Riyazuddin K (2012) A ranging model based components for localization in sparse networks NC'e-TIDES -12. IJCAE 3(1):71–81 ISSN NO: 0988 – 0382E
7. Sobrinho JL (2017) Correctness of routing vector protocols as a property of network cycles. IEEE Trans Netw 25:150–163
8. Hosen A, Cho G (2018) An energy centric cluster-based routing protocol for wireless sensor networks. Sensors 18:1520
9. Sharma D, Bhondekar AP (2018) Traffic and energy aware routing for heterogeneous wireless sensor networks. IEEE Commun Lett 22:1608–1611

10. Rudra Kumar M, Prasanna K, Suneel CV (2017) Frequent data partitioning using parallel mining item sets and MapReduce. Int J Sci Res Comput Sci Eng Inf Technol 2(4):641–644
11. Jeevitheswari B, Karimullah S, Vishnuvardhan D (2017) A low power DFT based CMOS receiver with dual use of power lines. IJSTR 6(22): 4470–4475. ISSN 2319-8885
12. Behera TM, Samal UC, Mohapatra SK (2018) Energy-efficient modified LEACH protocol for IoT application. IET Wirel Sens Syst 8:223–228
13. Karimullah S, Rahim A, Ushasree BC (2014) Design and verification of online bist for different word sizes of memories. Ijastr 4(4), July–August 2014. ISSN 2249-9954
14. Heinzelman WB, Chandrakasan AP, Balakrishnan H (2002) An application-specific protocol architecture for wireless microsensor networks. IEEE Trans Wirel Commun 1:660–670

Automated Speed Braking System Depending on Vehicle Over Speed Using Digital Controller

Ch. Nagaraju, G. Thirumalaiah, N. Rajesh, B. Bala Manikanta, N. Sai Sivaram, and T. Prakash Raj

Abstract The point of this extend is to construct a system for keeping the vehicle secured and protecting it by the intruders' occupation. The project's goal is to set up a programmed velocity control for vehicles and mischance evasion framework utilizing programmable logic controller (PLC) and encoder sensor. The encoder sensor send's out signals persistently to the PLC. When wheels begin turning and once the speed will reach greatest constrain the PLC will off the control supply consequently. After accepting this flag PLC sends a flag to the engine to decrease the car speed consequently which can control car speed quickly so that the car is worked consequently without any manual operation conjointly deliver buzzer sound to caution to the driver.

Index terms Programmable Logic Controller (PLC) · Encoder sensor

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_52

1 Introduction

Congestion in traffic is a universal issue. This issue is basically caused by human mistake including response times, delays, and mistakes of judgment which may impact activity stream and cause mischances. In a few such instances, driver intercession and the failure to reply in time are the cause of the mischance. Numerous Progressed gadget with assistant capacities was created to assist anticipate these mishaps and mitigate collision impacts. Typically accomplished by consequently raising the speed of the vehicle when it comes to over speed. The car brake itself should therefore have a good software system to help a driver along the lane. In the last 25 years the electronic brake control system has made the vehicle safer. Developments in braking have led in recent years to considerably greater driving health. There have been many car brake inventions over the past few years that use electronic functions such as Intelligent Cruise Control (ICC), Antilock Braking Systems (ABS), Traction Control System (TCS) and Sensotronic Brake Control (SBC) to be involved. In 2011, a question was posed to the European Commission concerning the activation of such 'breaking crash avoidance' systems. [2] As of 1 November 2013, the compulsory implementation of Advanced Emergency Braking Systems in commercial vehicles will be introduced for fresh vehicle types and for all other European Union vehicles on 1 November 2015. According to the impact assessment, this could potentially avoid about 5,000 deaths and 50,000 serious injuries each year around the EU.

2 Literature Review

A programmable logic controller is a computer system used to automate industrial processes including the operation of machines on assembly lines at factories. It is a programmable solid state software control system with functions for logic control, sequencing, timing, manipulation, and arithmetic data count. It can be specified as a memory and central processing unit industrial computer, user input output, and programming tool. The User Intelligence is provided via the central processing unit. It accepts data, status information from various sensing devices such as limit switches, proximity switches, executes the user control program stored in the memory, and gives appropriate output commands for devices such as solenoid valves, switches, etc. The result was a constant demand for better and more effective manufacturing and processing machinery requiring higher quality and reliability in control techniques. With the advent of smart, lightweight solid state electronic devices, this has become possible to provide control systems which can significantly reduce maintenance, downtime and increase productivity. Programmable controls are one of the latest innovations in solid state controls that enable consumers to operate flexibly and effectively.

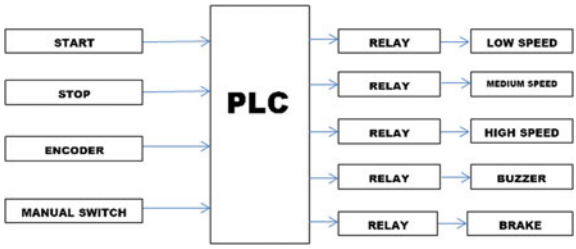


Fig. 1 Block diagram

3 Block Diagram

Software requirement

- Delta WPL Soft 2.48 version (Fig. 1)

Hardware requirement

- Push button
- Encoder Sensor
- Relay
- Buzzer
- Safety switch
- Dc motor
- Led

Features of PLCS

- PLC is an automated computer control system that continuously tracks the state of the devices input and makes decisions based on a custom algorithm to manage the state of the devices output.
- Suitable for multiple input and output environments, extended temperature ranges, protection at electrical noise, and tolerance for vibration and effect.
- Using this type of control system, nearly any production cycle can be significantly enhanced, with the main benefit of using a PLC being the ability to change and repeat the process or procedure while receiving and transferring vital information.
- This is modular, i.e. you can mix and match the input and output types of instruments to fit the system best.

4 PLC Wiring

- In general we have two major electrical cable concept types [1]. They sink and root.
- It's very important to have a clear sense of the sinking and sourcing principles when selecting the form of input or output module for your PLC device. Use of these concepts also happens when addressing input or output circuits.

- Origin & Sinking is used on Digital DC circuits only. If the specific pin is + polarity, so it is considered a circuit of sourcing. This is considered a falling circuit because it is–polarity.
- PLC usually has 2 different forms of production. They are Output style Relay or Output style Transistor.
- In transistor type it is having 2 types.
  - NPN (Sinking)
  - PNP (Sourcing) (Fig. 2, 3, 4, and 5)

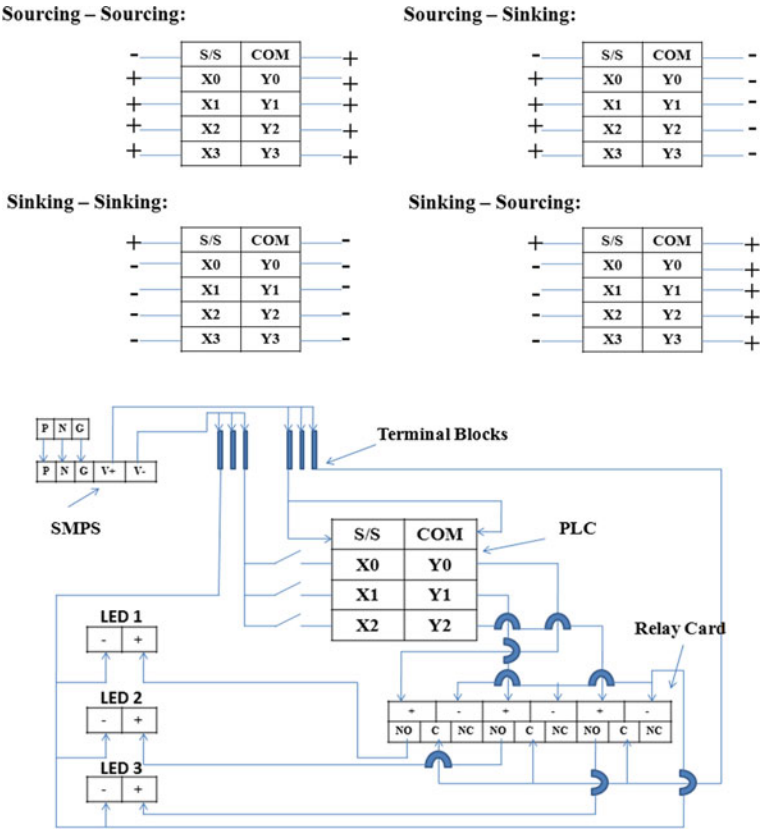


Fig. 2 Sourcing-souring

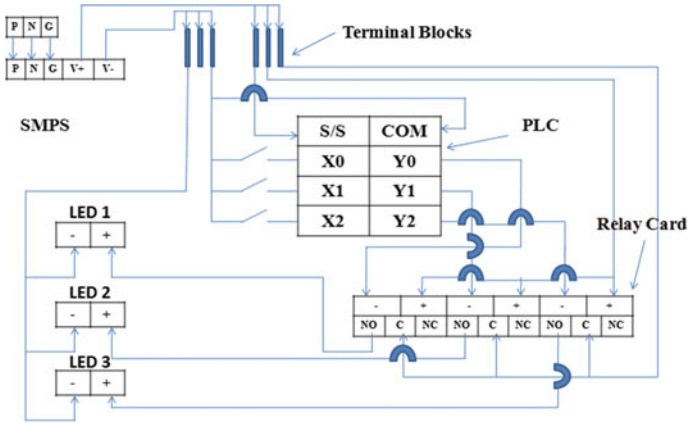


Fig. 3 Sourcing-sinking

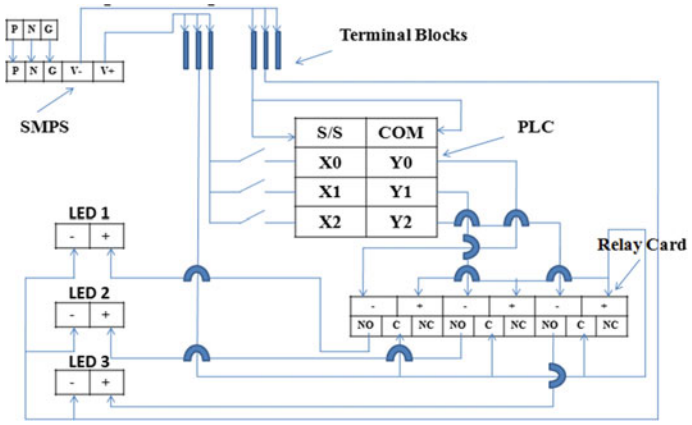


Fig. 4 Sinking-sinking

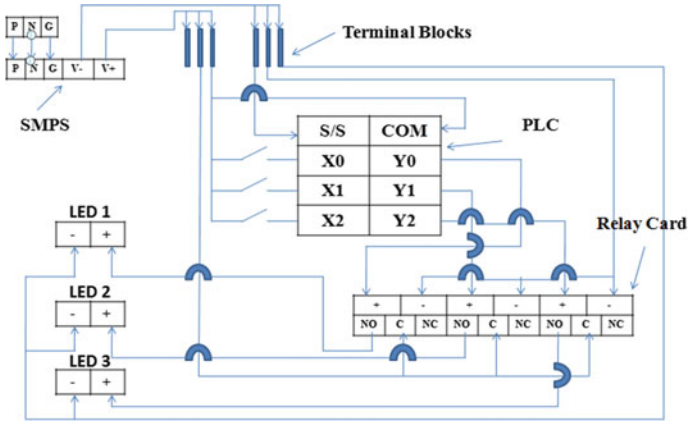
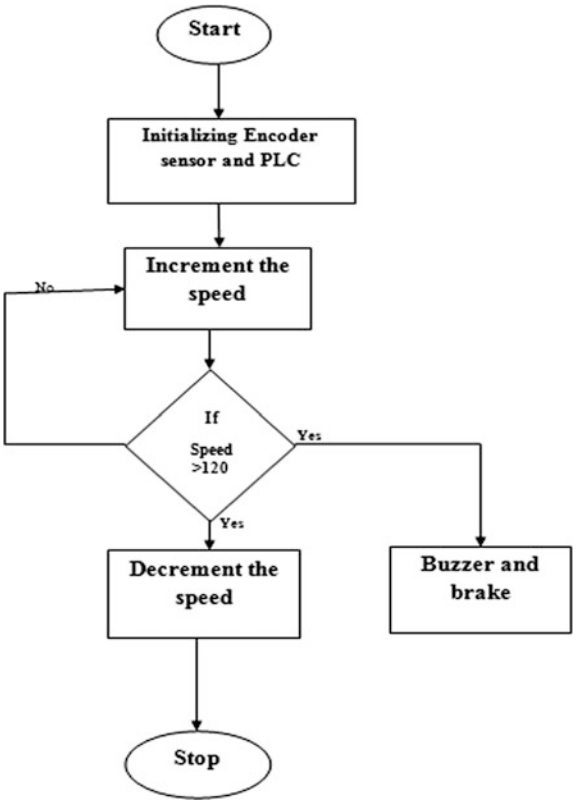


Fig. 5 Sinking-sourcing

5 Flow Chart



See (Fig. 6).

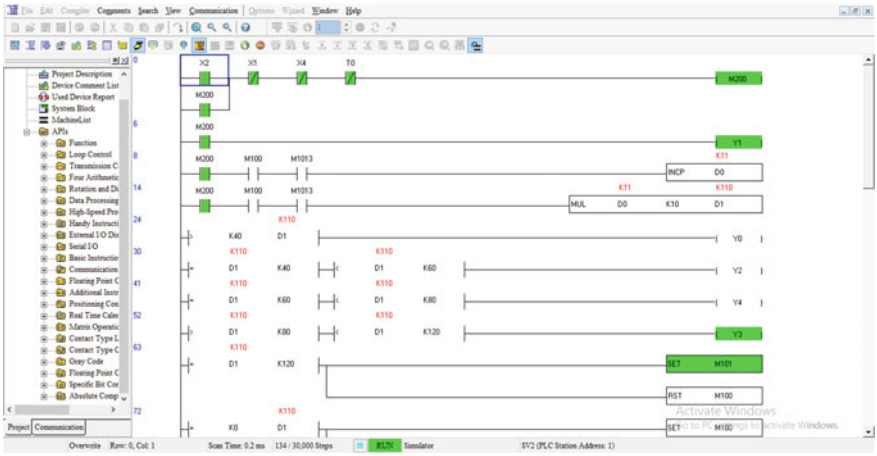


Fig. 6 Programming in WPL software

6 Simulation Results

There is various software available for various PLCs to render and model ladder programming diagrams with it [3]. The programming method is used for inserting the appropriate program into the memory of the processor. Inside the programming method, the software is generated and transferred to the PLC memory unit. DVP-14SS2 is DELTA PLC and Delta WPL Soft software is used for DELTA PLC programming applications. WPL Soft software in Ladder Diagram to render the whole system. RS-232 cable uses also cable for communication between my PC and PLC to pass the program into PLC memory

Experimental Results
The Encoder Sensor continuously senses the signal and sends to the PLC. Then the PLC will control the Speed of the Vehicle Depending on the signals given by Encoder Sensor as follows When the speed of the vehicle reaches 0 to 40 it indicates LOW speed by indicating LED lights and even when the speed of the vehicle reaches 40 to 60 it indicates AVERAGE speed such as if the speed of the vehicle reaches 60 to 80 it indicates MEDIUM speed but when the vehicle reaches 80 to 120 it indicates HIGH speed and a BUZZER blasts for 10 s and automatically decreases the speed when reached. The below Fig. 7 shows the Digital Controller connected with Inputs and Output Devices.

The Input devices consists of Start button, Stop button and Encoder sensor [4–6] where as the Output devices consists of LED which is used to indicate Low, Average, Medium And High Speeds And Also Buzzer When High Speed.

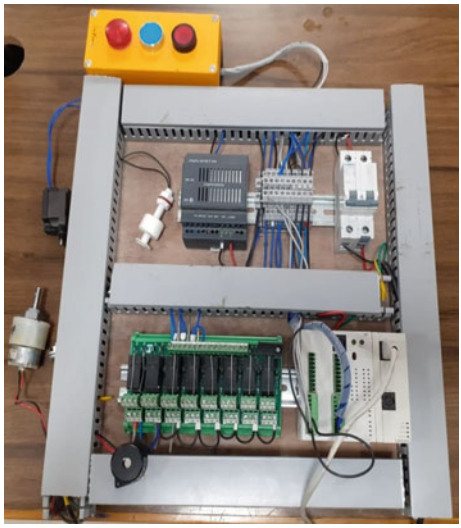


Fig. 7 Digital controller

7 Advantages

- **Less space:** PLCs are completely solid state devices, making them extremely compact compared to hardwired controllers using electromechanical systems.
- **Reliability:** Extremely robust equipment. There are very less chances of defect/ damage, because very few moving structures are present here.
- **Economic:** As the probability of a failure is very small, it should be treated as a one-time investment. Needless to mention, PLCs are more economical devices in this way. Costs for PLCs rise in a limited period.
- **Power saving:** Real power output is only 1/10th of the relay-dependent electricity produced by a comparable law.
- **Tremendous flexibility:** Rewiring is not needed if implementation of the enhancements is necessary. It that execute complex functions such as arithmetic operations, counting, comparing, producing time delays, etc. This has a very high processing speed and more flexibility in both digital and analogprocesses."On-line programming"/"off-track" is also possible in it.
- **Shorter Project Time:** Hard wired controls can be mounted only when the project is fully specified. In the case of PLC however, control configuration and installation are independent of the device's power description.

Easier Data Archiving and Documentation: This is because of its PC-AT, compatibility with printers and floppy disks.

8 Conclusion

The "Automatic Speed Braking System using Digital Controller depending on vehicle over time" project has been designed successfully using WPL Soft 2.48 version. Usually People drive very speed in heavy traffic areas which leads to the many accidents. With this device we will prevent road accidents because of over speed. In this project when the speeds of the vehicle reaches maximum limit it automatically slow the speed until the minimum speed is reached and there is also a safety option. The safety switch is said when we click the vehicle's safety switch going to stop until we start the vehicle. The results of the simulation suggest that the system feature effectively meets the design requirements.

References

1. PLC Programming Basics Part I. Control Systems & Automation. 23 July 2019. Accessed 23 Feb 2020
2. Parr EA (1999) Industrial Control Handbook. Industrial Press Inc. pp 450–451. ISBN 0-8311-3085-7
3. Laughton MA, Warne DJ (ed) (2003) Electrical Engineer's Reference book, 16th edn, Newnes, 2003 Chapter 16 Programmable Controller. https://en.wikipedia.org/wiki/Programmable_logic_controller
4. Alison D (2009) The father of invention: Dick Morley looks back on the 40th anniversary of the PLC. Manufacturing Automation. https://en.wikipedia.org/wiki/Programmable_logic_controller. Accessed 23 Feb 2020
5. Strothman, J (2003) Leaders of the pack. ISA. Archived from the original on 2017-08-08. Accessed 24 Feb 2020
6. A-B PLC inventor, Dr. OdoStruger, dies. Control Engineering. 1999-02-01. Archived from the original on 2020-02-24. Accessed 24 Feb 2020

Morphological Watershed Approach for the Analysis of Diabetic Nephropathy

P. Siva Kalyani and G. Sasikala

Abstract The main cause of progressive kidney failure and a significant cause of coronary mortality is diabetic nephropathy. The application of Watershed segmentation and Gradient magnitude has produced encouraging results among the image processing methods for detecting anomalies. The suggested algorithms using optimization as pre-processing and as post-processing approaches for segmentation. Clahe histogram equalization is an improvement of the previous approach that operates on specific parts of the image named titles rather than the entire image, and even another tool named dilation-based morphological reconstruction is used for pre-processing. Otsu Thresholding is used as a post-processing tool and is used to do automate image Thresholding. The Median filter is also used to eliminate noise from the signal and often retains the image edges when eliminating noise. The Segmentation of the Morphological Wetlands will accurately distinguish items on the foreground and context. The picture collection for this phase is from CT photographs of patients with diabetic nephropathy, as well as from Diabetic research institutes.

Keywords Diabetic nephropathy · Image processing · Median filter · Gradient magnitude · Morphological watershed algorithm

1 Introduction

Diabetic nephropathy in diabetic patients is referred as leading end-stage renal disease. Proteinuria (excretion of excess protein in the urine) is gradually increased. There is an urgent need to develop a non-invasive image processing algorithm to

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_53

detect anomalies at an early stage for better and effective treatment. Nephropathy is means that pathologically thickening of glomerular and tubular basal membranes in persons with type diabetes, with progressive mesangial expansion (diffuse or nodular) contributing to progressive reduction of glomerular filtration surface. Diabetic Nephropathy has been categorized into stages: albuminuria micro and albuminuria macro. Diabetic Nephropathy is a clinical syndrome with the following characteristics: persistent albuminuria (>300 mg/d or >200 μg/min) which is confirmed 3–6 months apart, at least 2 times. In recent research, only 30–45% of microalbuminuric patients have recorded proteinuria improvement over 10 years, possibly as a consequence of more rigorous glycaemic and blood pressure management strategies. In reality, in 56% of the cases, a recent analysis involving Type 1 diabetic patients with micro albuminuria recorded a decrease in UAE of 50% or greater. This decrease was primarily associated with a short micro-albuminuria period.

The ultimate aim of image processing applications is to extract essential features from the image data from which humans can gain a definition, explanation or perception of the situation, or to provide 'more' feedback for other automated image processing techniques [1]. The image processing techniques have been playing the pivotal role in various fields of application such as satellite imaging, medical imaging analysis etc. The biological vision mechanism is one of the most significant ways of human discovery of the environment, conducting complicated activities with great case, such as observing, reading, identifying and classifying patterns [3]. Enhancement is a important role of digital image processing and study, which seeks to enhance the picture's quality in terms of understanding of human brightness [4].

1.1 Objective

The objectives of this work are given below in a simple and obvious way which improves humans both physically and scientifically if these objectives are achieved.

- To research recent algorithms relevant to Image Enhancement (Methods of Contrast Enhancement) and Segmentation (Watershed and Cell Detection) to solve the problem and to seek and change the algorithm for different applications.
- To create the Adaptive approach by combining the techniques of image processing (enhancement and segmentation) according to the requirements, and also to tabulate statistical analysis of image attributes.
- Exploring and researching the importance of less widely used estimation parameters in medical image processing system.

- Developing a system function for qualitative predictive medical imaging to identify and predict anomalies for successful diagnosis in the question being considered.
- To allow the results of this work publicly accessible as an open access framework for the scientific and medical community.

1.2 Need and Importance

Several approaches have been used primarily for Diabetic retinopathy. Diabetic cardiomyopathy and Diabetic Nephropathy have been identified by others. Research done for Diabetic Nephropathy is minimal. Research done for Diabetic Nephropathy is minimal. If this problem is not approached with a thorough diagnosis at the correct and earlier level, this will contribute to permanent end-stage renal failure. While approaches to image processing are taken into account for research and study. The main objective here is to break the chain between the Diabetes and its related consequences by creating the computer aided technologies and also by creating awareness among the patients suffering from Diabetes and its related issues.

2 Literature Review

Many attempts have been made today to identify an illness and its diseases, because Human Existence is worthier than other else. Diabetic mellitus is a metabolic disorder consist of an inability of the pancreas to control the concentration of blood glucose. This question contributes to rates of blood glucose above acceptable range [2]. The International Diabetic Federation, India is one of the six IDF SEA (South East Asia) countries in the world. 387 million people globally have diabetes and 75 million people in the SEA region; that will grow to 123 million by 2035. In 2014 India had 66.8 million cases of diabetes [12].

There are many approaches according to the literature study that were primarily used for diabetic retinopathy [13]. Diabetic cardiomyopathy and Diabetic Nephropathy have been identified by others. Active Contour-based segmentation and Chan-vese algorithms have provided encouraging results among those approaches. The active contours for image segmentation dependent on Chan-Vese algorithm [5], to search for adjustments in the glomerulus. The “active contours” begin with an initialized contour and aggressively deform to the desired boundary, while simultaneously the given energy in increasing iteration until it converges [6]. Convergence is accomplished by finding a compromise between the external forces that draw the contour to its position and the “true” forces that hold it straight, typically by preserving some of its Chan-Vese algorithm’s curvature function [7].

But it also has its own limits because it provides borders for all structures and areas, because our aim is to distinguish between compromised cells and healthy cells in this application [8].

3 Methodology

The technique is set out below as a step-by-step protocol for understanding the issue being considered …

a. List of the Professional Video Databases:

To compile the image archive from the Nikon site (Public Archive), courtesy: electronmicroscopyu.com. The visual evidence comprises of diverse sources of various modalities and features of documents.

b. Proposed algorithm implementing:

The pre-processing technique is used to optimize images, and the post-processing technique is used for segmentation of data.

In the pre-processing technique, we use the Median filter. The median filter is primarily used to remove noise. It is a non-linear technique that is used to remove salt and pepper noise during image processing. It also maintained picture edges and was used to adjust image intensity levels [9]. A Gradient Filter and Morphological Watershed Algorithm are used in post processing methodology. The gradient filter is used to provide high gradient at edges and low within images for segmentation. Specific operating roles in the watershed algorithm such as opening, shutting, dilation, flooding, restoration, dilating, complementing, geographic limit and marks. These are used to map out items from the foreground and background [10]. The items on the foreground are described using reconstruction opening and reconstruction closing. The foreground picture is then superimposed on the original image. Initially original picture is measured for backdrop labeling and watershed ridge lines are identified. Then measure watershed translate segmentation into picture to superimpose the reference picture on the initial image in order to obtain the resulting output [11].

4 Experimental Reports

The Morphological Watershed method is extended to the pathological Diabetic picture with nephropathy.

Figure 1 explains the diabetes that involves defects in the kidney nephron tissues. Figure 2 represents a picture of the original image in gray level. The initial Fig. 1. Demonstrates the low glucose level microalbuminuria and is less than 300 mg.

Fig. 1 Input image

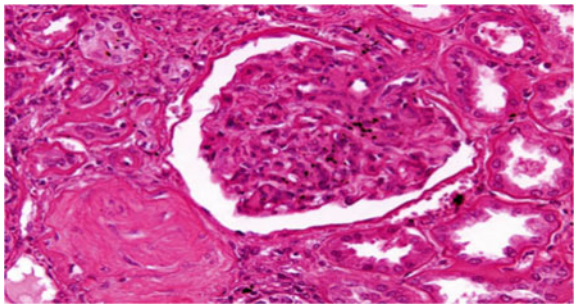

Fig. 2 Gray scale image

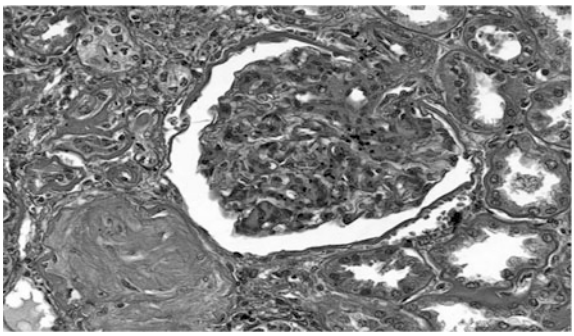

Fig. 3 Average filter

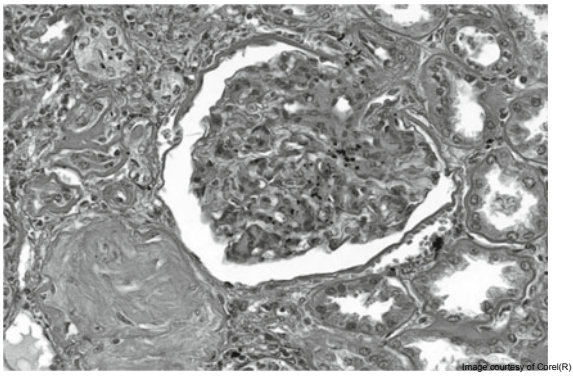

Figure 3 presents the resulting picture after median filter pre-processing technique is applied. It reduces noise in this statistic, and increases the picture quality for improved viewing. Later gradient magnitude is applied which changes the intensity according to edge and object gradient values as shown in Fig. 4. The watercourse model is mainly used to label items in the foreground and background.

Figure 5 displays the updated area maxima by superimposing the initial picture and foreground labeling images using the opening and closing models to evaluate the reconstruction. The marking of the background is done by marking the thin

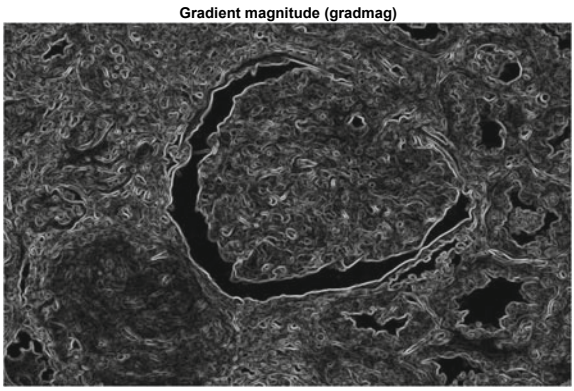

Fig. 4 Gradient image

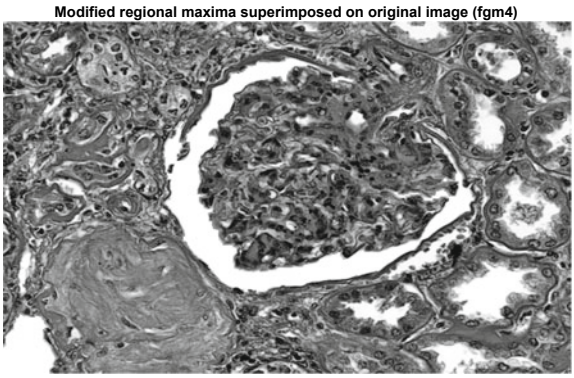

Fig. 5 Modified regional maxima by superimposing the original image

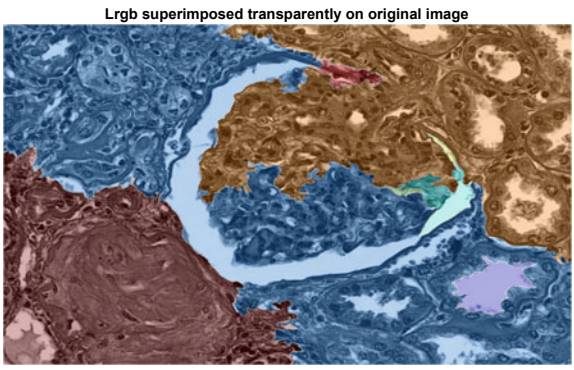

Fig. 6 Lrgb superimposed transparently on image

ridge lines in a superimposed image. Final Fig. 6. Shows the outcome of the initial test, showing the significant effect of glomerulus membrane and tubular membrane on tissue.

The different colors displayed on Fig. 6. Represents the watershed tag. It illustrates the essence of the cells in various shapes and cells because in reality if it is a healthy cell they will be of the same colour.

5 Conclusion

Diabetic nephropathy has become one of the complications that occur often when a patient is diabetic and vulnerable to kidney disorders. Therefore there is an urgency to sever the link.

Therefore methodologies in image manipulation act as an encouragement to the physicians. A technique has been adopted in this research merging watershed with morphology and gradient operators to provide an in-depth overview of the issue. With a few more advanced algorithms this issue may be further tested in the immediate future.

References

1. Gonzalez RC, Woods RE. Visual Picture Editing, A Pearson Education imprint, 1st edition
2. Sharifi A, Vosolipour A, Aliyari SHM, Teshnehlab M (2008) International 7. Conference on Computer Learning, Kunming, vol 3, pp 1265–1270, 12–15 July 2008
3. Kumar A, Shaik F (2015) Image processing in diabetic related causes. Springer. (Springer Briefs in Applied Sciences and Technology-Forensics and Medical Bio-informatics), May 2015. (ISBN: 978-981-287-623-2)
4. Asghar O, AL Sunni Sarah A (2009) Diabetic Cardiomyopathy, Heart Centre of Manchester, UK, Clinical Science
5. Ravindraiah R, Shaik F (2010) Detection of exudates in diabetic retinopathy images‖ national conference on future challenges and building intelligent techniques in electrical and electronics engineering‖ (NCEEE 2010), Chennai, India, pp 363–368, July 2010
6. Peres FA, Oliveira FR, Aneves L, Godoy MF (2010) Automatic digital imaging segmentation applied to cardiac medical images. In: IEEE, PACHE, conference, workshops and exhibits cooperation, Lima, Peru, 15–19 March 2010
7. Springer-Verlag Singapore Publishers (Springer Briefs in Engineering Sciences and Technology-Forensics and Scientific Bio-Informatics), May 2015. ISBN:978-981-287-623-2. http://www.springer.com/in/book/9789812876232#aboutBook
8. McCarty CA, Lloyd-Smith CW, Lee SE, Stanislavsky YL, Livingston PM, Taylor HR (1998) Use of diabetes people's eye treatment services: The Melbourne vision disability initiative. Br J Ophthalmol 82(4):410–414
9. Shaik F, Sharma AK, Ahmed SM (2016) Detection and analysis of diabetic myonecrosis using an improved hybrid image processing model. In: IEEE international conference on advances in electrical, electronics, information, communication and bioinformatics-2016 (AEEICB-2016 to be published in IEEE Explore) at Prathyusha Institute of Technology & Management, 27–28th February 2016. ISBN: 978-1-4673-9745-2
10. Askew A, Ware RS, Crossland L, Begg S, Cranstoun P, Mitchell P, Jackson CL (2012) Diabetic retinopathy screening and general practice control of early-stage illness: architecture and procedures. Contemp Clin Stud 33(5):969–975

11. Shaik F, Sharma AK, Ahmed SM (2016) Hybrid model for analysis of abnormalities in diabetic cardiomyopathy and diabetic retinopathy related images. Springer Plus J ISSN: 2193-1801
12. Peto T, Tadros C UK diabetes retinopathy screening and diabetic macular edema. Curr Diab Rep 12(4):338–345
13. Riphagen IJ, Lambers HJ, Heerspin K, Gans ROB, Carlo AJM (2014) Gaillard diseases of renal microcirculation: diabetic nephropathy. Living Reference Work Entry Pan Vascular Medicine, pp 1–34

Robust Algorithm for Segmentation of Left Ventricle in Cardiac MRI

M. Venkata Dasu, P. Tabassum Khan, M. Venkata Swathi, and P. Venkata Krishna Reddy

Abstract The left ventricle is one of four heart chambers. It is situated underneath the left atrium in the bottom left portion of a heart, divided by the mitral valve. The left ventricle was the thickest chamber in the heart and is essential for pumping oxygenated blood through tissues in the entire body. Left ventricular failure occurs where left ventricle dysfunction induces inadequate blood circulation to vital body organs causes breathing problems, which seems to be a threat to people. The non-invasive medical imaging techniques would be more effective in early diagnosis for left ventricle dysfunction. In this real connection different medical imaging techniques, such as image enhancement and image segmentation, were developed based only on the basics of image processing techniques. The objective of this study is to develop a novel and robust algorithm that can enhance the efficiency of automatic LV segmentation on short-axis cardiac resonance imaging (MRI). This project shall be carried out on the basis of different thresholding methods and related qualitative analysis, in order to determine the best algorithm. It can also be implemented with the Matlab R2015b method or above. The outcome of this work is aimed for early detection and also to carry out effective care and measures.

Keywords Image enhancement · Image segmentation · Left ventricular segmentation · Magnetic resonance images

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_54

1 Introduction

Cardiovascular disease is the number one cause of decapitation worldwide, the most severe health problem that has emerged. Cardiovascular diseases cause deaths of 17.5 million each year globally. A significant role in prevention is the early detection of cardiovascular diseases. A new method is suggested in this papers based on a series of image enhancement and image segmentation strategies to auto diagnose the left ventricle.

Next, the boundary of the left ventricle is defined instantly via the segmentation process. In addition, field-based contact trajectories of the tangent are calculated to make sure that they must be perpendicular to all intercepted boundaries. In addition, the intercepted points are smoothed with the desired Fourier type filter to eliminate noise and enhance diagnostic efficiency. Eventually, the mechanical dyssynchrony is defined as the time delay between the continuous movement in the computed boundary points and also the periodic change throughout the left ventricle region.

2 Need and Importance

Image enhancement and segmentation of images is one of the biggest problems in image processing. The purpose of the project is to develop a conceptual and reliable algorithm which can enhance the precision on short axis magnetic resonance images (MRIs) of automatic left ventricular segmentation. The desired results of this research are intended specifically for early detection and accurate treatment as well as measure.

3 Literature

The researchers [1] in their work had proposed a fuzzy logic rule based approach for automatic segmentation of right atrium. The rules were formed using texture characters. This thesis also uses the fuzzy rule based technique using the transition in texture characteristics to track the LV borders.

The authors framed an active contour model for segmentation of cardiac structures. The method requires placement of initial contour near the object of interest. This provided a contour shape by minimizing the global energy function [2]. The technique uses the information on pixel velocities for estimating the initial contour which enabled tracking of cardiac cycles. But the method is highly reactive to noises.

The researchers proposed a new temporal learning filtering procedure for tracking the LV borders by active contour model. Initial approximation of the LV borders is done using Hough transform and snake [3]. This is followed by PCA

transform to form a reduced ordered orthonormal basis of the LV deformations. This method has tracked epicardial boundaries of the heart.

The authors computed Markovian level set method for boundary detection in long axis echocardiography images. The method has combined Markov Random field (MRF) model for use of local statistics in level set method to handle topology changes. This technique is semiautomatic and vulnerable to noise [4].

The researchers proposed an adaptive snake initialization technique for delineating myocardial borders of mouse. The method has also incorporated the feature of speckle reducing anisotropic diffusion. Ghassan Hamarneh& Tomas Alf Gustafson (2000) proposed a method for segmenting the left ventricle in echocardiography images based on active shape models and active contour models [5].

The authors suggested a new level set propagation to track the left ventricle boundaries in [6]. The algorithm has made use of a new term based on local phase and local orientation derived from the monogenic signal to avoid attenuation artifacts. The method has also used Cauchy kernels for feature extraction. The technique has shown good results on low contrast boundaries. But the method needs the addition of recent region terms, which might suffer from inter and intra observer variations.

The authors developed a conventional hybrid segmentation method (Gaussian-mixture model with region restricted dynamic programming) which is incorporated with three different techniques such as ray scanning, region restricted technique and edge mapping for left ventricle analysis in CMR images [7]. Clustering with level set hybrid segmentation methods overcome the limitation of initialization in level set methods by incorporating the centroid from the clustering methods.

The research team suggested an intra-segment similarity based pattern recognition strategy that uses a standardization scheme to map each LV scale, intensity level and location with the polar coordinates [8]. They used differentiable multiple analysis (based on principles of differential geometry) to describe a deforming multiple for the parameterization of the LV domain. Features such as longitudinal, circumferential pressure, and tissue-rotation angle were also used to prepare and check a dataset with the proposed system findings by manually segmenting the myocardium.

4 Methodology

4.1 Algorithm for Image Segmentation

Step: 1: Image acquisition
Step: 2: Image smoothing (Gaussian convolution)
Step: 3: level set algorithm
Step: 4: results and analysis

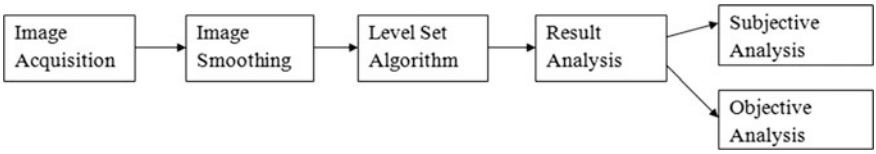
Step: 4.1: subjective analysis and objective analysis

Image processing is the development of a digitally encoded image of an object's visual properties, such as a physical scene or an object's internal structure.

Smoothing of the image is accomplished by convolving the image to average filter. It is beneficial for the noise reduction. It effectively eliminates high frequency material (e.g., noise, edges) from the picture culminating in edges becoming obscured while applying this filter.

Level set approach can be used effectively during curve evolution to overcome topology challenges while the preceding algorithms can't handle them. There is several image segmentation algorithms focused on level-set methods in recent years. People have put forth the corresponding solutions for various applications of image processing and a large number of experts are also continuing to develop and enhance the performance and usefulness of this algorithm.

4.2 Flowchart



5 Results and Analysis

MRI image of left heart ventricle is regarded for analysis in this work.

MRI is indeed a medical imaging tool to view the human body's internal cycle and anatomy. MRI scanners shape the body's medically relevant images utilizing magnetic fields via radio waves. MRI scans used to generate a range of clinical data in relation to digital images. MRI is used to get the phase of the disease and follow it up avoiding exposing the individual to radiation.

The input image is pre-processed using an average filter, and the objects introduced during the image acquisition process are minimized to produce an improved image.

The resulting image is subjected to existing thresholding methods such as Zhenzou thresholding, Fuzzy c means, Iso, Otsu, Max entropy. Figures 1, 2, 3, 4 and 5 displays the respective effects of all thresholding methods. These photos show the endocardium and epicardium layers, respectively defined by the blue and red boundaries. Around the same time, the threshold picture of each process is displayed sideways.

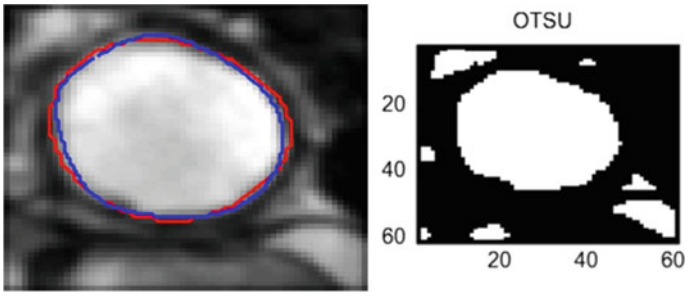


Fig. 1 Otsu

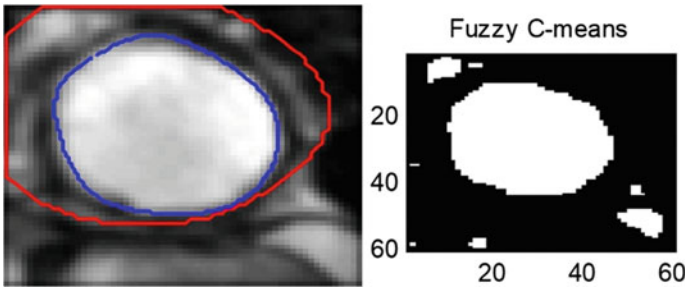


Fig. 2 Fuzzy c means

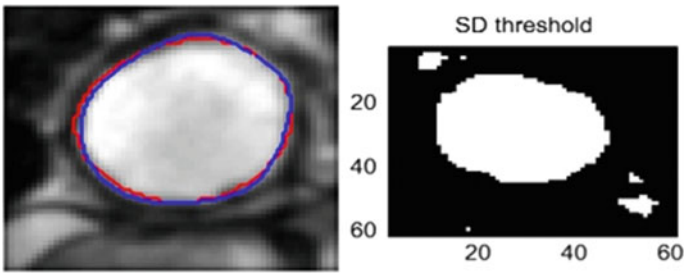


Fig. 3 Zhenzou thresholding

These threshold images display the exact region of interest i.e., the lv with its contours extracted from the original image.

The blood vessels (i.e. right and left ventricles) tend light in the short-axis MRI image, and all their corresponding structures seem dark (i.e. myocardium, lung, and liver) for various intensities, as shown in figures below. Only the left ventricle appears as a circular image in the short-axis image. This helps in fast discovery and boundary recognition.

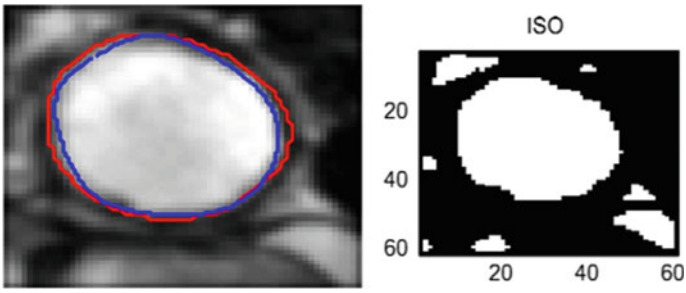


Fig. 4 Iso

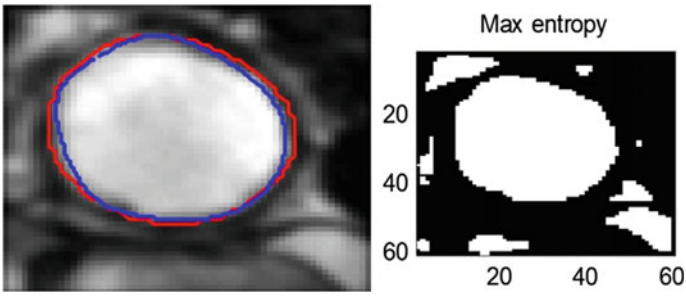


Fig. 5 Max entropy

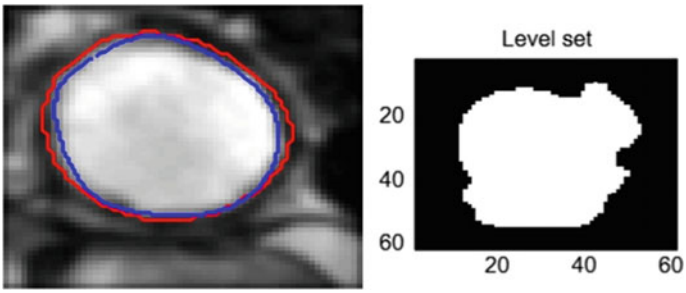


Fig. 6 Level set

The initial image is analysed even more with the proposed method i.e., level set function. In this approach the image is filtered using Gaussian convolution via smoothing procedure. The resulting picture is exposed to the process of gradienting to obtain edge indicators.

However initialization is described of parameters just like initial area, level set factor function. Thus level set function method is implemented to the image acquired after gradient method in order to obtain the output image with precise

Table 1 .

S. no.	Methods	APD	Dice
1	Zhenzou Thresholding	0.5370	0.9662
2	Fuzzy c means	7.3578	0.6693
3	Iso	1.0861	0.9220
4	Otsu	0.7334	0.9487
5	Max entropy	0.9053	0.9321
6	Level set	1.2681	0.9128

contours and to exclude the related regions is shown in Fig. 6 which is obviously visible in the current practices as shown in Figs. 1 through 5.

In this connection these parameters are obtained and tabulated in the Table 1.

The Dice must be approximately 0.90 according to the normal values and the APD must be at an average value of 1–2 mm. From Table 1 it is explicitly observed that the desired method level set function derives a dice worth of 0.9128 and APD of 1.2681, which are expected to be equivalent to the normal thresholding method calculation values.

6 Conclusion

In this work a data-driven technique is built to measure effectively and robustly the mechanical dyssynchrony of the left ventricle from cardiac MR images.

The proposed method uses 4 imaging and signal processing techniques:

(1) Automatic boundary identification by segmentation tool.
(2) Estimation of automated tangent field correspondence trajectory.
(3) Elimination of noise from the distance loop by a proposed type filter.
(4) Computation in cross-correlation in mechanical dyssynchrony.

The proposed approach for auto-diagnosis has been checked for a few cases. As it turns out, the suggested solution should make a clear distinction between the hypothetical case and the actual case and the level of dyssynchrony calculated. The outcome of a proposed method shows that the left ventricle is ready for fast and efficient segmentation.

References

1. Wang ZZ (2016) An efficient and robust method for automatically identifying the left ventricular boundary in cine magnetic resonance images. IEEE Trans Autom Sci Eng 13 (2):536–542

2. Wang ZZ (2017) Segmentation of the left ventricle in short-axis sequences by combing deformation flow and optical flow. IET Image Process. https://doi.org/10.1049/iet-ipr.2016.0410
3. Kaus M, von Berg J, Niessen W, Pekar V (2004) Automated segmentation of the left ventricle in cardiac MRI. Med Image Anal 8:245–254
4. van Assen H, Danilouchkine M, Behloul F, Lamb H, van derGeest R, Reiber J, Lelieveldt B (2003) Cardiac LV segmentation using 3D active shape model driven by fuzzy inference. In: Proceedings of Medical Computing and Computer-Assisted Intervention (MICCAI 2003), Montreal, QC, Canada, 16–18 November 2003, pp 533–540
5. Pednekar A, Kurkure U, Muthupillai R, Flamm S (2006) Automated left ventricular segmentation in cardiac MRI. IEEE Trans Biomed Eng 53(7):1425–1428
6. Lynch M, Ghita O, Whelan P (2006) Automatic segmentation of the left ventricle cavity and myocardium in MRI data. Comput Biol Med 36(4):389–407
7. Constantinidès C, Roullot E, Lefort M, Frouin F (2012) Fully automated segmentation of the left ventricle applied to cine mr images: description and results on a database of 45 subjects. In: 2012 annual international conference of the IEEE engineering in medicine and biology society. IEEE, pp 3207–3210
8. Hu H, Pan N, Wang J, Yin T, Ye R (2019) Automatic segmentation of left ventricle from cardiac MRI via deep learning and region constrained dynamic programming. Neurocomputing 347:139–148

An Optimized Clustered Based Video Synopsis by Using Artificial Intelligence

G. Thirumalaiah, S. Immanuel Alex Pandian, D. Teja Sri, M. Karthik Chowdary, and A. Kumarteja

Abstract The proposed paper is about a static video rundown strategy based on the development of Artificial Bee Colony, which refers to the outline of a video by the most indispensable edges present in that particular video. First the video outlines pixel bunches or regions of interest that capture the most important varieties of substances are differentiated. A tale set of highlights estimated as far as the normal tone estimations of every one of these areas is then used to describe the edges. In view of these highlights, the grouping of casings the Artificial Bee Colony Advancement Measurement divides the video into parts. The serving lengths are increased to the point that all the edges of a specific fragment have comparative highlights, while, the center edges of various sections are essentially not the same as one another. These center edges are viewed as the key-edges of the concerned video. Any excess present in the main outlines chosen is dispelled by looking at their histograms of shades. The proposed work is accepted on this freely accessible SumMe dataset and also, on other hazardously selected web video recordings.

Keywords Video summarization · Panorama video synopsis · Clustered based video synopsis

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_55

1 Introduction

In the present days, a tremendous number of recordings are transferred in the web in consistently because of the expanding requests of video sharing sites (for example YouTube) and interpersonal interaction locales (for example Facebook). It isn't practical for any individual to experience the whole substance of every video. Along these lines the need of setting up a self-ruling strategy for envisioning the abstract of a video gets clear [1]. This summary ought to be intended to such an extent that it is equipped for portraying the overarching tale of the video in question in a brief and professional manner [2]. This is the inspiration which drives the present video outline work. This applies to video summaries, which gives the client information about the substance of the video in brief timeframe. The requirement for age of video rundown is pushed for both the client and the creation perspectives [3].

Video rundown which gives a short and exact portrayal of unique video cuts by indicating the most agent summary is increasing more consideration. The fundamental goal of Video outline is to give an away from of the video by expelling repetitive and separating key casings substance from the video [4]. The engineering in video rundown shows how an enormous video skims in to short and story substance. In this manner, the objective of video synopsis is to process video succession with additionally intriguing, important and helpful to the client [5]. The significant assignment in video rundown is to section the first video into shots and concentrate those video outlines from the first video that would be generally enlightening and brief portrayal of the entire video. There are two primary classification of video synopsis that is static outline and dynamic skimming [6].

There may be broad differences in the content of various videos. The backdrop is constant in some videos while sudden scenic transitions occur in others [2, 7]. The video summary approach should therefore be sufficiently general to apply to all types of videos and to deliver in any case equally promising results. Current ways to deal with adjustable video rundown acquire the client's inclinations prior to the summarization process [8–11]. As a result, the user needs to physically change the outline to additionally meet the inclinations. Right now, present Active Video Summarization, an intuitive way to deal with assemble the client's inclinations while making the outline [12].

The substance of various recordings can have wide varieties among themselves. In certain recordings the foundation stays consistent while in some others unexpected changes of scenes happen. So the strategy for video synopsis ought to be sufficiently conventional to be relevant to all classifications of recordings and ought to give similarly encouraging outcomes in all the cases [13]. To address this test, here we try to examine another learning target that considers the job of purposeful activities performed by nonexclusive specialists inside the human-produced rundowns and use this connection to play out a powerful programmed synopsis [14].

2 Need and Importance

However, in this present scenario, we have a lot of video with huge substance, all the potential casings may not uniformity significant or a portion of the substance is excess or immaterial substance. Taking a shot at video synopsis is a serious troublesome assignment while finding the potential data to make a fascinating short video with either no tedious or missed data from the entire substance gives the needed information [15].

In this way, numerous strategies and methods proposed by specialists from old style PC vision until the ongoing profound learning draws near. Most of the work shows greater part of the video age and rundown approaches a move into profound generative models and variational auto encoders. These procedures may fall into abridged, solo and profound fortification learning draws near. Video portrayal arranged in static and dynamic synopsis ways [16]. Video rundown despite everything tested with various issues, these are computational gadgets, multifaceted nature, and absence of dataset are some them. The viable usage of video synopsis applied in various certifiable situations like motion pictures tailor in the film business, feature in football soccer, oddity recognition video reconnaissance framework [17].

The reason of our work comes from our perception that people will in general incorporate edges with conscious activities all the more every now and again in the outline, since they tend to represent more "unexpected and important" events, and tell more about the account of the video. This is acceptable practice to spare different assets time, stockpiling and other system and sight and sound foundation. Truth to be told, there are two sorts of video outlines: (1) static video unique, which is a grouping of key frames and (2) powerful video skimming, which is an assortment of dynamically composed sound video sub-cuts, and in the two cases, the point is to gather the most intriguing or significant video portions that show the embodiment of the first clips [18].

Digital video contains many features like motion, voice and color. These techniques work well if user wants to specialize the features of any video. For example, if user wants to ascertain color features then it's good to select color based video summarization techniques. Feature based video summarization techniques are classified on the basis of motion, color, dynamic contents, gesture, audio-visual, speech transcript, object. In some way or another related methodology is Multi-Video Browsing and Summarization, which endeavors to synchronize video streams by moving casings in time, so outwardly comparative edges are seen in all recordings simultaneously and this plan estimates similitude by a lot of prepared visual likeness descriptors among outlines, rather than our work which is object based [19].

It satisfies the need of creating precise video with all the information required which is present in the given video. Also it reduces all the unwanted frames and eliminates them in the summarized video. The summarized video is a short video

which represents the synopsis of a particular video. Here the length of the video will be reduced without making any new changes to the given video.

3 Literature Survey

The foundation of knowledge on this topic was obtained by going through various research papers and scholarly articles. Numerous kinds of research were done before and progressing as of recently. Here is the information of literature review regarding the progress involved in the proposed paper.

Prof. Shmuel Peleg of the Hebrew University of Jerusalem, Israel, invented video synopsis technology and was produced under a commercial license by BriefCam, Ltd. BriefCam has obtained a license from Yissum to use the technology. Also few other researchers named Migliorati, A. Bonzanini and R. Leonardi presented "A Semantic video indexing using vectors of the MPEG phase". EUSIPCO'00, pp. 147–150; Tampere, Finland, Sept. 2000 [19].

Before video summarization techniques has came into existence, it was all about fast forwarding a video. In 2005, N. Jojic, N. Petrovic and T.S. Huang launched a tool for the purpose of video abstraction which is tit led as "Adaptive video fast forward", Multimedia Tools and Applications, vol. 26, no. 3, pp. 327–344 [20].

Later Adami and S. Benini has proposed "An overview of video shot clustering and summarization techniques for mobile applications" in the year 2006. Many articles have been published regarding video summarization by using various static and dynamic summarization techniques.

In the year 2011, the video overview chooses a limited number of frames from the clusters by using Video SUMMarization (VSUMM) algorithm, which selects keyframes by extracting frames to cluster centroids with minimal distances. A.P.B. Lobes, de Albuquerque Araújo and S. E. F. De Avila introduced "VSUMM: A mechanism which is designed to produce static video synopsis and a novel method of evaluation," Pattern Recognition. Lett., pp. 56–68, vol. 32, no. 1, 2011.

Many citations along with patent rights have been given to the respective projects that evolved with various approaches. In 2017, P. Cui, T. Mei, W. Zhu and Y. Yuan used a different approach and published an article titled "Video Synopsis by using deep side semantic embedding".

In 2019, Choi, R. Muhammad, conference, has given another developed version of video summarization technique March 2019 as "Soccer video synopsis using deep learning". With reference to all these existing approaches, we have proceeded with this proposed system to present the improvised output.

4 Existing System

Video summarization plays an important role as it helps the user navigate and retrieve through a wide sequence of videos. In recent years, it has become an emerging field of research, but due to the complexity of methods and approaches, the implementation is far behind.

As we know, there are many existing systems, which are developed based on different approaches and are still being improved. Each system follows a different methodology but the motive behind every approach is same. Video synopsis can be obtained by using various video summarization techniques. The following Fig. 1 gives a clear information about video summarization techniques that have been used in various existing systems.

Generally video summarization techniques that have been used in all the existing works can be categorised into cluster based, featured, mosaic based, event based, trajectory based, key frames based. Again, feature based technique can be based on dynamic content, motion, object, colour and gesture. Clustering method depends upon activity, partitioning and spectral based. Also, trajectory based are classified as spatio-temporal and curve saliency based.

All previously existing systems might have used one or the other technique of above. Choosing a suitable technique completely depends upon the main theme of the proposed system. There are several research papers cited and published by various authors. The drawbacks of such works include abrupt changes in the acceleration and unstable display at every major lateral swing.

5 Proposed Methodology

Static video synopses provide a series of keyframes taken from the original video while dynamic video synopses consist of a selection of photos and are created taking into consideration the similarities or backgrounds over all video images. The proposed methodology is based on dynamic video synopsis.

In this paper we present a strategy for making video synopses continuously on any Mp4 video. At first, low-level highlights are used to dispose of unfortunate casings. Next, video is partitioned into fragments, and section level highlights are extricated for each portion. Tree-put together models that are prepared with respect to broadly accessible video synopsis and computational datasets are then used to rank individual fragments, and top-positioned portions are chosen to create the last

Fig. 1 Video summarization using clustering techniques

video rundown. Panoramic video synopsis has been constructed in the similar way by aligning all the frames with reference to one main frame.

5.1 Block Diagram

The block diagram of the suggested method is as seen in the given Fig. 2. As explained above, these approaches describe the video frames and their transformations by means of features and afterwards implement an optimization problem by incorporating these features that achieve all goals, dynamic smoothness and textual highlight. The flow diagram clearly shows the step by step process starting from giving the input video, feature extraction and segmentation followed by redundancy elimination to getting the video summary output.

Firstly, the given input video should be present in the directory and video link is to be provided in the respective matlab program. Feature extraction plays a prominent role which is performed after converting the frames to suitable format.

Input video is segmented and histogram processing will be done after which we find out variance and hue values. Certain frames with high content are to be selected which are represented as keyframes. This is nothing but keyframe extraction. Unwanted or similar frames are reduced which is represented as redundancy elimination in block diagram. The pseudo code of the program follows the same procedure as mentioned in the flow chart. Finally, the output video is the summarized video with less frames and the content being remained same.

5.2 Frame Level Roi Detection

Each of the frames can be portrayed by a lot number of F highlights, which are taken care of the ABC algorithm that will acquire the key-casings of the video D. So the highlights ought to be picked to such an extent that they are sufficiently

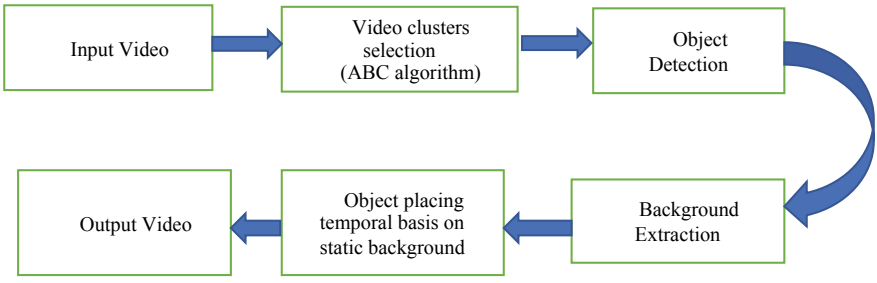

Fig. 2 Block diagram

adequate to speak to the attributes of a specific cases n($1 \leq n \leq N$). Frames are to be selected by using clustering methods like k-means and hierarchical. Key frames are selected and are combined later. During the process, one main problem emerges that the locations of these F RoIs should be. Since various videos depict different tales, it doesn't clarify the fixation of RoIs for all the given videos that are to be summed up. Therefore, we must choose a easy but effective method for classifying the RoIs.

Let, each frame be represented by n of a video which is denoted by D, contains a total number of pixels ($H * V$). The value of hue of any pixel (h, v) is given by I_{hv}^{n} where h € [1, H] and v € [1, V] are located. Taking into account all the values of hue of all pixels at a given (h, v) positions by considering all the N frames, a (1 × N) vector would be given as follows [I_{hv}^{1}, …. I_{hv}^{n}, ….I_{hv}^{N}].

The variance R_{hv} of the values of a vector can be calculated as,

$$R_{hv} = \frac{(I_{hv}^{1} - M_{hv})^2 + \cdots (I_{hv}^{n} - M_{hv})^2 + (I_{hv}^{N} - M_{hv})^2}{N}$$

5.3 Video Segmentation

The entire N frame sequence should be divided into different segments of variable lengths, so that the intermediate frame of each segment is the largest one. For this reason the problem of segmentation is presented in the proposed solution as one of the restricted optimisation, with the ABC algorithm being applied to deal with it.

The primary objective of the optimization problem is to identify S segments of the video in such a way that the middle frames of successive segments differ significantly while all frames of each segment contain only a small level of variation. Let the s^{th} section contain l_s(s =1, 2, …, S) numbers of successive D frames in this regard. If the index of the s^{th} segment's first, middle and last frame is represented by α_s, β_s and γ_s respectively, then these three parameters can be described in the following equations.

$$\alpha_s = \begin{cases} 1, \textit{ when } s = 1 \\ \sum_{q=1}^{s-1} l_q + 1, \textit{ otherwise} \end{cases}$$

$$\beta_s = \begin{cases} \frac{l_s+1}{2}, \text{ when } s = 1 \\ \sum_{q=1}^{s-1} l_q + \frac{l_s+1}{2}, \textit{ otherwise} \end{cases}$$

$$\gamma_s = \sum_{q=1}^{s} l_q$$

The standardized cumulative absolute difference O1 should be maximized between system characteristics where the relevant distance between the middle

frames of the successive segments is known and it is given by the following equation.

$$O_1 = \frac{1}{s-1}\sum_{s=1}^{s-1}\sum_{t=1}^{F}|f_t^{\beta_s} + f_t^{\beta_{s+1}}|$$

On the contrary, the uniform total absolute difference O2 among the characteristics of an intermediate segment system only makes a small variation of the frames for each section and each of the remaining frames should be minimized, where

$$O_2 = \frac{1}{N-S}\sum\nolimits_{s=1}^{s}\sum\nolimits_{q=\alpha_s}^{\gamma_s}\sum\nolimits_{t=1}^{F}|f_t^{\beta_s} - f_t^{q}|$$

The resultant function O, can be formulated as shown below

$$\mathrm{O} = O_1 - O_2$$

5.4 Elimination of Redundant Keyframes

Elimination of some frames is essential because different videos are viewed at various speeds and all videos are segmented into fixed S number of segments that lead to redundant keyframes. This repetition of similar frames must be avoided when taking a look at any video. A keyframe reliability check is carried out in the proposed method.

Each key-frame's hue histogram is obtained in terms of 20 bins probabilities. The number 20 is specified after experimentally analyzing the production of different number of containers. When there is a less than a preset threshold (τ_h), contained in Euclideans between a couple of histogram probabilities of key frames, the latter is not further taken into account in the summary in respect of the time period.

6 Result and Analysis

We have indicated in the above sections that a MATLAB program would provide a significant scope to summarize a given input video. We then developed a hypothesis by conducting a study of various research papers. Through evaluating the results of the study it is clear that the final output video is a short video with no content changed in it. It is simply a synopsis video. All calculations for this paper was rendered using MATLAB 2017a on a laptop with an Intel Core i5 CPU.

The summary produced by every automatic procedure in contrast with increasing human-generated ground-truth description using the same approach as the redundant keyframe mechanism mentioned in Sect. 2. If a ground-truth key-frame's hue histogram (expressed as probabilities of bins) varies. The two frames shall be contrasted from the one created automatically by a main frame which is less than the predefined threshold value. This key-frame pair is then omitted from the comparison's subsequent iterations. Here too, the number of hue histogram bins is set at 20, and the predefined gap threshold is set at 0.2.

The key frames which are selected by a random user follows the approach suggested for a video are illustrated pictorially. The proposed algorithm can be clearly noted to be extremely effective when using main frames for a broad range of photographs. So it is inferred that these two key frames match and this process of comparing is tailored to calculate the CUS values which gives accuracy rate and error rate.

Figure 3 represents three input video frames. As we can see, the camera panned and the perspective of the target shifted as well. And we can't just borrow the video from last segment to get clear history.

(a) BQmall Video Input frames

(b) Office Video input frames

(c) Terminal video Input frames

Fig. 3 Sample input sequences at different time lapses

In this case, we will follow the object as one way to extract it from the foreground and use panoramic stitching to get the context.

For an input video in which we can see some tigers running and we can observe some rectangular points on images, this is because of the window mask tracking. To bypass this effect, we can directly use object mask that I obtained using optic flow instead of moving it to the tracking window. Another way to integrate tiger into the context is to use Poisson Image Editing I introduced for coursework on Image Processing. The following Fig. 4 shows the panorama synopsis result.

The Panorama Video Synopsis is mounted in a format that is similar to something like a standard video synopsis and is used to match all frames with such a reference structure. The new solution is being evaluated on videos from the freely accessible SumMe video summary repository and on other online videos accessed anonymously from the Internet.

In order to explain the accuracy and experimental results, three videos are given as an input and the following Table 1 shows the parameters of the video in terms of total number of frames, resolution, frame rate and bit depth.

In Matlab, the use of the SURF function matching is a much more effective way to estimate homography. This includes SURE component extraction(extract Features), (matching Features) and geometric relationship estimation (estimate GeometricTransform) between frames. For hypothetical frames, their homography with others can be represented by a sequence of comparative homography multiplications starting from the keyframe to the targeted frame. So only select the relevant frame and evaluate the comparative homography between that and the rest of that same frames, we get only the matched sequence centered on both the reference frame. Then we use a mixer to glue frames together just to create a panoramic context.

Through our implemented video synopsis approach, we extract moving objects from that of the video object using techniques and attach video crease cutting to query cuts. The results of these experiments are evaluated by three previous methods time equidistant (TEA), noise model (LDS), (information equidistant algorithm (CEA), and information rearrangement methods) to test a proposed method as well as its performance. In order to generate video synopsis efficiently, our designed algorithm is used for multiple different clips and parameters, such as

(a) BQmall Ouput frame (b) Office Video output frame (c) Terminal Output frame

Fig. 4 Video synopsis result

Table 1 Parameters of input video

Video name	Total frames	Resolution	Frame rate	Bit depth
BQmall.mp4	220	160 × 120	25 fs/s	8
office.mp4	349	384 × 288	26 fs/s	8
Terminal.mp4	130	160 × 120	25 fs/s	8

Table 2 Comparison results for different methods

Methods	BQmall.mp4			office.mp4			Terminal.avi		
	Frames	Compression ratio	No of output frames	Frames	Compression ratio	No of output frames	Frames	Compression ratio	No of output frames
Kmeans [11]	220	0.192	178	349	0.294	257	130	0.315	124
FCM [11]	220	0.112	157	349	0.269	240	130	0.169	106
KFCG	220	0.215	190	349	0.278	269	130	0.245	94
Our approach	220	**0.115**	73	349	**0.198**	145	130	**0.168**	46

compressed frames, minimal distortion or even just aspect ratio are measured and then compared to existing system. The following Table 2 illustrates the comparative results of various methods.

7 Conclusion and Future Scope

This article discusses the optimisation-based approach to resolving the problem of static video summarization. This also indicates a novel set of functions which are intended to define video clips. Such characteristics capture certain frame regions that bear the largest amount of information. Experimental testing reveals that the new approach can provide successful description of a wide selection of videos and, by a significant margin, outperform current methods for video summarisation.

Recently, classical computer vision strategies for video description methods are dynamically shifting to deep learning, particularly deep generative model, recurrent neural network, auto encoders for variety. Video review can be treated in controlled (RNN, TVSUM and DPP SQDPP), unsupervised (ILSUM, VAE and GAN) and even. Video summarization is threatened by various factors ranging from dataset to computing unit, especially in new deep learning models. Of different reasons, the program video description can be used in a different scenario, such as entertainment, film industry, and defence, and decreased computing power.

Generally speaking, a deep generative model and variational auto encoder is a relatively good way to use video description techniques in both static and dynamic summary approaches. The future challenges would be active object detection which is capable of handling cluttered scenes such as changes in the object size, position,

direction, movements, or irregular motion or suspicious thing detection, and other problems. ToolboxTM Computer Vision Program offers a variety of methods to tackle object detection problems.

The primary contributions of this initiative are:

(1) This provides a method for creating static video synopses, and incorporates the benefits of the main concepts in the associated work throughout the video summary.

References

1. Varma HL, Talbar SN (2010) ViSum: video summarization using dyanamic threshold. In: 2010 3rd international conference on emerging engineering and technology developments (ICETET), pp 120–123
2. De Lopes, De Albuquerque A, Da Luz A Jr. (2011) VSUMM: a novel form of evaluation system and the development of static video summaries
3. Gianluigiy C (2006) Innovative algorithm for the retrieval of main frames in video summarization. J Real-Time Process Image 1(1):69–88
4. Gandhi K, Dohare S (2009) Audio synopsis: an summary of techniques
5. Calic D (2007) Efficient layout of video summaries like comics. IEEE Trans Syst Loops Technol Photo 17(7):931–936
6. Zhang J-H (2005) Graph simulation of the video description and scene detection. IEEE Trans Syst Circuits Technol Photo 15(2), 296–305
7. Karaboga D, Basturk B (2007) A powerful and effective algorithm for the optimization of numerical functions: an artificial bee colony (ABC) algorithm. J Glob Optimizing 39 (section 3):459–471
8. Cui P, Zhu W (2017) Doing deep side semantic embedding video summarisation. IEEE Trans Syst Loops Technol
9. Chua T-S, Yan S (2012) Event-driven description of web video by tag location and key-shot recognition. IEEE Tran. Multimedia 14(4), 975–985
10. Basturk B (2008) On the artificial bee colony (ABC) efficiency algorithm. Appl Simple Comput 8(1):687–697
11. Kang W, Tang X, Matsushita Y, Chen X-Q (2006) Space-time video montage. In: IEEE computer society panel discussion on computer vision and image processing. IEEE
12. Gygli L, Van Gool G (2015) Video description by studying submodular combinations of targets. In: IEEE 2015 conference
13. Zhang K, Shau F (2016) Summary transfer: outstanding subset collection for content summarization
14. Nikolay-Acha A, Pritch A (2006) Making a long video brief: dynamic video brief summary. In: CVPR
15. Pritch Y, Rav-Acha K, Peleg S (2007) Webcam synopsis: looking all over the world
16. Pritch A, Aguirre-Acha A (2008) Nonchronological video synopsis as well as indexing. IEEE, pp 1971–1984
17. Gridson, Stauffer (1999) Dynamic background mixing models besides real-time tracking

18. Gandhi NM, Misra R (2016) Performance comparison of orthogonal graph coloring methodologies using hadoop. In: International computing, networking and communications conference. IEEE
19. Zhong, Wang (2014) Fast synopsis of moving objects using compressed video. IEEE
20. Ishwar P (2019) A signal method. Video condensation of ribbon carving

Performance Analysis of LTE Based Transeiver Design Using Different Modulation Schemes

C. H. Najaraju, P. Veera Prasad Reddy, Nidiginti Suneel, and Gona Naveen Kumar

Abstract Creation of wireless transceiver designs based on Long-Term Evolution (LTE) architecture initiated by the 3GPP consortium. Initially, a performance comparison on Bit error rate (BER) and Signal to noise ratio (SNR) is evaluated for a single transmitter and receiver storage system, both in fading (Rayleigh channel) and non-fading (AWGN) channels. Specific modulation schemes are used including Binary Phase Shift Keying (BPSK), Quadrature Phase Sift Keying (QPSK), and Quadrature Amplitude Modulation (QAM).

Later, the transceiver designs implement multiplexing of the Orthogonal Frequency Division (OFDM) with the required requirements for the LTE modulation formats. BER and SNR performance assessments on designed transceiver structures are analyzed. This paper further assesses the channel's efficiency or throughput using Shannon efficiency equation for a band-limited AWGN channel with an average transmit power limit. The channel efficiency is evaluated using parameters such as bandwidth and conveying power as constraints. Such parameters describe communication device boundaries.

Keywords LTE · Rayleigh · QAM · SNR · BER · Capacity · Transceiver · OFDM

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_56

1 Introduction

Wireless networking standards available in 2 G wireless networks in GSM and GPRS deliver appreciable voice quality but limited data or internet services. The 3GPP Long Term Evolution (LTE) reflects a major event in wireless 3 G technology and beyond. With the advent of a revolutionary market for increased data rate with improved service quality (QoS) such as smaller transmission power, low noise level, improved bandwidth and negligible spectral congestion, and others designing a transceiver system, this posed a significant challenge. Quality evaluation on channel parameters such as BER and SNR, efficiency or throughput, bandwidth, power level, noise level acceptance and others are also considered influences once designing application equipment and a base station containing a pair of transceivers [1]. 4 G standard used LTE architecture release 8 that combines MIMO with 16 format OFDM modulation. The recent launch of LTE like 12 and beyond is the basis for the creation of the architecture for 5 G communication standards [2].

This paper focused on designing LTE architecture-based transceiver program which is the main component of the 5 G standard. The simulation of the transceiver design begins from the single transmitter and receiver structure for common modulation schemes such as BPSK, QPSK M-QAM in stochastic fading channel Rayleigh and non-fading channel AWGN. Later designs include the transceiver structure that is the foundation of LTE architecture, using OFDM [3]. In this paper numerical simulation of the designs is created. For the premium processing, Matlab is used as simulation environment.

1.1 Objective

For different transceiver design structure performance comparison of system parameters such as BER and SNR is evaluated. Shannon efficiency equation is measured for the AWGN channel and the average power and bandwidth are taken as constraints in estimating the communication system's ability or throughput [4].

1.2 Need and Importance

Long-Term Evolution (LTE) is a standard in telecommunications for wireless broadband connectivity for mobile devices and data terminals, based on the GSM/EDGE and UMTS/HSPA technologies. It increases capacity and speed in conjunction with core network improvements using a different radio interface. The standard is developed by the 3GPP (3rd Generation Partnership Project) and specified in its Release 8 document series, with minor enhancements described in

Release 9. LTE is the upgrade path for both GSM/UMTS networked and CDMA2000 networked carriers [5].

The numerous LTE frequencies and bands used in different countries suggest that LTE can only be used by multi-band phones in all countries where it would be supported [6].

LTE was branded as both "4 G LTE" and "Advanced 4 G," but it does not meet the basic requirements of a 4 G wireless service as set out in the LTE Advanced 3GPP Update 8 and 9 document series. LTE is commonly referred to as 3.95 G too. The specifications were originally laid down in the IMT Advanced specification by the ITU-R organisation.

The LTE Advanced norm formally meets the ITU-R specifications to be called IMT-Advanced. In order to differentiate LTE Advanced and Wi MAX-Advanced from current 4 G technologies, ITU has described them as "Real 4G".

LTE's goals would maintain the quality of 3GPP over cellular technologies. Some of LTE's essential enhancement parameters centered on significantly higher data rate, increasing spectral performance, reducing costs, ensuring QoS, allowing use of new spectrum possibilities such as millimeter wave spectrum, alignment with other standards, backward compliance with earlier mobile system standards such as GSM, GPRS and others. LTE new versions 12 and beyond are standard architectural design for 5 G

2 Literature Review

Implementation of OFDM transmitter and receiver MATLAB is carried out. By breaking the wideband frequency selective fading channel into some narrow band flat fading channels, OFDM is intended to cope with the impact of multipath propagation.

Sim et al. explained the layered detection algorithm to reduce residual interference for a quadrature amplitude modulated filter bank (FBMC-QAM) multi-path fading channels. We use two thresholds in this algorithm: a selection threshold, and a national threshold. First we search in the selection threshold whether the termination of interference generally applies or not [7]. We divide the sub carriers into two pieces in region threshold according to their channel gain.

Taheri et al. discussed how multicarrier filter banks are enforced using the fast Fourier convolution approach. Fast-convolution scheme reduces process complexity. There are two types of convolution, which are as cross pollinate-adding and interchange-saving. In case of variability-adding the zeroes are padded into segment to reach the length of the window. The signal divided into segments into overlapped blocks in overlap-save method. The final signal can be obtained by discarding the opposing portion of the filtered segments.

Razavi et al. analyzed the intrinsic interference that can be used to increase the OFDM/OQAM spectral efficiency. The ability of OFDM/OQAM is evaluated by knowledge computational chemistry with the isotropic orthogonal transfer

algorithm (IOTA) pulse shaping. The addition of the cyclic suffix in the previous OFDM system decreased system spectral efficiency. So to eradicate this introduced multicarrier manufacturing drawback filter scheme, which increased the performance. But now an algorithm is added to resolve the OFDM weakness which is IOTA.

This use of multi rate stream banks was investigated in a systematic way. High frequency selectivity, the property of filters can be achieved through the proper design of filtration banks. Transmission in FBMC is based mainly on the TMUX configuration with the same size of the filter bank in synthesis and the filter bank for analysis. The partial synthesis technology allows for the renovation of an uplink transmitter-receiver pair with filter banks of unequal sizes and gives the transmitter processing a low complication. Using this scheme there is the possibility of doing the analog interpolation and limiting the sampling rate of digital to analog conversion.

Yonghong Zeng et al. demonstrated the technique of duplexing with the FBMC (Filter Bank Multicarrier). Downlink and uplink transmit data at the same time with the same frequency band but with different subcarriers. Since we know it is not possible to get the complete match in time and frequency with downlink signals and uplink both signals. So matching errors will kill the orthogonality between downlink and uplink. These types of faults make duplexing unstable or inefficient in OFDM, but the duplexing is very good in FBMC using the prototype filters to reduce these faults. Uses duplexing to allow two-way communication between two users.

3 Methodology

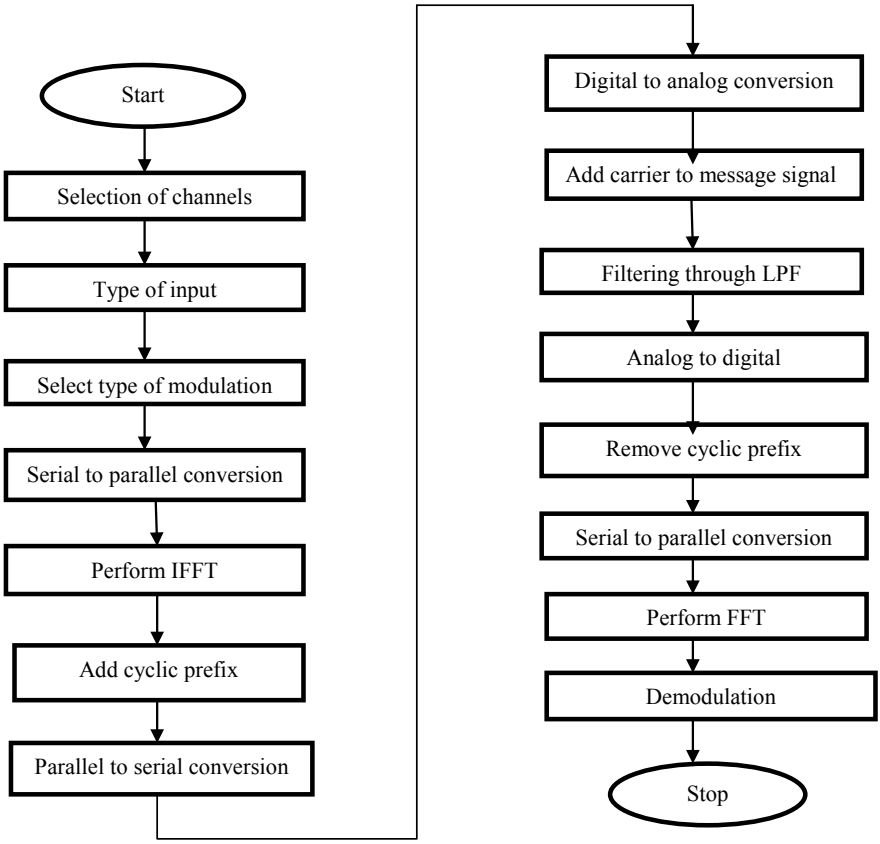
ALGORITHM:

Step:1- Start
Step:2- Selection of channel
Step:3- Select type of input(raw data or image)
Step:4- Select type of modulation
Step:5- Serial to parallel conversion
Step:6- Perform IFFT for orthogonality
Step:7- Add cyclic prefix
Step:8- Parallel to serial conversion
Step:9- Digital to analog conversion
Step:10- Add carrier signal to message
Step:11-Filtering through LPF
Step:12-Analog to digital
Step:13-Remove cyclic prefix
Step:14-Serial to parallel conversion

Step:15-Perform FFT to remove orthogonality
Step:16-Demodulation of signal
Step:17- End

Cyclic Prefix is applied to the OFDM symbol that passes parallel to the serial converter and the digital bits are transferred to analog by D/A converter resulting in the OFDM baseband signal that is then transformed and transmitted over the medium of the air interface. Reverse procedure is conducted at the receiver side to collect demodulated signal. In this segment, FFT structure is used to convert samples from frequency domain to matched filtering.

4 Flow Chart



5 Result and Analysis

In Matlab setting transceiver designs are simulated. The simulation results depict BER Vs. SNR, plotted under the Rayleigh fading channel between different modulation schemes. Further, in BER assessment, QPSK, 16-QAM. Under various modulation schemes the OFDM scheme is plotted which is an integral part of LTE. Also analysed is the capacity of the channel using the expression of Shannon taking bandwidth and transmission power as constraints.

The findings show that for higher order modulation types, the BER increases. But, in order to increase the data rate with appropriate BER, consideration must be taken when designing the transceiver architecture for a tradeoff between modulation schemes (Figs. 1, 2, 3).

The final part of the simulation outcomes depicts the channel's capacity through Shannon's equation to evaluate transceiver design capacity or throughputs under AWGN channel. Two computations are used to estimate capacity, which shows that transmission power can be the main constraint, rather than bandwidth. The simulated results indicate that capacity increases after a limit with transmit power but not with bandwidth (Fig. 4).

This shows that modulation schemes are theoretical in nature. For higher order modulation schemes, more bits are mapped with the available signal power and attempted to transmit to the receiver to increase the channel's data rate parameter.

Table provides the parameter BER and SNR performance evaluation analysed through simulation.

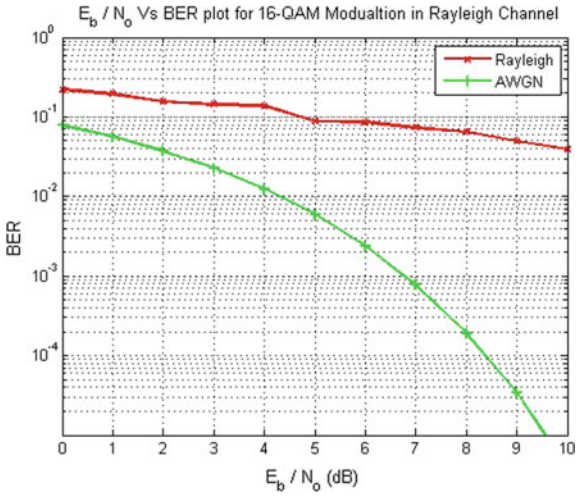


Fig. 1 BER Vs SNR-16-QAM over Rayleigh channel and AWGN

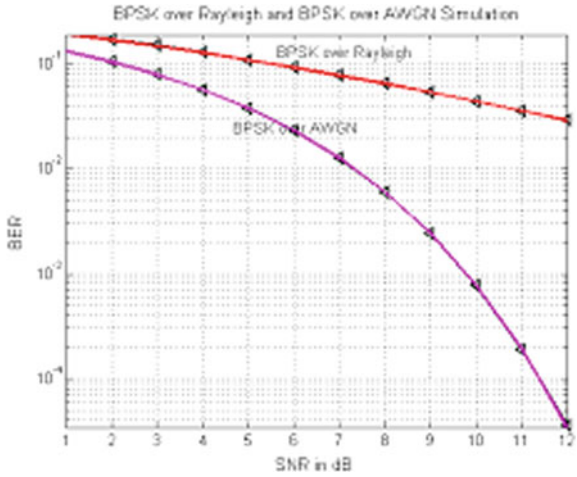


Fig. 2 BER Vs SNR- BPSK over Rayleigh channel and AWGN

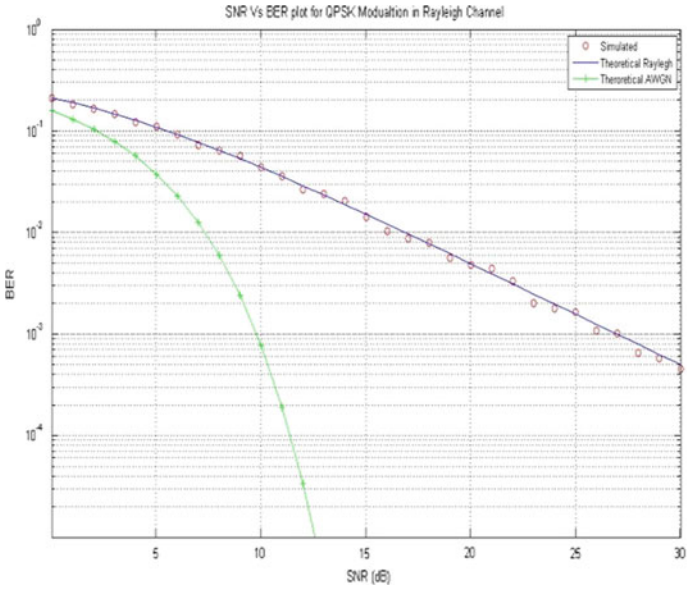


Fig. 3 BER Vs SNR- QPSK over Rayleigh channel and AWGN

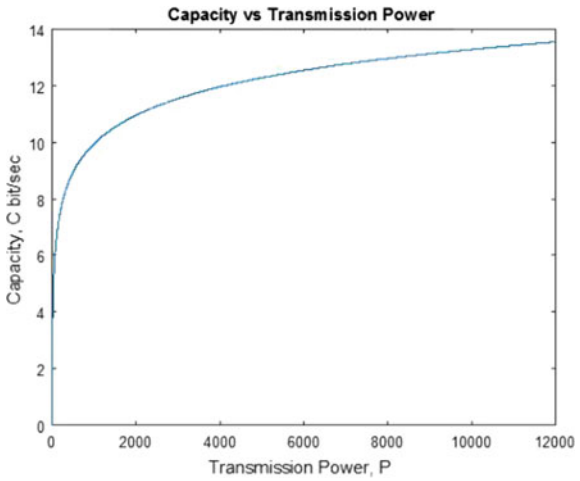


Fig. 4 Capacity Vs transmission power

SL NO	Modulation	Channel	Number of bits	SNR (dB)	BER (dB)
1	BPSK	AWGN	1000000	6	0.002
2	QPSK	AWGN	1000000	6	0.002
3	16-QAM	AWGN	10000	6	0.1
4	16-QAM	RAYLEIGH	10000	6	0.09
5	OFDM	RAYLEIGH	10000	6	0.11
	16-QAM				

6 Conclusion

Simulation designs of the transceiver designs are evolved based on different modulation schemes and a relative analysis of system performance variables in the context of SNR and BER is carried out. The simulation results reflect different BER values for the same SNR value 6 db for simulation of transceiver designs under fading and non-fading channels for various modulation schemes. OFDM, the main feature of LTE with 16-QAM modulation scheme under the Rayleigh interface, offers low bit rate but retains low transceiver architecture data rates.

Simulation results show that the approach proposed offers an optimal solution, while previous methods either have values closer to zero/null or high interfering values.

References

1. Boccardi F et al (2014) Five disruptive technology directions for 5G. IEEE Commun Mag 52:74–80
2. Goldsmith A (2005) Wireless communications. Cambridge University Press
3. Kamath H et al (2016) Transmit receive chain in LTE. In: IEEE annual ubiquitous computing, electronics & mobile communication conference (UEMCON). IEEE, pp 1–7
4. Kumar KNS et al (2009) LTE-advanced: future of mobile broadband. In: TATA consultancy services, white paper, pp 1380–1408
5. Lu L et al (2014) An overview of massive MIMO: benefits and challenges. IEEE J Sel Top Sig Process 8:742–7588
6. Proakis JG et al (1994) Communication systems engineering, vol 2. Prentice Hall, New Jersey
7. Raju M, Ashoka Reddy K (2016) Evaluation of BER for AWGN, rayleigh fading channels under M-QAM modulation scheme. In: IEEE international conference electrical, electronics, and optimization techniques (ICEEOT)

Unsupervised Segmentation of Image Using Novel Curve Evolution Method

Fahimuddin Shaik, B. Vishwaja Reddy, G. Venkata Pavankumar, and C. Viswanath

Abstract Here, a novel algorithm for unsupervised field-depth (DOF) image segmentation is defined. To detect the object of interest (OOI) in the saliency space, a multi-scale re-blurring technique is used first. Firstly blurring is carried out to remove artifacts, later reblurring procedure. Thereafter, an active contour model based upon hybrid energy system is suggested to evaluate the OOI boundary. A global energy element relevant to the saliency map is implemented in this model to find the globally minimum, and a local energy term about the low DOF picture is used to increase the precision of segmentation. Additionally, this model is equipped with an elastic parameter to offset the weight of global and local resources. In addition, an unsupervised approach for initializing curves is intended to reduce the amount of iterations for evolution. More the iterations, the complexity and computation time to obtain the results may hike up leading to slow up the process of acquiring precise contours. Lastly, we perform experiments on different low DOF pictures, and the resultant demonstrates the high precision and robustness of the proposed method.

Keywords Depth of field · Object of interest · Segmentation · Reconstruction · Enhancement

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_57

1 Introduction

In recent years, more engrossment has been paid to image segmentation due to the rapid growth of computarized vision, medical segmentation or satellite and image analysis applications [1–5]. The main objective of image segmentation is, classify a picture into a definite no. of non-overlapping areas, where the pixels in a same area share unified properties like intensity, color, texture [1]. A good amount of research has been done in relation to these basic features from the past few years. However, OOI (object of interest) is seldom sharing the same colour, strength or texture in actual photos, so that more visual features should be erupted to separate real world pictures Photographers in action often use a small depth field (DOF) which is quite common nowadays to emphasize an item whereas the other sections are blurred. This will help recognize the point of focus and reduce the impact of detracting from the context, allowing audiences to consider the visual trend. An efficient unsupervised segmentation approach for lower DOF images would therefore have wider applicative prospects [7], such as 3D object reconstruction, image indexing, and digital camera image enhancement.

2 Existing Method

The active contour model is used for the detection of boundary of artifacts. These artifacts come in different forms such as noise, additive noise or sharp transitions which are misunderstood for a correct signal. Thus it has become necessary to remove these type of artifacts which were mainly added while Image acquisition procedures to avoid The central theory of this method is curve evolution, i.e. the transfer of the curve through its natural interior to the boundaries of object [1]. This method is applied by reducing energy and allowing use of functional energy. Unlike the monotonous dark backdrop, the foreground in a low-DOF image typically has strong contrast. The contour part of the Image processing methods has been a vital one in deciding the exact outline of an image and to carry forward the future operations on the proposed image to yield good results. This function introduces significant difficulties in deciding low-DOF pictures, and challenges them to the foreground. This produces the force required to push an emerging curve toward its regular interior and to stop at the boundary of the body [3]. With regard to certain visual characteristics, this technique has achieved a great triumph in segmentation of image, so that it can be concluded that active contour model can provide a latest way of segmenting low DOF pictures. For edge-based active contour models, the energy functional usually contains edge detectors, so it is often used to detect foreground with the edge described by a strong gradient. It is obviously not appropriate for low DOF images [4]. The gradient procedures mainly involve mathematical computations to avoid even the smallest of the distortions in the image processing.

In computer vision, the snake model is common, and snakes are commonly used in applications like edge detection, shape recognition, segmentation, object tracking and stereo matching [5]. Snake is a power-minimizing, moldable spline shaped by restrictions and picture forces forcing it to contours of structures and internal forces resisting deformation. Snakes can be interpreted as a remarkable case of the general technique of toning a deformable object to an image by minimizing the strength [6]. The deforming part of these type of models will increase the accuracy in obtaining the perfect and precise contour zones which can be further assessed for upcoming algorithms or post processing procedures. The region-based active contour models are becoming common as the edge-based solutions have been noticed to be far too sensitive to the noise and preliminary curve positioning. However it is based upon assumptions we go for novel curve evolution method [7, 8].

3 Proposed Method

In the proposed method, a multi-scale re-blurring system in saliency space determines the focused regions in a lower DOF image. This technique's basic principle is curve evolution, i.e. moving the curve into its natural interior up to the object's boundaries. By the use of functional energy this approach is implemented by minimizing energy. Instead, based on retained saliency map and the original picture, a hybrid active contour models, whose energy characteristic is comprised of outer and inner terms, is implemented for the evolution of curve [9]. Additionally, this segment incorporates an unsupervised initialization process for curve, that aim to decrease the no. of iterations for curve evolution [10].

3.1 Object Detection

The objective of unsupervised segmentation is used to distinguish OOI f($\vec{x}$) from context b($\vec{x}$) without the use of any manual assistance. The low DOF image is modelled in [12] a

$$\mathrm{I}(\overrightarrow{x}) = l(\overrightarrow{x}) f_{\varepsilon}(\overrightarrow{x}) + (1 - l(\overrightarrow{x}))\mathrm{h}\,(\overrightarrow{x}) * b_{\varepsilon}(\overrightarrow{x}), \tag{1}$$

$l(\vec{x})$ is simpler binary feature to differentiate focused foreground image Ω_f from the unfocused region area Ω_b which is defined as

$$l(\overrightarrow{x}) = \begin{cases} 1, & \overrightarrow{x} \in \Omega_f \\ 0, & \overrightarrow{x} \in \Omega_f \end{cases} \tag{2}$$

A system of object detection is dependent on the re-blurring model and then proposed to produce a FSM that is given by,

$$\mathrm{FSM}\left(\overrightarrow{x}\right) = \left|\mathrm{I}(\overrightarrow{x})) - \mathrm{IG}\left(\overrightarrow{x}\right))\right|, \tag{3}$$

where $\mathrm{IG}(\vec{x}) = \mathrm{I}(\vec{x}) * \mathrm{g}(\vec{x})$, and $\mathrm{g}(\vec{x})$ is a Gaussian kernel of parameter blur σ_g.

This method succeeds in distinguishing focused Object of interest from defocused background that is not blurry enough. However, the scale of the Gaussian kernel will be constrained by a single small σ_g, resulting in the low FSM $(\vec{x})$ values in these regions.

Thus, it will be hard to detect any smoother regions in directed OOI that may leave holes or hollows in segmentation resulting. To solve such type of problems we suggest a multi-scale solution to re-blur the actual image. In this, we follow the 2-Dimensional Gabor transformation [11] and the data fusion method of multiple-scale and multi-orientation to recognize adaptive blurred selection of parameter. The transformation procedure will lead to promising corrections required and as fusion is adopted the images have less chances of losing the details due to various reasons. For the reconstruction of the original image, the multiple-scale and multiple-orientation data fused method is done after 2-Dimensional Gabor filtering. Multi-scale kernels are used for the re-blurring of input artifacts in this object detection process. The larger-scale kernel is distributed to smooth regions, while the small scale will be chosen for harsh areas [2]. Gabor filtering is used a pre-processing procedure to filter the images and once again re-blurred for the object detection process (Fig. 1).

3.2 Extraction of Focused OOI

This stage will focus over the unsupervised extraction of the centered OOI based upon the saliency map obtained $\kappa\ (\vec{x})$. As discussed in Step I, Global Energy Function Approaches produces the globally minimum result but cannot assure precision at OOI boundary [12]. The precision parameter has been most preferred in these applications in order to obtain the optimal results. In this method, we therefore propose a novel active contour models dependent upon the hybrid energy mechanism that can be expressed as

$$\mathrm{E} = E^G + \eta\, E^L, \tag{5}$$

Detailed form of E^G, E^L and η are as described below.

First, when contemplating the form of the global energy function E^G, it should be remembered that E^G is used to guarantee the segmentation effect to be global minimum. The global minimum is considered here to avoid any over feature extraction may damage the entire process of drawing the perfect boundaries. Since

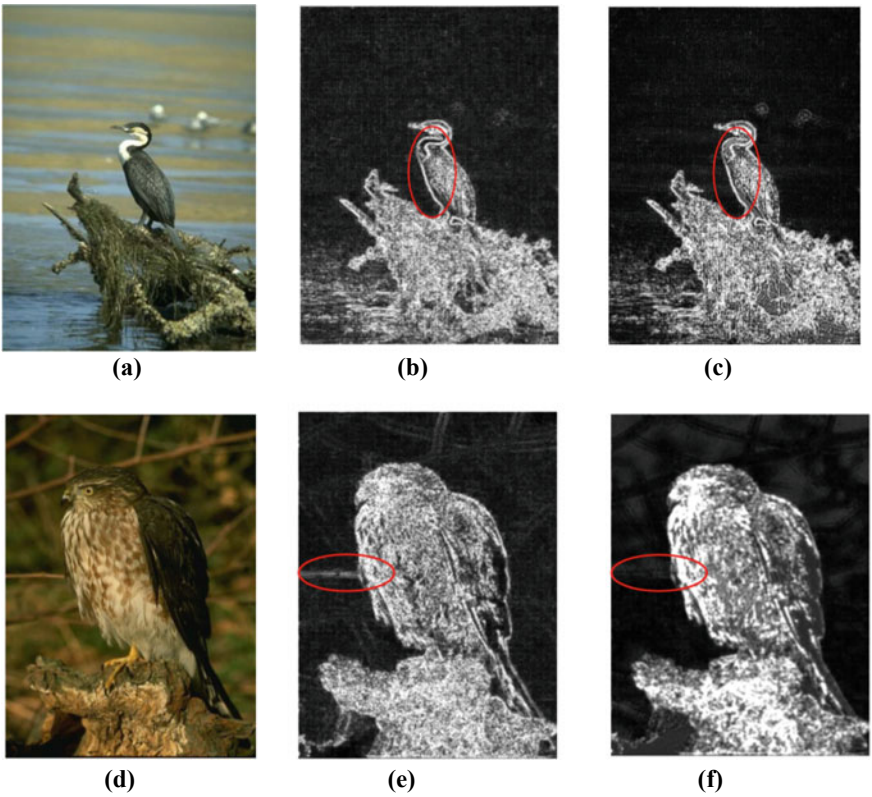

Fig. 1 Illustration of the performance in object detection process between Li's process and the proposed algorithm. (a) and (b) are actual images; (c) and (d) are maps of salience obtained using Li's method; (e) and (f) are contour method output

saliency space κ $(\vec{x})$ provides OOI's global details, the form of E^G is chosen to be constructed over the basis of κ $(\vec{x})$. In this study, we chose MDL criteria as the type of a energy function, globally E^G, given by

$$E^G = \mu \int_c ds - \lambda_f \int_{\Omega_f} \log p_1 d\vec{x} - \lambda_b \log p_2 d\vec{x} \tag{6}$$

At Eq. 6, The selection of the pre-specified distribution of likelihood p is very significant, as it specifies the efficiency of the global energy function E^G by p. If p is selected with a defined variance as the Gauussian distribution, Eq. 10 is converted into the CV model's power function [13]. The Gaussian distribution is considered as one of the most used default function in this type of algorithms due to its inherent property to hold all the functions in its distribution curve. A more appropriate probability distribution function (PDF) should therefore be added to cope with the

saliency diagram, the gray leveled distribution of which is typically heterogeneous [14].

$$p(k(\overrightarrow{x})|\alpha) = g(k(\overrightarrow{x})|k,\theta) = \frac{1}{\Gamma(k)}(k(\overrightarrow{x}))^{k-1}e^{-k(\overrightarrow{x})/\theta}\,\theta^{-k}$$

The 2-parameters of continued gamma PDF is more appropriate for representing the saliency map of Distribution of heterogeneous intensities than that of the Gaussian distribution due to the asymmetric function of gamma PDF. Choose $\lambda 1 = \lambda 2 = 1$, and the global function of energy will be restated as

$$E^G = \mu \int_{cc} ds - \int_{inside(C)} \log(g(k(\vec{x})|k_1,\theta_1)) - \int_{inside(C)} \log(g(k(\vec{x})|k_2,\theta_2 d\vec{x} \quad (8)$$

Secondly, E^L function is to enhance precision at the OOI boundary. Even though E^G has global convergence, in the targeted detection stage the OOI boundaries in the saliency map was blurred due to re-blurring process. This helps to remove all the artifacts including added noises making the image captured suitable for the future process. As shown in Fig. 2(a) That is, E^G of the bird's border is not known to be correct since saliency mapk($\vec{x}$) can not contribute such detail. We therefore need further knowledge from the original image I to build the local energy feature in order to obtain a refined segmentation result E^L.

In this method, the provincial energy function form E^L which is formulated as

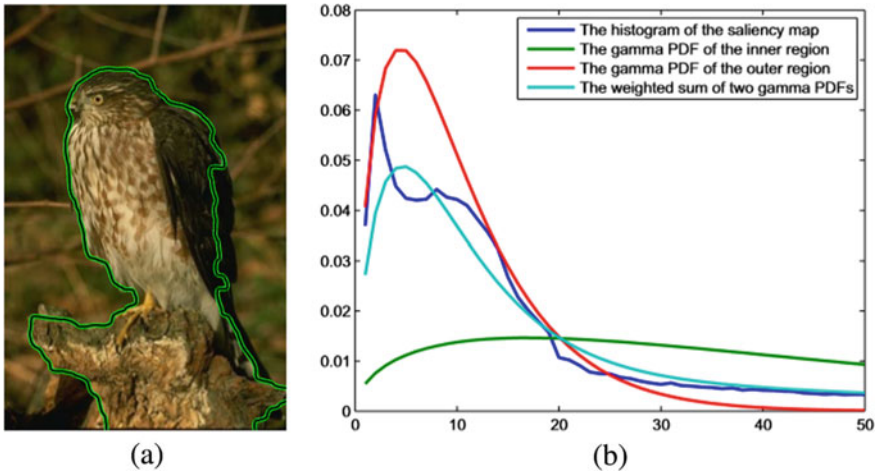

Fig. 2 The two separate gamma distributions are merged through the global energy minimization cycle to match the saliency map to histogram. (a) the curve is C. (b) is the saliency map histogram, the distribution of the two gammas and their weighted sum

$$E^L = \int_{C(\vec{x})} \int_{C(\vec{y})} B_r(\vec{x}, \vec{y}).F(I(\vec{y}), C(\vec{y}))d\vec{y} \tag{9}$$

To identify the local area label, the two vectors are combined,

$$B_r(\vec{x}, \vec{y}) = \begin{cases} 1, ||\vec{x} - \vec{y}|| < r \\ 0, ||\vec{x} - \vec{y}|| \geq r \end{cases}. \tag{10}$$

This provincial energy function leads to achieving high precision in making best use of local information at the boundary of OOI. The criterion for convergence of such a local power feature is that of initial curvature should be below the OOI. The precision process is considered very seriously to attain the exact required contours for the purpose of achieving the exact boundaries for a given image. The first term E^G is generally minimized at first, as it is measure of global energy and its peak would equip a basic curve for a 2nd term E^L. The global energy leads to attain a possible situation which adjusts the peak. When the emerging curvature is close to the OOI, provincial power function E^L becomes dominant. Thus, in the process of curve evolution, η must be set in the beginning as a low value, so it will further grow larger once the curvature moves nearer to the OOI limit. It is therefore critical to detect the list which signifies whether the curvature can be described as being nearer to the OOI. The result for image segmentation is achieved by decreasing the energy feature.

Therefore, emergence of curve C corresponds to

$$\frac{\partial \emptyset}{\partial t} = \mu di\vartheta\left(\frac{\nabla\emptyset(\vec{x})}{|\nabla\emptyset(\vec{x})|}\right) + \delta(\emptyset(\vec{x}))\left[\log\frac{g(k(\vec{x})|k_1,\theta_1)}{g(k(\vec{x})|k_2,\theta_2)} + \eta\int_{\Omega_f} B_r(\vec{x},\vec{y})\delta(\emptyset(\vec{y}))\left((I\vec{y}) - m_1(\vec{x})\right)^2 - \left((I\vec{y}) - m_2(\vec{x})\right)^2 d\vec{y}\right] \tag{11}$$

Where $\delta\emptyset$ is the function of Dirac delta, which is a partially differential equation of a Heaviside function, represented as $\delta\emptyset = \frac{d}{d\emptyset}H(\emptyset)$.

It must be illustrated that the process of evolution of curvature might be very sluggish if the original curve is positioned at a non-optimal location. The next section suggests an unsupervised curvature initialization approach to enhance efficiency.

3.3 Curve Initialization

Unsupervised Curve Initialization Process While globally convergent methodologies can generate a global minimal of energy feature anywhere the initial curvature is placed, an optimal initial curve always moves faster to a boundary of OOI, while an incorrect one might result in a sluggish evolution of curvature process [7]. Thus, necessary precautions are considered at each and every step to avoid any hassles

that may lead to failure of the proposed method. We take the initial curve at random. Initially, split the image evenly into different areas, and determine the mean gray level and variability for each area. First, the regions with the lowest variation and mean gray level value are selected as the backdrop due to the weak gray scale value of the context. And the limits of these regions are known as the initial curve. The settings are calculated as

$k_1 = 0.7432$ and $\theta_1 = 24.4162$ for the inner region,

$k_2 = 0.7578$ and $\theta_2 = 25.1006$ for the outside. Therefore, for effective curve initialization, we suggest an unsupervised method. Initially, the saliency map $k(\vec{x})$ is divided equally into n regions $k_i(\vec{x})$, i = 1, 2, ⋯, n, as well as the mean gray level m_i^k and variance σ_i^k are evaluated for every region. The statistical attributes such as mean and variance are computational values which helps to carry the process to a further step. Next, because of the lower gray-scale background value, multiple areas with low variance and mean depth are selected as background, which is expressed as

$$[i_1, i_2, \ldots\ldots\ldots i_k] = arg_i^{min}\left(\sigma_i^k | m_i^k < \zeta\right) \tag{12}$$

If ζ, the corresponding threshold could be used as the average gray level of the saliency maps and the limit of such k regions is assumed to be 1 part of the actual curve. Later on, in addition to somehow increase the acceleration of the curve evolution, the edge of the picture is viewed as the other part of the actual curve.

4 Results and Analysis

Figure 3(a) reveals the image for which the OOI at the first sight is easily recognizable. Allegedly, the main figure in the image show the same features, i.e. it is in sharp focus, apart from the blurry backgrounds. Input image is re-sized with respect to various co-efficients like kappa parameter.

The saliency map of input image is displayed in Fig. 3(b) and its gamma PDF is shown in Fig. 3(c). Fig. 3(b) saliency map obtained by subjecting the original image to the integration of two separate gamma distributions for fitting the saliency map of histogram through the method of global energy minimization. Figure 3(c) shows the saliency map histogram and the gamma distribution for the interior and exterior regions differentiated by the curve evolved.

The focused Object of interest is highlighted, while the defocused background. Figure 3(d) is the resultant output that shows robustness and accuracy.

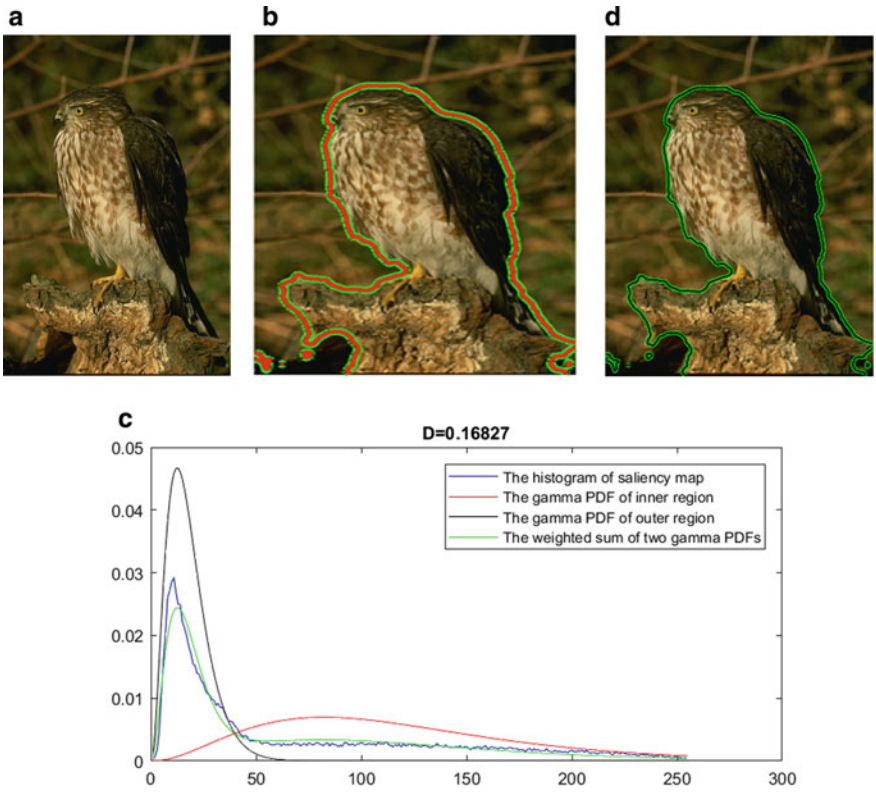

Fig. 3 (a): Input Image. (b): Saliency Map. (c): Gamma PDF with different patterns. (d): Output Image

The saliency map of input image is displayed in Fig. 4(b) and its gamma PDF is shown in Fig. 4(c). Fig. 4(b) saliency map obtained by subjecting the original image to the integration of two separate gamma distributions for fitting the saliency map of histogram through the method of global energy minimization. Figure 4(c) shows the saliency map histogram and the gamma distribution for the interior and exterior regions differentiated by the curve evolved.

The focused Object of interest is highlighted, while the defocused background. Figure 3(d) is the resultant output that shows robustness and accuracy. Depending upon the features in the OOI the distribution of gamma PDF varies along with the decrease in the no.of iterations. From the analysis we observe Fig. 3 has more features in OOI when compared to Fig. 4.

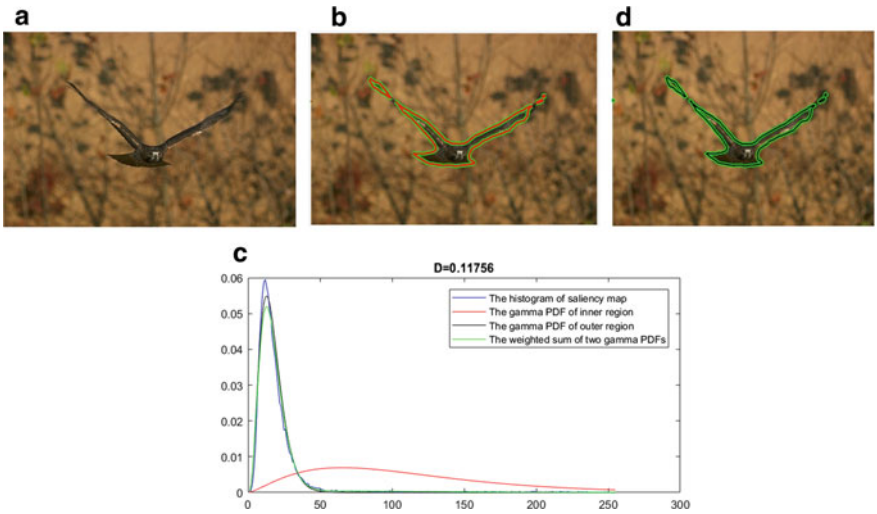

Fig. 4 (a): Input Image. (b): Saliency Map. (c): Gamma PDF with different patterns. (d): Output Image

5 Conclusion

Considering the various problems of unsupervised segmentation for low depth of field (DOF) images, that exists in different applications, the possible modifications are carried out to obtain optimal results. With the aid of a multiple-scale re-blurring model, the focused OOIs are distinguished in saliency space. The artifacts are reduced with the help of double blurring procedure leading to obtain the better images for post-processing Later the active contour model is proposed based upon hybrid energy. The globalized energy model is defined with the advent of gamma PDF, which well defines a saliency map's heterogeneous intensity distribution. To achieve more precise segmentation performance, the local terms based on the original picture is applied to active contour models, and a weighted variable allows the curves to adapt faster and more accurately to actual OOI boundary. The specific extraction and drawing of the perfect contours are most required for this type of applications. This depends on the global energy function as described in the above sections. The global energy function provides the global minimum by integrating global energy with local energy while the local energy function ensures accuracy at the OOI boundary. In fact, an un-supervised initialization approach is introduced to create a proper initial curve that will recede the number of iterations of curve evolution. Eventually the results show the robustness and accuracy of the suggested solution.

References

1. Houhou N et al (2008) Fast texture segmentation model based on the shape operator and active contour. In: Proceedings IEEE conference computer vision pattern recognition, June 2008, pp 1–8
2. Mei J et al (2013) A curve evolution approach for unsupervised segmentation of images with low depth of field. IEEE Trans Image Process 22(10)
3. Gunjan VK, Shaik F, Kashyap A, Kumar A (2017) An interactive computer aided system for detection and analysis of pulmonary TB. Helix J 7(5):2129–2132. ISSN 2319 – 5592
4. Cheng H, Jiang X, Sun Y, Wang J (2001) Color image segmentation: advances and prospects. Pattern Recogn 34(12):2259–2281
5. Shi J, Malik J (2000) Normalized cuts and image segmentation. IEEE Trans Pattern Anal Mach Intell 22(8):888–905
6. Gunjan VK, Janga Reddy M, Shaik F, Hymavathi V (2018) An effective user interface image processing model for classification of Brain MRI to provide prolific healthcare. Helix J 8 (3):2129–2132
7. Lindeberg T, Li M (1997) Segmentation and classification of edges using minimum description length approximation and complementary junction cues. Comput Vis Image Underst 67(1):88–98
8. Adams R, Bischof L (1994) Seeded region growing. IEEE Trans Pattern Anal Mach Intell 16 (6):641–647
9. Kass M, Witkin A, Terzopoulos D (1998) Snakes: active contour models. Int J Comput Vision 1(4):321–331
10. Shaik F, Sharma AK, Ahmed SM (2016) Hybrid model for analysis of abnormalities in diabetic cardiomyopathy and diabetic retinopathy related images. Springer Plus J (ISSN:2193-1801)
11. Caselles V, Kimmel, R, Sapiro G (1997) Geodesic active contours. Int J Comput Vis 22 (1):61–79
12. Chan T et al (2000) Active contours without edges for vector-valued images. J Vis Commun Image Represent 11(2):130–141
13. Shaik F, Sharma AK, Ahmed SM (2016) Detection and analysis of diabetic myonecrosis using an improved hybrid image processing model. In: IEEE international conference on advances in electrical, electronics, information, communication and bioinformatics-2016 (AEEICB-2016 to be published in IEEE Explore) at Prathyusha Institute of Technology & Management, 27–28th February 2016. ISBN: 978-1-4673-9745-2
14. Darell T, Wohn K (1990) Depth from focus using a pyramid architecture. Pattern Recogn Lett 11(12):787–796

A Genetic Algorithm with Fixed Open Approach for Placements and Routings

Shaik Karimullah, Syed Javeed Basha, P. Guruvyshnavi, K. Sathish Kumar Reddy, and B. Navyatha

Abstract Multiple traveling salesman issues can model and resolve specific real-life applications including multiple scheduling, multiple vehicle routes and multiple track planning issues etc. Though traveling salesman challenges concentrate on finding a minimum travel distances route to reach all communities exactly again by each salesman, the goal of a MTSP is just to find routes for m sellers with a reduced total cost, the amount of the commute times of all sellers through the various metropolises covered. They must start by a designated hub which is the place of departure and delivery of all sellers. As the MTSP is an NP-hard problem, the new effective genetic methodology with regional operators is suggested to solve MTSP and deliver high-quality solutions for real-life simulations in a reasonable period of time. The new regional operators, crossover elimination, are designed for speed up searching process consolidation and increase the consistency of the response. Results show GAL finding a decent set of directions compared with two current MTSP protocols.

Keywords MTS · MTSP · NP-hard problem · GAL

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_58

1 Introduction

TSP (Traveling Salesman Problem) is a widely prescribed problem concerning optimization. Provided an array of cities and their distances, the TSP is described as a route for a salesman through visit every city exactly once, It starts and ends in that same place [1]. The purpose of a TSP is just to mitigate the salesman's driving distance. Many systems in reality can be modelled as a TSP, for example, pcb boards, punching, order selecting and floral minimization issue Multiple Traveling Salesman Problem (MTSP) is an expansion of the TSP, in more least one salesman simultaneously deploying to visit their cities [2].

Our research is inspired by the problem of planning multiple quadcopter paths. Quadcopters have different aerodynamics compared with fixed wing aerial vehicles [3]. Given that the flight time is extremely restricted by the internal batteries, an efficient route planning optimization can help perform as many activities as possible throughout multiple quadcopters implementation [4]. You can model such a problem as a three-dimensional MTSP. Can the MTSP also be expanded with different demands or objectives, including multiple targets, multiple depots, multiple vehicle routing, multiple Stacks traveling salesman problem?

There was no known quadratic-time algorithm for all the MTSP, since the MTSP is an NP-hard. So, solving the problem by heuristic algorithms is more practical. This paper proposes and develops an effective algorithm based on genetic algorithm (GA), called Genetic Algorithm with Local Operators (GAL), to solve the MTSP [5].

2 Need and Importance

The Traveling Salesman Problem is extraordinary compared to other known NP-difficult issues, which implies, there is no precise calculation to understand it in polynomial time. The insignificant anticipated that time should acquire ideal arrangement is exponential.

Traveling Salesman Problem is characterized as a change issue with the target to finds the way of the briefest range (or the base expense) [6]. Traveling Salesman Problem can be seen as an unguided weight graph, with the ultimate goal that urban neighborhoods are really the vertices of the diagram, ways are the edges of the diagram, and separation of a way is just the length of the edge. It is a reduction problem that started and ends for a particular part after visiting one another vertex only once [7]. The template is a finished map, daily. In case there is no way around two cities, adding a self-assuredly long edge would complete the map without affecting the ideal visit.

The most famous viable use of Traveling Salesman Problem are standard dispersion of merchandise or assets, finds the briefest of customer adjusting course, arranging transport lines and so forth, yet in addition in the regions that have nothing to do with movement courses [8].

3 Literature

Chiung Moon in 2001, presents the idea of TS which is characterized as a requesting of a coordinated graph. Another hybrid activity is produced for the proposed GA.

A heuristic to tackle the summed-up voyaging sales rep issue. The strategy fuses a nearby visits improvement heuristic into an arbitrary key hereditary calculation. The calculation performed very well when tried on a set of 41 standard issues with known ideal target esteems in 2005, by Lawrence V. Snyder presents.

Milena Karova in 2005 presents the arrangement, which remembers a hereditary calculation usage for request to give a maximal guess of the issue, adjusting Gupta. A produced arrangement with hereditary administrators [9].

In 2006, PlamenkaBorovska explores the effectiveness of the equal calculation of the voyaging sales rep issue utilizing the hereditary methodology on a leeway multicomputer bunch.

A two-level hereditary calculation (TLGA) was produced in 2007 for the issue, which favors neither intra-bunch ways nor between group ways, in this manner acknowledged incorporated transformative improvement for the two degrees of the CTSP [10].

A novel molecule swarm streamlining (PSO) based calculation in 2007 for the voyaging sales rep issue (TSP) is exhibited, and is contrasted and the current calculations for settling TSP utilizing swarm knowledge [11].

A product framework is proposed to decide the ideal course for a Traveling Salesman Problem utilizing Genetic Algorithm system in 2008 [12].

S.N. Sivanandam presents two methodologies i.e. Genetic Protocols and Particle swarm streamlining to find answer for a given target work utilizing various strategies and computational procedures; accordingly their presentation can be assessed and looked at this in 2009.

A paper half and half PSO discrete calculation has been exhibited by include factor of heuristic, hybrid administrator what's more, versatile aggravation factor into the methodology. Outcomes of Numerical show that the investigated calculations are powerful [13].

A relative presentation of Elitism and roulette wheel competition choice strategy is introduced to take care of the Traveling salesman issue in 2011 [14].

4 Methodology

4.1 Algorithm

Step 1: Initialize and override the default configuration with user inputs.
Step 2: Assignment of inputs, sanity check, route break point and populations.
Step 3: Select colors for the plotted routes.
Step 4: Run the genetic algorithm and evaluate members of populations.
Step 5: Find and plot the best route.
Step 6: Repeat the algorithm.
Step 7: Generate random set of break points.
Step 8: Force breaks to minimum tour length and override the user inputs.
Step 9: Display the best solution.

4.2 Flow Chart

See Fig. 1.

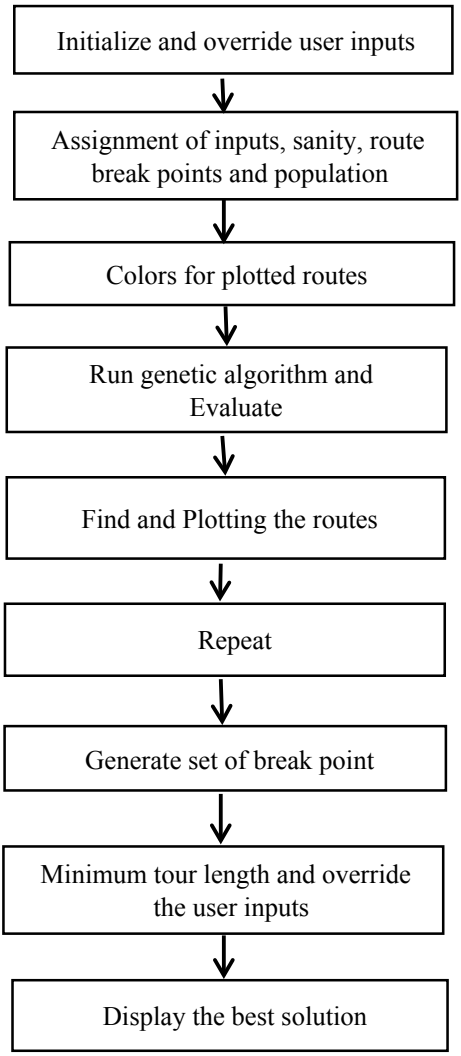

Fig. 1 Flow chart for genetic algorithm

5 Result and Analysis

The proposed genetic algorithm with different routes is initialized with different city locations and keeping the four routes constant. the algorithm travelling salesman problem in order to achieve best solution.in this connection the first investigation is carried out for 25 city locations and the placement of city locations can be seen in Fig. 2 and the four routes for the placed city locations can be visualized in Fig. 3 represented with four different colors. based on the city locations and routes the best solution is obtained as shown Fig. 4.

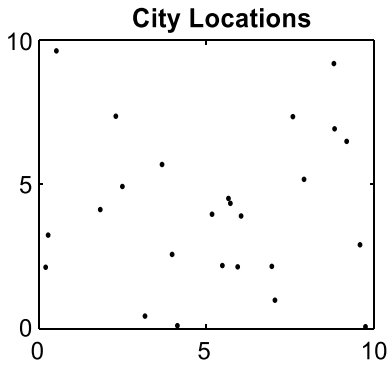

Fig. 2 City locations

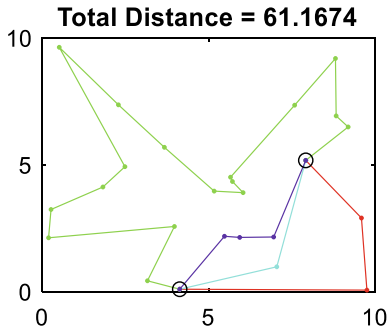

Fig. 3 Routes of city locations

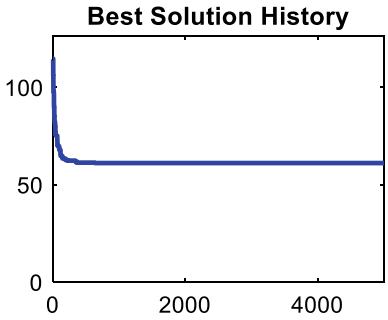

Fig. 4 Best solution history

In similar fashion the entire experiment is carried out for city locations with numbers 30, 35, 40, 45 and 50 and their respective placements can be observed from Figs. 5, 8, 11, 14, 17.

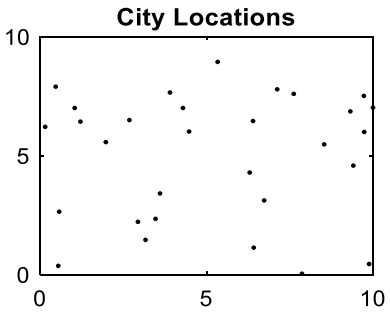

Fig. 5 City locations

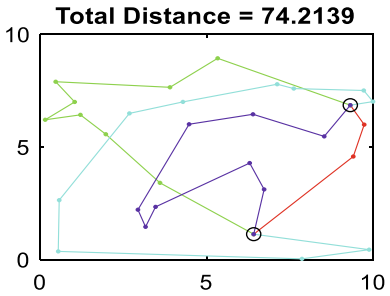

Fig. 6 Total distance measure

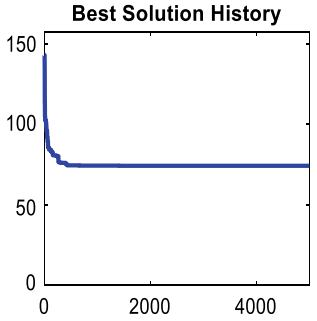

Fig. 7 Best solution analysis

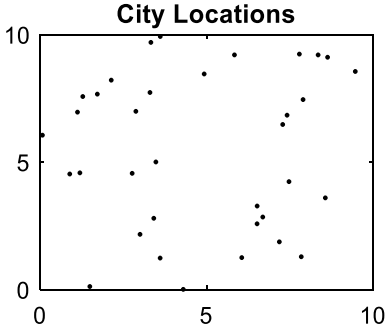

Fig. 8 City locations arrangement

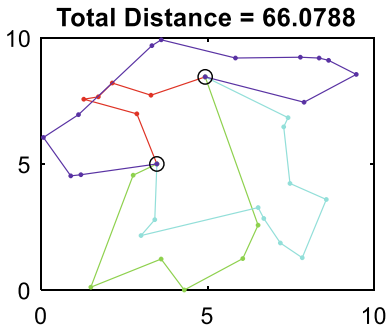

Fig. 9 Total distance value

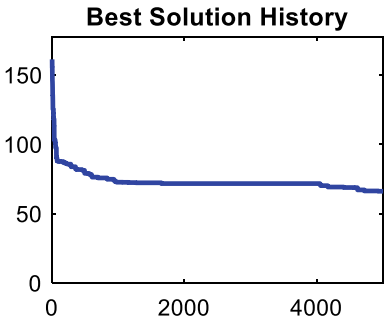

Fig. 10 Representation of best solution

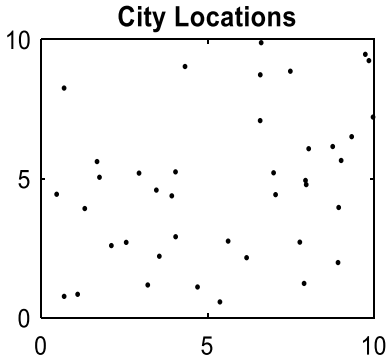

Fig. 11 City locations generated

Similarly, the routing for 30, 35, 40, 45 and 50 city locations are visualized in Figs. 6, 9, 12, 15 and 18 respectively.

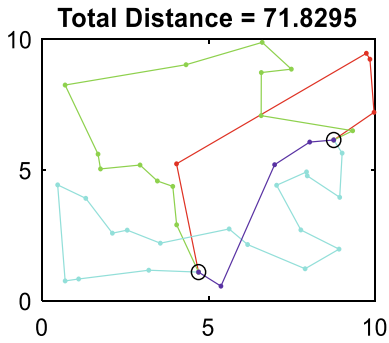

Fig. 12 Routes and total distance

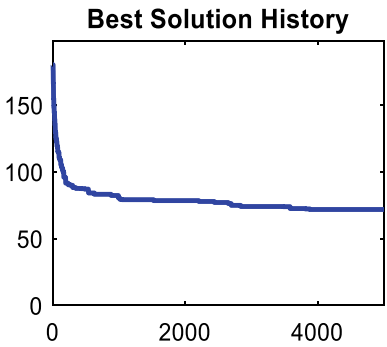

Fig. 13 Best solution graph

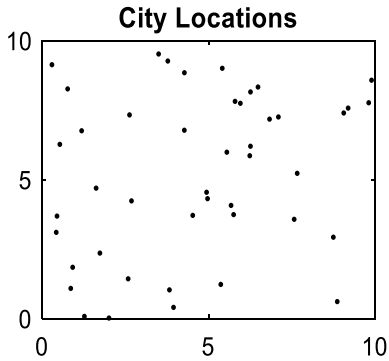

Fig. 14 Obtained city locations

And also, the best solutions for concerned city locations are observed in Figs. 7, 10, 13, 16, 19. These best solutions for number of cities are tabulated in Table 1.

- It is observed from that Table 1 that the best solution is independent and number of city locations as the process implemented completely depends on iterative nature of algorithm.

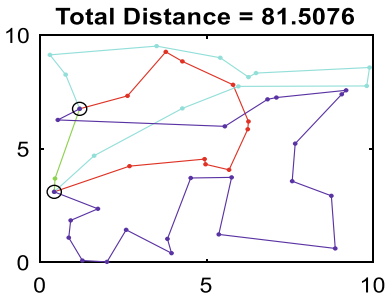

Fig. 15 Total Distance measured

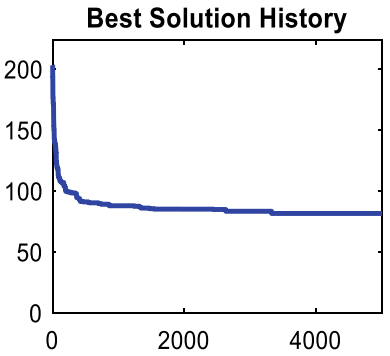

Fig. 16 Best solution

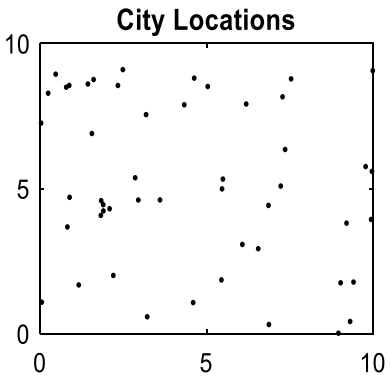

Fig. 17 City locations

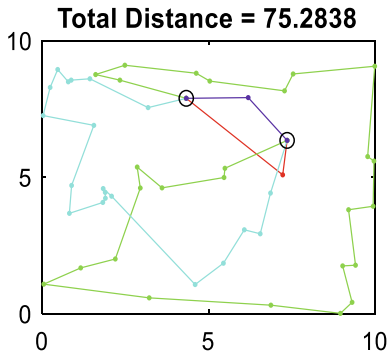

Fig. 18 Total distance attained

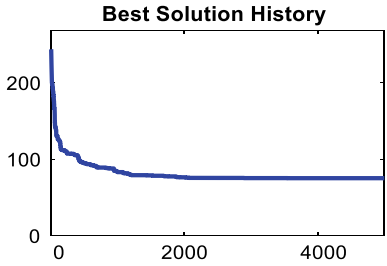

Fig. 19 Best solution value

Table 1 Best solution measure

No of cities	Best solution in distance
25	61.1674
30	74.2139
35	66.0788
40	71.8295
45	81.5076
50	75.2838

6 Conclusion

A promising approach to solving the TSP is the application of information from heuristic approaches and genetic algorithms.

Genetic algorithms seem to find good solutions to the problem of the traveling salesman, but it depends heavily on how the problem is encoded and which methods are used for crossover and mutation. A variety of genetic algorithm methods for solving TSP have been analyzed and surveyed. The research work may be expanded to include multiple operators. The suggested solution can be extended to different models such as vehicle protocols, logistics network, mission scheduling models etc.

References

1. ChetanChudasama SMS, Panchal M (2011) Comparison of parents selection methods of genetic algorithm for TSP. In: International conference on computer communication and networks (CSI- OMNET)
2. Dwivedi TC, Saxena S, Agrawal P (2012) Travelling salesman problem using genetic algorithm. Int J Comput Appl (IJCA), 25–30
3. Naveen Kumar K, Kumar R (2012) A genetic algorithm approach to study travelling salesman problem. J Glob Res Comput Sci 3(3)
4. Philip A, Taofiki AA, Kehinde O (2011) A genetic algorithm for solving travelling salesman problem. Int J Adv Comput Sci Appl 2(1)
5. Brezina Jr I, Cickova Z (2011) Solving the travelling salesman problem using the ant colony optimization. Manag Inf Syst 6(4)
6. Al-Dulaimi BF, Ali HA (2008) Enhanced traveling salesman problem solving by genetic algorithm technique (TSPGA). World Academy of Science, Engineering and Technology, vol 14
7. Yang R (1997) Solving large travelling salesman problems with small populations. IEEE
8. Moon C, Kim J, Choi G, Seo Y (2002) An efficient genetic algorithm for the traveling salesman problem with precedence constraints. Eur J Oper Res 140:606–617. Accepted 28 February 2001
9. Sankar Ray S, Bandyopadhyay S, Pal SK (2004) New operators of genetic algorithms for traveling salesman problem. IEEE
10. Snyder LV, Daskin MS (2006) A random-key genetic algorithm for the generalized traveling salesman problem. Eur J Oper Res 174:38–53
11. Karova M, Smarkov V, Penev S (2005) Genetic operators crossover and mutation in solving the TSP problem. In: International conference on computer systems and technologies - CompSysTech
12. Borovska P (2006) Solving the travelling salesman problem in parallel by genetic algorithm on multicomputer cluster. In: International conference on computer systems and technologies – CompSysTech
13. Ding C, Cheng Y, He M (2007) Two-level genetic algorithm for clustered traveling salesman problem with application in large-scale TSPs. Tsinghua Science and Technology 12 (4):459-465. ISSN 1007-0214 15/20
14. Shi XH, Liang YC, Lee HP, Lu C, Wang QX (2007) Particle swarm optimization-based algorithms for TSP and generalized TSP. Inf Process Lett 103:169–176

Big Data and Social Media Analytics-A Challenging Approach in Processing of Big Data

Mudassir Khan, Aadarsh Malviya, and Surya Kant Yadav

Abstract As the world is moving towards the new technologies, the enormous amount of growth in population constructing usage of social media in their everyday life, the social media statistics are scattered in various disciplines. The footprints of social media data analytics system growth into four different steps, data analysis, data formation, data discovery and data collection. The main objective of this article is to analyze the status and evaluation of social networks on big data. The challenges and difficulties faced during distinct data analysis methods, the distinct stages of research's data discovery, collection and preparation hardly exist. The challenge not only to conquer big data although in scrutiny and providing valuable data, which can be used for decision-making. In this article, we review the major challenges faced by researchers to process social media data. The outcomes are frequently used to enlarge an existing framework on social media. This article represents a comprehensive argue of the different studies linked with big data in social media.

Keywords Big data · Social media analytics · Social data · Big data analytics

1 Introduction

Social media analytics is still growing and the latest area of research. The fame of social media is to get or initiate and distribute public data at a very marginal cost. The enormous growth of social media users is generating a huge amount of data,

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_59

whatever it has been described as social media big data. The distinct social media platforms display much viability of data formats (e.g. text, audio, video, image, geo-locations, and animations/graphics). Mainly this data is branched into Unstructured and structured data. The enormous amount of social media data growth needed to store the data. The prosperity of social media manipulates, create advance and latest conveniences for analyzing distinct aspects and patterns in transmissions. For example, the analysis of social media data to achieve intuition into concerns, directions, significant actors and available data. Golder and Macy (2011) analyzed twitter data to investigate how people's attitude varies with available time in a day, weekday and months. With the occurrence and growing use of the internet, social media has become an essential factor in people's daily routines. Social media is not only recycled to interact with others but it has grown an adequate platform for businesses to influence their ambition audience.

With the evolution of big data, social media appearance has attained an altogether advance level. It is predicted that by 2020 the expanding volume of big data will overtake 44 trillion gigabytes. With such a huge amount of available data, marketers are adept to handle it to take actionable insights for covering effective social media marketing strategies.

In the different types of social networking platforms, users are generating an enormous amount of data. All the photos, status, videos, audios, locations and text data posted by users on their social networking platforms contain valuable information about their likes and dislikes. The different business organizations are using this information in numerous fashions, administering and analyzing it to gain a competitive point. The big data is worn by the marketers to forecast the future social media operation by planning everything about their valuable customers and reaching them. This manuscript will give light on the application of big data on social media marketing, auditing its current as well as future impact.

1.1 Integration of Big Data

Big data implement the integration that is allowing different brands to surround their audiences in an effective personalization manner placed on their choices and likes. The integration gives detailed insights and a comprehensive understanding of the audience. With big data, the advertisements used by different brands will become easier. The interesting consumers, turning ads into a non-pushy practice. The advertisement's brands will follow the targeted based on users' posts, what they share and watch, etc.

1.2 Decision Making of Big Data

Big data grants marketers to classify social media trends and achieve insights, which is used to cause the pact decision like which users to interact with, which effective group of users should gain marketing emails, etc. It is also believed that the track of the demographics is much easier and to finalize which social media platform to target.

The different businesses and organizations can easily accept the opinion of the market over big data, facilitate them to raise winning approaches. Rather than relying entirely on the previous performance to confirm which types of improvements are required, big data aids in building future decisions to excel in the future needs and expectations of the audiences.

1.3 Effectiveness of the Campaign

The big data is very effective in tracking the performance of social media networks and giving the best outcome of time to time changes in ROI. It also grants the marketers to examine them barnstorm before the project, first analyze the outcomes, make changes in the barnstorm as required by the consumers, and retest it. The different predictive analytical tools and techniques empower the businesses to hold decisions regarding when to interrupt the barnstorm to avoid heavy losses.

2 Related Work

To analyze big data on social media has been becoming demanding. The authors in described the methods used in analyzing Twitter data to disclose the feelings transition and paring it with developments because of the changing ability of Big data. Also, the related process of analyzing the available data used in US elections by using a computational approach to identify and excerpt the most leading people in the elections. They decorated the way to measure and analyze various sets of issues to observe the bias, general people, and calligraphy style resources by proving Support Vector Machines, which is now called a machine learning technique. In the latest inclusion, they interpreted the systems used in determining the transition of various sets of articles in different languages of various networks from hundred of countries by using machine translation technology united with other computational methods. As per many types of research to analyze the big data on social media is a challenging approach. The authors in [8] introduced various distribution techniques and algorithms that could be used for analyzing large-scale social media data like Latent Dirichlet Allocation, support vector machines and Naïve Bayes classifier. The proposal of an assignment for analyzing social media

data would be based on the available assignment, the tools can be enforced to implement integration in-between conditional qualitative analysis and the apprehension algorithms.

The Analytics of social media data is an advance foundation of powerful digital marketing. The analytics of social media, existing businesses are targeting social media audiences to have their business through the social media platform. They are targeting social media audiences through the need and requirements. They are publishing different types of attracting ads on social media. To obtain insights from different types of social media data, firs of all you'll have to establish a suitable method of social media data analysis or collection.

2.1 Big Data and Social Media

Businesses can grow on the existing requirements of their customers to the highest scope available. The increasing demands of people's online attitudes are therefore enhancing important for their chances to get success in their businesses. Organizations are lending in a contest such analytics applying big data as a pivotal role for auditing social media movement, especially on different social networking platforms websites such as Facebook, Twitter, LinkedIn. The social media analytics is the fusion of the attitude of internet end users. The opportunity of data on customers' web skimming, online shopping style, customers' assessments and marketing investigation on social networks concede organizations to achieve well-timed and vast on diverse objectives like promoting and product casts (Fig. 1).

2.2 Tools and Metrics

The possibility of new sources and operative data structures must force to the progressing of modern apparatus to produce key information and construct metrics around clarity of websites. It is achievable to collect metrics like different countries/

Fig. 1 Big data and social media platforms

cities where website visitants were bases, the web browsers used by the users, the keywords they had practiced questing for a website and the available webpages they had traveled ahead and after pervading a website.

2.3 Social Data

Simply social media is a huge amount of information generated by trillion users per day and that's collected from different social media platforms. It manifests how the users view, like, share and capture with the available existing content. E.g. Facebook, Social media data describes the number of likes, followers, following and a number of shares. In the same way, twitter represents the numbers of impressions and re-tweets. But on Instagram, the hashtag plays the main role and work on raw data provided by the customer or audiences (Fig. 2).

2.4 The Optimization of Social Content

The main target is to gain the highest level of arrangement possible, and the way of optimizing the social media content according to the audience's requirements. The collection of social media data required the most suitable platform based on the customer or audience's popularity. The necessity of the best platform is based on the customers are handing out online. The findings, users can create and enhance the data that have been reached at maximum.

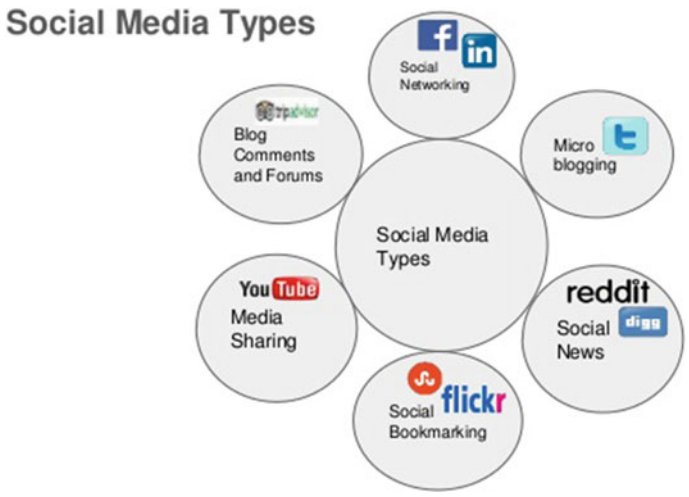

Fig. 2 Types of social media

2.5 Saturate Content Strategy

To identify how the customers are sharing and posting the data, we can design a content strategy that can give clear answers to the questions and remedy created by the audiences. The strategy design will be recent and applicable to the user's requirements and needs. To enhance the power of customer's needs, we have to make a report on the authenticity of the content. In this way the influence factor in their decision to follow the identification of outcome if your strategy is properly working.

2.6 Enhanced SEO Strategy

The SEO strategy can't be successful without the integration of social media data. Rather than targeting the general keywords. The user can start with focusing on the desired keyword that is the demand of customers. Sometimes the audience or customer searches the data throughout their social networks. The social networks are engaged with search engine platforms like Google, Bing, and Yahoo. As per the survey the Face book alone handled one trillion queries in a single day in 2018 end and the beginning of 2019. According to a survey Twitter fielded 10 trillion searches in a single month in 2018. The enormous amount of growth of customers throughout the different social media networks is generating a huge amount of data. The huge amount of generated data analysis and storage can't be preceded by the existing traditional system. For this, we need Big Data to process, analyze and storage. We can analyze the data generated by different platforms by using the different tools of Big Data.

2.7 Social Media Strategies and Big Data

Big data is gaining popularity to produce marketing analytics soon fore-cast and realize the existing planned strategies. Predictive analysis achieving reputation along the operators and big data has an emergence aspect to show in it. The marketers can't predict the customer's behavior, but they can also utilize the results from their data investigation in different other ambiguous marketing approaches, such as split testing, the exact analysis, and approval of big data will confirm that the planning will swing the object and produces a compelling rise to ROI.

2.8 How to Create a Social Media Strategy with Big Data

The enormous amount of unstructured data generated from social media would be pertinent with the structured data formerly available, such as customer information, to determine planned insights with big data. From there, we can generate a social media blueprints based on the observations achieved. If we have the strategy in hand that girds the key aspects to emphasize consumer-directed outcomes. With the plan is equipped in hand palm, the time is indicating to create the content. The content is vital to complete the achieved system; hence it is very important to settle the time in outlining the indulge.

At last, the time is indicating to execute them. Equipped along with the appropriate content form the analysis, it's now to investigate the validity of the analysis and approach in current the timely frame.

Big data plays a major advance aspect in the healing and advancement of social media marketing to the maximum of all marketing methods. The different types of marketing an organization may utilize, big data is acting a compelling part in the whole of it.

3 Big Data Analytics on Social Media

The digitization of the world today displays us win an issue we have not to deal with before. Every and each small appliance in our house is either available or directly to be interconnected to the Internet of Things (IoT) and that steps it is capable to analyze and aggregate the data. The introduction of possessed data grants businesses to enhance the understanding of observable and getting figures of the customers, but big data goes alike out of range. It is capable to suggest analyst deal with world-wide concerns, and it is contributing marketers with data required for appropriate choice making. Earlier, it was not strictly the case with social media. In fact, that the big data availability on social media platforms and the advancement of the social media advertising arena can benefit us to worth understanding and how Artificial Intelligent smart technology efficacy shift our daily lives soon.

4 The Concept of Big Data as Presented Through Social Media

The best example of how big data presently outlines our life is social media analytics. The information is provided by the trillion of users that is actuality analyzed in social networking platforms to let on marketers to have a good understanding of consumer's choices, targeted user groups and pact. In a very simple way, the two available sides of the coin that is big data on social media, within the digital marketing world, are microtargeting and brand analytics.

4.1 Big Data as Social Media Analytics

As we have discussed that if the coin tossed in the air, we can't predict which side is going to show off the coin. Same as the side of the imaginable coin the big data on social media is imaginable even more critical for businesses. As the use of social media is growing, almost all the companies are demanding to receive a portion of social media workable. Constructing the profiles on multiple social media networking platforms in concern to gain the popularity of the brand that is grouped well and better.

To access diverse metrics, such as likes, post opinion and much more, grants a business to have improved cooperation between their customer support and their content. The big data analytics tools for social media can respond in a way to see the most functional metrics of brand achievement. For example, the stakeholder's popularity chart will produce the number of current likes/follows on different social media profiles (Fig. 3).

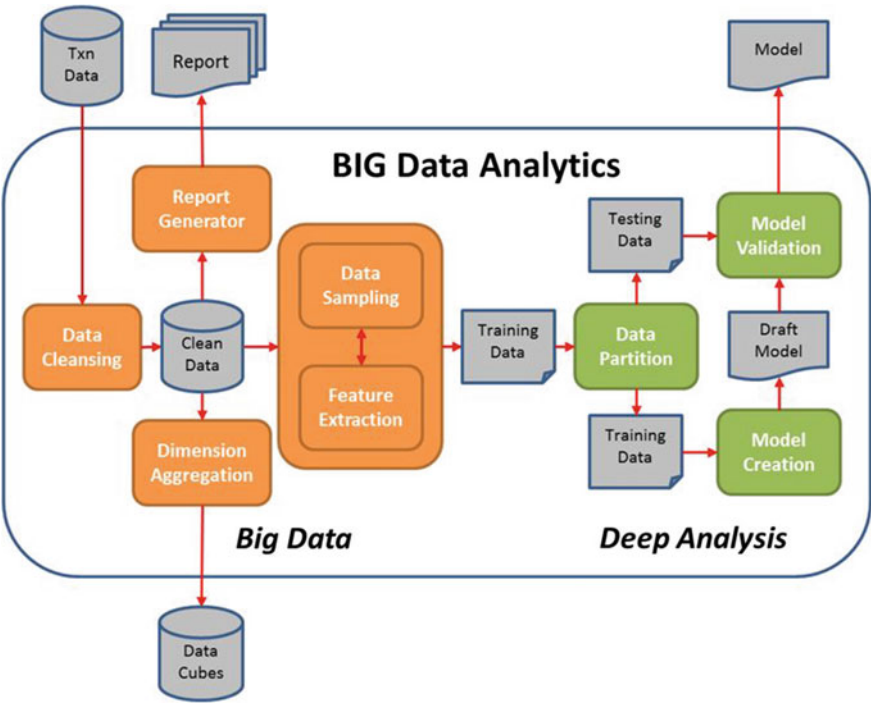

Fig. 3 Big data analytics

4.2 Big Data in Different Industries

Social media analytics is the advance and the most suitable example of how big data is transforming our day to day life. Today's principle is that big data is a basic mechanism for almost all conditions of our lives. As we know that big data is not used by a convinced industry, it wouldn't be a doubtful thought that in the near future it might be. With the growing rise of the latest technologies that power of artificial intelligence at homes and with different appliances to collect information becoming shorter in size and more effective.

4.3 Social Media Monitoring

The different organizations are capable to be in current contact with their valuable client's over social media platforms like Facebook, Twitter, Flickr, LinkedIn, YouTube and many more. The organizations can directly communicate with their employees and other collaborators by using tools like Yammer, a private social networking framework that provides collusion over all the divisions, sections and running business operations. The systems can directly audit the announcements and disclose who is the main patron are in online gossip with them. They can reach out to the results of their operations and monitor potential obstacles. The existing businesses can get interested from sensing the interconnections among their online customers.

The handling of a few of the observing tools which attempt to provide basic metrics is free. However, different types of services that can provide employment can be very costly. To execute an important business with a strategic plan and their requirements are from online monitoring tools. As we know that. It is not a simple work, because social media is the latest and fast-growing field. In the inclusion of different assistance providers in this space is gaining popularity and it may be ambitious to find a stable provider. The tracking of a few tools might be necessary before choosing the most convenient outcome. According to the survey, all tools would accomplish the demands of every organization. The reports generated by the different tools should be easy to analyze and worth the cost.

4.4 Tools for Social Media Monitoring

The existing few suitable tools to follow social media are Yomego, Ubervu, Hootsuite, and Vocus. The alternative available tools that social media stakeholders may get appropriate are given in Table 1. Table 1 includes many web analytics reporting tools that can be used for generating insights from users' own webs. The data is optically presented using tables and graphs that can be tailored through the indicator panel.

Table 1 Web analytics tools

S. No	Service	Description
1	Google Analytics	Google Analytics is the most widely used website metrics work. It produces precise metrics about website influx
2	AWStats	An open-source web analytics reporting tool where all the users are motivated to commit its progress
3	WebSTAT	Its peculiar trait is the part of visitor's behavior once on the web

Still, this type of information may not be exactly authentic; it can be highly effective to get an overall report of market research.

5 The Present and Future of Big Data

Big data is developing our world and growing fast. There is no contradict in this experience. The way we shop, what we eat, the way we interact, how we are supervised, how we conscious are all concerned using Big Data. However, it should be kept in mind that data using in routine life is not the latest approach. Hundred years ago, civilizations construct their calendars by concluding global operations based on data recorded previously. Recently the improvements in digital and telecommunication technologies have the force to an enormous amount of data available. The entire world has never been so interconnected. Every person who browse the internet, the telephone, or the use of credit cards drop a trail of data which can be governed by different organizations to anticipate their behavior and adapt accordingly.

6 Conclusion

The Big Data as of now is constructing our future. There is an everlasting growth in the number of people connecting with brands on social media platforms. This interacting growth makes it essential for users to be information keen to persist competitively and follow the relevant social media landscape. As we can see the trillion gigabytes of data produced by these social platforms, it has become decisive that we fabricate the handling of big data in the social media marketing barnstorm. Big data will grant us to analyze the behavior of customers and target an exact group of existing people. The insights of the manuscript are to assists the users in fine-tuning social media messages and determine the best platform to communicate with buyers. The more accurate information received about the customers, this way we will be capable to target them the social media campaigns.

References

1. Tan W, Brian Blake M, Saleh I, Dustdar S (2013) IEEE Computer Society 13:1089–7801
2. The Data Deluge (2010) Businesses, Governments, and Society Are Only Starting to Tap Its Vast Potential, The Economist
3. Mislove A et al (2007) Proceedings 7th ACM SIGCOMM conference internet measurement. ACM, pp 29–42
4. Müller O, Junglas I, vom Brocke J, Debortol S (2017) Eur J Inf Syst 25(4): 289–302 (2017)
5. Al-Hajjar D, Jaafar N, Al-Jadaan M, Alnutaifi R (2015) Advances in intelligent systems and computing 312. https://doi.org/10.1007/978-3-319-10518-5_23
6. Chaudhuri S, Dayal U, Narasayya V (2011) Comm. ACM 54(8):88–98
7. Khan M (2018) Big data analytics evaluation. Int J Eng Res Comput Sci Eng (IJERCSE) 1(2)
8. Bradbury D (2013) Effective social media analytics. The Guardian. http://www.theguardian.com/technology/2013/jun/10/effective-social-media-analytics
9. Raconteur Media (Ed) (2013) Big data. The Times [supplemental material]
10. Lohr S (2012) The age of big data. The New York Times. http://www.nytimes.com/2012/02/12/sunday-review/big-datas-impact-in-theworld.html?pagewanted=all&_r=0
11. Kalil T (2012) Big data is a big deal. http://www.whitehouse.gov/blog/2012/03/29/big-data-big-deal
12. Gold MK (2012) Debates in the digital humanities. University of Minessota Press (2012)
13. Deters R, Lomotey RK (2014) Int J Bus Process Integr Manag 6:298–311
14. Mayer-Schönberger V, Cukier K (2013) Eamondolan/Houghton Mifflin Harcourt, New York (2013)
15. Robinson D (2013) Part 1. Making data meaningful
16. Khan M, Ansari MD (2019) Security and privacy issue of big data over the cloud computing: a comprehensive analysis. IJRTE-Scopus Indexed 7(6s):413–417
17. Gautam P, Ansari MD, Sharma SK (2019) Enhanced security for electronic health care information using obfuscation and RSA algorithm in cloud computing. Int J Inf Secur Priv (IJISP) 13(1):59–69
18. Khan M, Ayyoob M (2017) Computer security in the human life. Int J Comput Sci Eng (IJCSE) 6(1):35–42
19. Khan M, Malviya A (2020) Big data approach for sentiment analysis of twitter data using Hadoop framework and deep learning, In: 2020 International Conference on Emerging Trends in Information Technology and Engineering (ic-ETITE), Vellore, India, pp 1–5. https://doi.org/10.1109/ic-ETITE47903.2020.201

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Open Switch Fault Diagnosis of Switching Devices in Three Phase VSI

N. D. Thombare

Abstract Condition-based maintenance of complicated electrical apparatus is a measure issue in the automation industry. Condition-based maintenance includes fault detection, diagnosis, and prognosis of the system. Different techniques are used for fault diagnosis including knowledge-based fault diagnosis, model-based fault diagnosis and pattern recognition based fault diagnosis. This paper presents an open switch fault diagnosis of a three-phase voltage source inverter used to drive the induction motor. The three-phase real-time current is sensed without using an additional sensor and transformed to the d-q plane. The different patterns are observed for the healthy and faulty condition of switching devices. The patterns are observed to diagnose a faulty switch. The real-time results are presented to validate the proposed method. This method is effective and robust.

Keywords Condition based maintenance · Open switch fault · D-q plane · Slop of pattern

1 Introduction

Condition-based maintenance (CBM) is a maintenance approach to monitor the real situation of a system to decide what repair requires to be done. CBM states that repair should only be done when definite indicators confirm symptoms of diminishing performance or future breakdown [1]. Different types of CBM are used in industrial applications like Oil Examination, Infrared, Electrical, Operational, Performance, Ultrasonic, Acoustic and Vibration analysis [2]. The different contact techniques are zero series current spectrum measurement, non-identical time resampling of current, motor current spectrum investigation, vibration measure-

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_60

ment, etc. Non-contact methods are infrared thermography, stray flux measurement, acoustic emission measurement, temperature measurement, etc. [3].

Rising significance has been noticed in CBM methods for electrical apparatus, together with transformer, generator, and ***the induction motor (IM)*** in power plants, as CBM, has the prospective to decrease working costs, improve the consistency of function, and develop power supply and tune to clients [4].

Literature is collected on rising bright CBM systems with superior achievability, compassion, consistency, and computerization. A literature survey is experienced essential through a plan to reproduce modern progress in this significant area [5].

At present ***Voltage Source Inverter's (VSI's)*** are used in a location and speed-controlled drives. Accordingly, the continually raising requirements in process control, the supplies for modern drive schemes enhance too. Superior control of electrical and mechanical capacities has to be made, for example, high accuracy current and voltage control joined with input power factor modification - speed and position control with torque ripple minimization, correspondingly [6].

Though present drive schemes comprise a lot of qualities and its configuration acquires increasingly complex. Extra components, for this reason, for price reason, usually not are introduced keen on the drive system. These components are very susceptible to faults [7]. Different faults can occurs in ACIM, 38% faults in ACIM are caused due to failure of power devices, electroctrolytic capacitors, and other electronic components. The catastrophic breakdowns in power transistors can be classified as open circuit and short circuit faults as shown in Fig. 1.

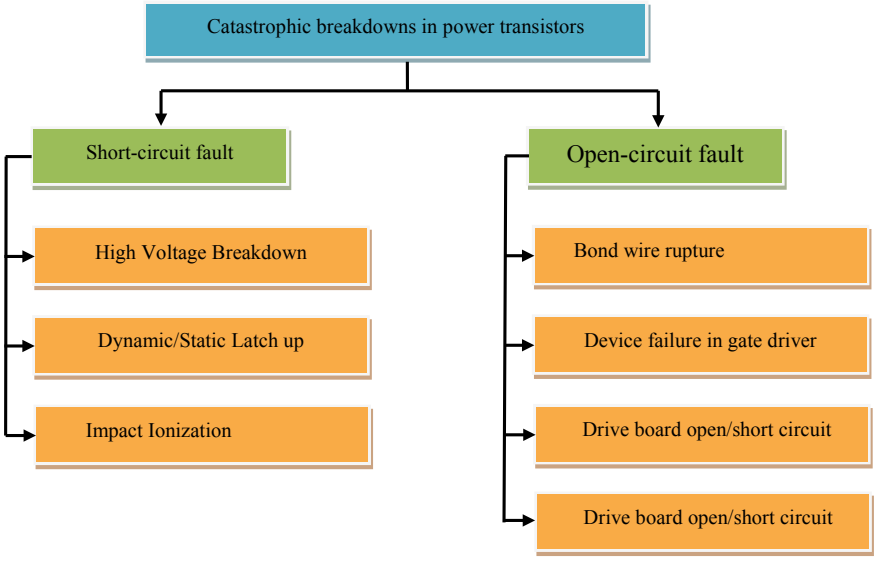

Fig. 1 Catastrophic failures in power transistor

The ***Open Circuit Fault (OCF)*** diagnosis of switching devices in three phases VSI is a significant area for researchers. In the current years, a large amount of effort has been taken on the study and classification of faults in drive systems [8].

Diagnosis of single switch OCF is validated using the current trajectory of phase currents which is implemented on a three-phase two-level VSI [9].

The results show good efficiency under variable load conditions with the lowest computational and implementation effort. The three-phase current is converted into two-phase which shows different patterns. The three-phase currents are just sinusoidal and the pattern will be circular in a healthy condition. When a fault takes place the unique pattern for every switch will be observed which helps to diagnose the faulty switches. An OCF in the switching devices of a grid-connected neutral-point-clamped inverter for photovoltaic applications is proposed by using combined model-based and data processing perspective. The combination is used to avoid ambiguity in the model-based technique by utilizing the average line currents to build additional fault signatures. This method requires only line currents and grid voltages to isolate single and double switch faults in lower than a fundamental period of the frequency [10].

A current observer-based online OCF diagnosis technique for the VSI is proposed by calculating the vector angle which is based on the estimated currents from Luenberger observer as well as the real currents [11].

The rate of the on-line OCF diagnosis technique can be attained as quick as 4% as well as slow as 16.7% of one current fundamental period with low errors. This method improved reliability and robustness with less missed or false alarms.

OCF diagnosis of four types of switching devices in ***Pulse Width Modulation (PWM)*** rectifier without using additional sensors is proposed in [12]. Real-time simulations are carried out to validate the effectiveness of this method.

An OCF of ***Insulated Gate Bipolar Transistors (IGBTs)*** in a four-quadrant PWM rectifier has been proposed in [13]. The ***switching system model (SSM)*** of the rectifier was created to construct four-fault current observers. The residual vector was generated by subtracting the real-time current sensed without using additional sensors from the observed current. The residual vector was compared with threshold values to identify the OCF.

Researchers mentioned different researches, primarily covering rule-based, model-based and case-based approaches, and applications. Increasing costs, shorter product lifecycles and rapid changes in technology are driving the need for automated diagnosis. So the selection of proper systems particularly cost-sensitive is important. The main contribution of this paper is to improve the accuracy of open-circuit fault diagnosis.

2 Methdology

The structures of three phases VSI with switching devices T1 to T6 and their associated switches to introduce faults are S1 to S6 respectively, and shown in Fig. 2. IGBTs are utilized as the switching device for VSI and it is rugged. All parameters play a severe role in enhancing the consistency of ***Induction Motor (IM)*** drive. The switching sequence of IGBT is shown in Table 1. IGBT failures are categorized as [14]:

- *Short-circuit fault (SCF),*
- *Intermittent gate-misfiring faults (IGMS),*
- *Open-circuit fault.*

The VSIs are considered as SCF protected and no need to work on this fault. The effect of IGMS on effective working of VSI will not affect but repeated occurring of this fault will result in OCF. The effect of OCF when T4 is fault is shown in Table 2.

If VSI is working in healthy conditions then the output will be pure sin wave which is represented by Eq. 1.

$$i_l = \begin{cases} i_r = I_m \sin(\omega_s t + \phi) \\ i_y = I_m \sin\left(\omega_s t - \frac{2\Pi}{3} + \phi\right) \\ i_b = I_m \sin\left(\omega_s t + \frac{2\Pi}{3} + \phi\right) \end{cases} \quad (1)$$

where i_l is load current with three phases current i_r, i_y and i_b. ω_s is angular frequency and ϕ phase shift. The three phases waveform under healthy and different faulty conditions are shown in Fig. 3.

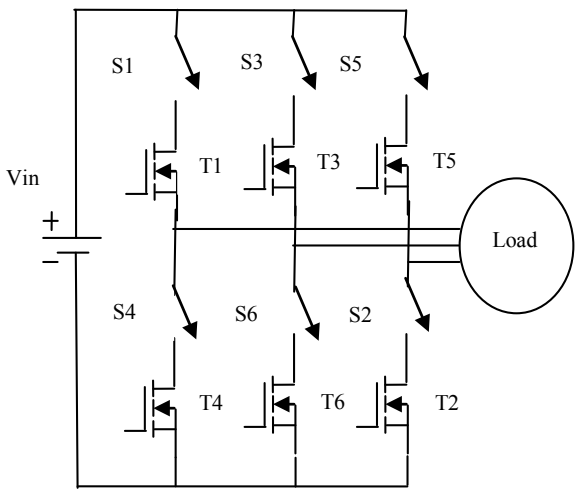

Fig. 2 Three phase PWM based VSI

Table 1. Switching operation for healthy condition

State	T1	T2	T3	T4	T5	T6
1	1	0	0	0	1	1
2	1	1	0	0	0	1
3	1	1	1	0	0	0
4	0	1	1	1	0	0
5	0	0	1	1	1	0
6	0	0	0	1	1	1

Table 2. Switching operation for faulty condition (switch T4 is permanently open)

State	T1	T2	T3	T4	T5	T6
1	1	0	0	0	1	1
2	1	1	0	0	0	1
3	1	1	1	0	0	0
4	0	1	1	0	0	0
5	0	0	1	0	1	0
6	0	0	0	0	1	1

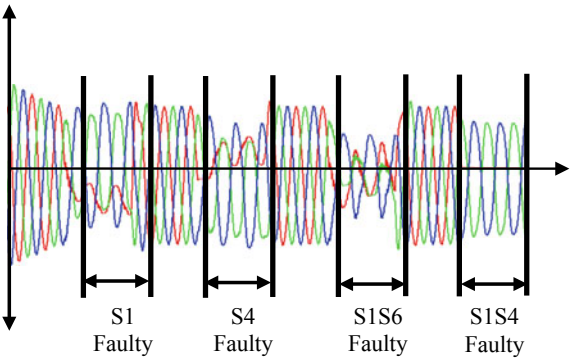

Fig. 3 Current waveforms during healthy and faulty conditions

The current waveforms are shown for IGBT S1, S4, S1S6 and S1S4 OCF. It is observed that if fault is occurred in upper IGBT of phase like IGBTs T1, T3 and T5 then the negative bias will be added in that particular phase current.

Let us consider, T1 is faulty which belongs to the upper part of R-phase, and then negative bias will be added in the same phase which is observed in Fig. 2. Similarly, if a fault has occurred in the upper IGBT of phases like IGBTs T2, T4 and T6 then the positive bias will be added in that particular phase current. T4 is

faulty which belongs to the lower part of R-phase, and then positive bias will be added in the same phase which is also clearly observed in Fig. 2.

For the proposed ***OCF Diagnosis System (OCFDS)***, the three-phase currents are converted into two phases d-q plane using ***Park's Vector Transform (PVT)*** using Eq. 2 [15]. The pattern is plotted for healthy and faulty conditions to diagnose a fault on the d-q plane.

$$i_d = \sqrt{\frac{2}{3}} i_r - \frac{1}{\sqrt{6}} i_y - \frac{1}{\sqrt{6}} i_b \tag{2}$$

$$i_q = \frac{1}{\sqrt{2}} (i_y - i_b) \tag{3}$$

3 Results and Discussion

The OCFDS is implemented on three phases VSI. The specifications of VSI are given in Table 3 and the experimental setup is shown in Fig. 4.

The PVT performed on three-phase load currents on IM drive outcomes in a pattern, which possibly will show circular or elliptical shapes, along with others. A healthy status of VSI without OCF is specified by a circle. The size of this circle depends on the operating condition of VSI like load and frequency. Larger circle for higher load condition and vice- versa. The healthy condition of IGBTs is shown in Fig. 5a. A fault in IGBTs is diagnosed by a deformation in the circular pattern. For diagnosis of the assortment of faults, it has attempted to increase modified transforms to make simpler the investigation still further. The VSI that supplies the IM also has deformation patterns similar to types of fault conflicts inside the device.

Table 3. Specifications of VSI model

Specification	Description	Value
Vdc	Input DC Voltage	800 V
C	DC Link Electrolytic Capacitor	5000 μF
L	Load Inductance	10 mH
R_L	Load Resistor	0.20 Ω
V_{out}	Output AC Voltage	230 Vp
I_{out}	Output current	5.0630 Amperes
F	Output Frequency	50 Hz
P_L	Load Power (Variable)	5 kW–50 kW

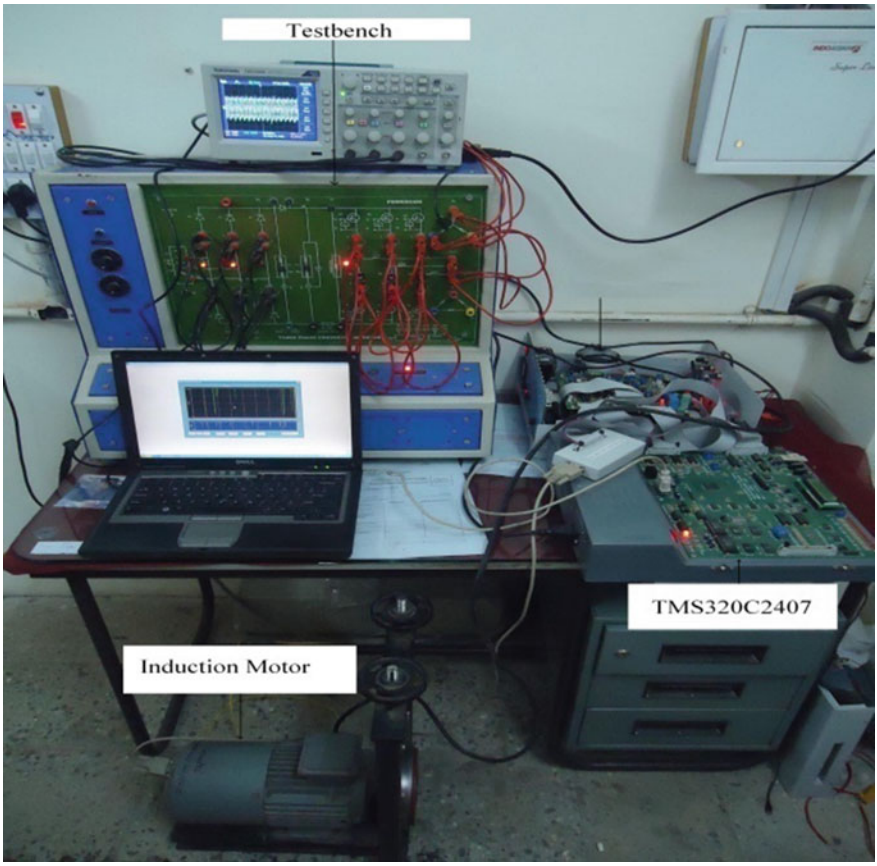

Fig. 4 Experimental setup

The main variation is the lack of regular circular shape as would be in the IM shown in Fig. 5b. The patterns for an OCF concerning a particular switch for T1 to T6 of VSI are shown in Fig. 5. By shortening the observed patterns of the PVT using what is called a d-q transform computation explained in an earlier section, real-time OCF diagnosis of real location and category of fault is feasible.

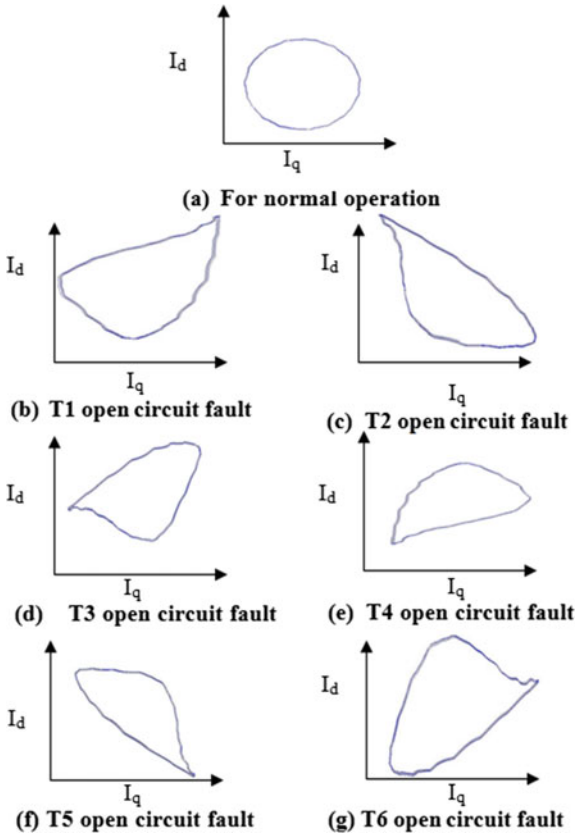

Fig. 5 Current patterns for healthy and faulty conditions

4 Conclusion

This paper has observed the recommended theory of open-circuit fault diagnosis in a three-phase voltage source inverter. The proposed technique of fault diagnosis is depending on the original idea of a Park's Vector Transform. It has been observed that the common faults taking place in a three-phase voltage source inverter initiate with the weakening of the balanced operation of the induction motor. In the course of wide simulation and experimentation, it has been verified that the perfect d-q pattern for a healthy three-phase voltage source inverter is a circle of perimeter-based upon the operating load condition. The patterns for an Open Circuit Fault concerning a particular switch for T1 to T6 of VSI. By shortening the observed patterns of the PVT using what is called a d-q transform computation, real-time Open Circuit Fault diagnosis of real-location and category of fault is feasible.

References

1. Jardine AKS, Lin D, Banjevic D (2006) A review on machinery diagnostics and prognostics implementing condition-based maintenance. Mech Syst Sign Process 20(7):1483–1510
2. Dhumale RB (2016) Condition monitoring of renewable energy resources. J Emerg Technol Innov Res 6(5): 563–567
3. Yan R, Gao R (2006) Hilbert–Huang transform-based vibration signal analysis for machine health monitoring. IEEE Trans Instrum Meas 55(6):2320–2329
4. Chen X, Liu J, Deng Z, Song S, Ouyang S (2019) IGBT open-circuit fault diagnosis for modular multilevel converter with reduced-number of voltage sensor measuring technique. In: 2019 IEEE 10th international symposium on power electronics for distributed generation systems (PEDG), 22 August 2019, pp 1–6
5. Hua K, Liua Z, Iannuzzob F, Blaabjergb F (2018) Simple and effective open switch fault diagnosis of single-phase PWM rectifier. Microelectron Reliab 25:1–5
6. Dhumale RB, Lokhande SD (2016) Neural network fault diagnosis of voltage source inverter under variable load conditions at different frequencies. Measurement 91:565–575
7. el khil SK, Jlassi I, Marques Cardoso AJ, Estima J, Bellaaj NM (2019) Diagnosis of open-switch and current sensor faults in PMSM drives through stator current analysis. IEEE Trans Ind Appl (Early Access), 23 July 2019
8. Dhumale RB, Lokhande SD (2016) Diagnosis of multiple open switch faults in three phase voltage source inverter. Journal of Intelligent and Fuzzy Systems 30(4):2055–2065
9. Dhumale RB, Lokhande SD (2017) Comparative study of fault diagnostic methods in voltage source inverter fed three phase induction motor drive. IOP Conf. Series: Materials Science and Engineering 197:1–14
10. Dhumale RB, Thombare ND, Lokhande SD: Modeling and diagnosis of open switch fault in three phase VSI. In: Proceedings of IEEE international conference on recent trends in electronics information communication technology (RTEICT), Shri Venkateshwara College of Engineering, Bengaluru, pp. 1901–1910, 19–20 May 2017
11. Wang X, Wang Z, Xu Z, He J, Zhao W Diagnosis and tolerance of common electrical faults in T-type three-level inverters fed dual three-phase PMSM Drives. IEEE Trans Power Electron (Early Access)
12. Yang S, Sun X, Ma M: Fault detection and identification scheme for dual-inverter fed OEWIM drive. IEEE Trans Power Electron (Early Access)
13. Ye S, Jiang J, Li J, Liu Y, Zhou Z, Liu C: Fault diagnosis and tolerance control of five-level nested NPP converter using wavelet packet and LSTM. IEEE Trans Power Electron (Early Access)
14. Bin L, Sharma SK (2009) Sharma: A literature review of IGBT fault diagnostic and protection methods for power inverters. IEEE Tran Ind App. 45(5):1770–1777
15. Ubale MR, Dhumale RB, Lokhande SD (2014) Method of open switch fault detection in three phase inverter using artificial neural network. Int J Res Sci Adv Technol 3(3):78–82

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Analysis of Dynamic Scheduling Algorithm for Reconfigurable Architecture

Pushpa M. Bangare and M. B. Mali

Abstract A dynamic scheduling algorithm is proposed to organize the upcoming task to be executed by the newly described architecture. To exhibit the concept, two tasks are considered as the third-party tasks and the third task is deemed to be routine activity task. These tasks are operated in concurrent mode and priority driven mode using proposed dynamic scheduler. The proposed dynamic scheduler is conceptualized and implemented using concurrent architecture and the system is critically analyzed with respect to the possible traits of the applications. For cogent analysis, the system is time simulated using Modelsim and subsequently it is synthesized to juxtapose the outcomings and to pick up the best performing device with respect to the application need. Finally, the tightly optimized version of the proposed system is introduced at different integrating scale. Towards the end of the system, the task completion time and task switching time are computed and compared with the other previously reported data base.

Keywords Dynamic scheduler · Task completion time · Task switching time · GPP · CPD

1 Introduction

In the present scenario, considering different traits of the applications, the Reconfigurable Computer Architecture (RCA) is becoming more popular due to their peculiarities. In RCA, the supporting hardware architecture is configured each time, to fulfill the application demand. At physical implementation, the General Purpose Processor (GPP) is used as the central processing element. Along with

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_61

GPP, Co-Processing Devices (CPD), having ability to change the internal architecture, are connected. GPP executes the instructions in queue and whenever additional resources are required, GPP initiates the necessary steps to configure the co-processing device. This co-processing device can be reconfigured number of time as and when required. The minimum amount of time, the co-processing device can be reconfigured is called as endurance cycle. Xilinx devices can be reconfigured for minimum up to 20,000 times.

The reconfigurable CPDs are different from the fixed co-processor devices. In fixed co-processor devices, the internal architecture is fixed like floating point co-processor and graphic processor, while in case of the reconfigurable CPDs, the internal hardware can be changed. If the internal architecture is changed after making the rest of the computing process idle, then it is called as static reconfiguration while if the reconfiguration is done in run time, it is called as dynamic reconfiguration.

2 Related Work

A hybrid task scheduler is implemented for reconfigurable architecture [1]. To execute hybrid architecture, the incoming tasks are bifurcated according to their features and are then scheduled to be executed by general purpose processor and reconfigurable processor. A coarse-grained architecture is implemented using multiple functional units [2]. The reconfigurable tasks are efficiently mapped on the functional unit to increase the highest IPC. Dynamic scheduling for run time reconfigurable architecture was proposed in [3]. The proposed system is designed considering discrete event systems, multi-context scheduling and partitioning for reconfiguration. The greedy algorithm was proposed to be implemented for effective partitioning so that the partitions can be properly configured dynamically further used in parallel reconfigurable computing in [4] as shown in Fig. 1.

The novel mapping methodology was proposed for heterogeneous reconfigurable architecture. The proposed scheme is best suitable for the environment in which multiple GPPs and multiple reconfigurable processors are working together [5]. In this implementation, the separate track is maintained for FPGAs be level

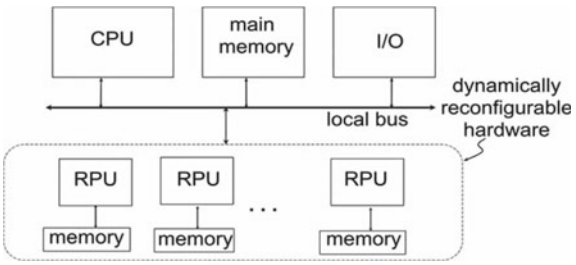

Fig. 1 Parallel reconfiguration computing

based and clustering based temporal partitioning and scheduling of tasks for GPPs using simple list based schedular and complex extended dynamic level scheduling.

A method of system architecture synthesis was proposed in for high performance reconfigurable applications on FPGAs [6]. A methodology was proposed into address the issues in context scheduling in multi-context reconfigurable architectures in order to optimize the context loading overhead [7]. Novel HW/SW scheduling algorithm was proposed for 3D reconfigurable system on chip platform for multiprocessor layer and heterogeneous reconfigurable layer. [8]. The proposed algorithm intelligently computes if the task is to be executed using SW resources or HW resources and accordingly region of the HW, in order to optimize the total execution time of the application as shown in Fig. 2.

A scheduling algorithm is designed in which the algorithm concurrently handles multiple tasks and optimizes the resource usage overcoming multitasking issues for reconfigurable coprocessors in random application context [9]. The authors have proposed an algorithm for addressing the issues in static scheduling technique by proposing dynamic scheduling hardware architecture with four distinct scheduling algorithms [10]. A solution to optimum utilization of flexible reconfigurable SCO area is proposed through [11]. To attain this, a dynamic task scheduling algorithm was proposed to online schedule the task onto reconfigurable SOC. Figure 3 below unfolds the internal block arrangement for dynamically reconfigurable system on chip architecture.

The total execution time is significantly optimized by incorporating hardware task library, essentially comprising of multiple architectural variants for each hardware task. A genetic algorithm-based mapping approach was developed which ponder the number of tasks and target platform [12]. Whereas the authors in have implemented cryptographic algorithms like DES, LOKI, DESX and other algorithms on a reconfigurable architecture [13]. The authors have used a branch and bound search method with a non-deterministic heuristic to find quasi optimal solution to the allocation problem [14]. To optimize the system performance, for satisfying constraints of application parts executed on the reconfigurable architecture, a temporal partitioning algorithm was proposed for a coarse-grained reconfigurable architecture [15]. The authors attempted to improve the performance of the hardware task configured in reconfigurable architecture by minimizing

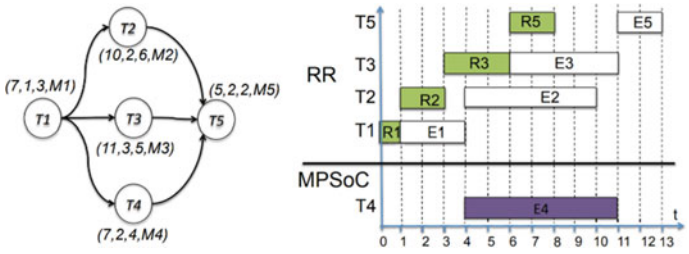

Fig. 2 Dynamic scheduling for 3D SOC

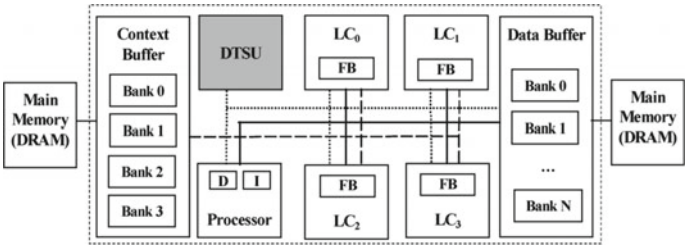

Fig. 3 Dynamically reconfigurable system on chip architecture

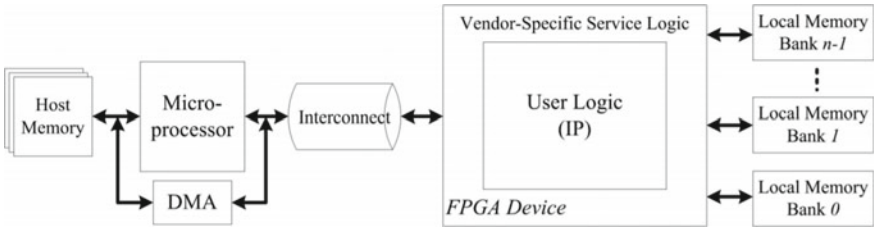

Fig. 4 General architecture of high-performance RC

communication overhead and configuration overhead, introduced by FPGA devices [16]. Subsequent Fig. 3 indicates the general architecture of high-performance reconfigurable computer (Fig. 4).

A distinct program graph structuring algorithm for dynamically reconfigurable multi-processor system using dynamic connection reconfiguration is disclosed in [17]. Using multicast configuration technique RoMultiC, multicasting the reconfiguration data packet to the multiple processing elements, data compression technique for coarse-grained reconfiguration architecture was proposed [18].

An application for temporal partitioning of applications into small size segments and scheduling of these segments was proposed through [19]. A systematic approach using HARPO/L was proposed for compiling parallel applications to a coarse-grained reconfigurable architecture [20]. A unique architecture template modeling was disclosed for overcoming the issues arising due to highly dense system components in [21]. A genetic algorithm based systematic approach was proposed for bifurcating the hardware and software task to make it useful in the architecture essentially comprising of reconfigurable architecture [22]. A possibility of utilizing selective frequency for each task in order to optimize the overall bandwidth utilization and maximize the performance of the system by adopting data parallelism property, theoretical principles are proposed [23].

3 System Modelling

The system design considerations under task service request generation, request recognition and task handling are discussed in the subsequent section.

3.1 Task Service Request Identification

To identify the service request, by some contrivance a mechanism is implemented using sequential task detection scheme. In this case, two separate sequential task detection schemesare developed to identify the task service requests *"t_{req}"*. Whenever, any task raises a service request, it is recorded in status register. Two dedicated four-bit registers are designed to read the status of the request raised. *"fpt_{status}"*, records the status of requests been raised for service from first priority task group. On the other hand, *"spt_{status}"* keeps track of the service request raised by the tasks in the second priority task group. These status registers are used by the system to decide the task to be served from next clock edge.

3.2 Task Handling

The system for dynamically routing the tasks in reconfigurable architecture, the system is conceptualized considering "n" different tasks. These "n" different tasks are categorized into three categories. In each of the categories, four tasks are considered, for modeling. These categories are First Priority Task *"fpt"*, Second Priority Task *"spt"*and Routine Task *"rt"*. Each of the task *"i"*, of the two categories are operated in two different ways. If no tasks in the *"fpt"* and *"spt"*is executing, in either of the mode, then *"rt"* tasks are operated, as default operations in the processor, continuously in loop. Based on the way of handling the incoming task service request *"treq"*, the proposed system can be operated in two modes.

- **Mode 1:**

In this case, priority is assigned at group level. tasks in *"fpt"* group is assigned with the highest priority. Tasks in the *"spt"* group are having second priority and the task in *"rt"* are at third priority. So if task 4 in the "fpt" and task 1 in the *"spt"* raise service request t_{req}^{fpt4} and t_{req}^{spt1} then, t_{req}^{fpt4} will be served first. It is assumed that, at a time only one service request can be considered for execution from one group. If multiple service requests are generated then other tasks have to wait till completion of the other task in the group. Internally, no priority is assigned among the tasks, since they belong to same group. In this mode of serving the tasks requests, priority-based task handling is observed.

- **Mode 2:**

In this case, the priority is assigned among tasks in the group. So, in case, if task 1 in the *"fpt"*raise service request t_{req}^{fpt1} exactly when task 1 in the *"spt"* raised service request t_{req}^{spt1} then both of the service requests are served at the same moment. In this case concurrency is observed while handling the task service request.

3.3 Task Handling

The proposed system is generic in nature; to exhibit the concept, twelve different tasks are considered for execution. It is assumed that, once the request is served, for execution of routine task *"rt"* minimum 5 clock cycles duration is needed, for execution of first priority tasks *"fpt"*, 10 clock cycles duration is needed and for execution of second priority tasks, 15 clock cycles are needed.

3.4 Best Method of Performance

The two dedicated sequential task detection schemes are executed concurrently, to detect the service request raised by the tasks in two groups. According to the service request raised the status registers are updated. These status registers are used by the system internally, to detect the multiple tasks seeking service execution. Based on the status and priority knowledge, the system picks up the task to be served first and task execution is initiated from the next clock edge. Once the task service execution is initiated, the routine task execution is kept to ideal condition.

As shown in the Fig. 5 below, since no other higher priority tasks are active the routine task t_{rt}^{1} is activated for execution. Accordingly, *"rts"* is update to *"0001"* and *"rtc"* starts counting from 0 to 5 indicating the minimum clock duration required for execution. Soon as the *"rtc"* reaches to highest count value, another routine task t_{rt}^{2} is triggered for execution, at this moment, the *"rts"* is updated to *"0010"* and *"rtc"* initiates counting. During the second clock counting, the t_{req}^{fpt1} is observed, upon which, t_{fpt}^{1} is triggered. On the next clock edge, the *"rtc"* freezes to *"3"* and *"rts"* is to *"0010"*. Simultaneously, on the same clock edge, the *"*fpt_{status}*"* is updated to "0001" and fpt_{count} initiates counting the clock pulses till it reaches to 10, again indicating minimum clock duration required to complete the *"fpt"* (Table 1).

As shown in Fig. 6, On completion of the t_{fpt}^{1}, the "fptstatus" is updated to "0000" and fptcount is reset. During the last clock duration, when the t_{fpt}^{1} being completing the execution, t_{req}^{fpt1} is observed upon which, t_{spt}^{1} is triggered which set

Table 1 Terminologies

Sr. No.	Notation	Description
1.	n	Number of tasks
2.	i	Task i
3.	fpt	First priority task
4.	spt	Second priority task
5.	rt	Routine task
6.	t_{req}	Task service request
7.	t^{i}_{req}	Task service request by *"i"* task
8.	fpt_{status}, spt_{status}&rts	First, second priority& Routine task status register
9.	fpt_{count}, spt_{count}&rtc	First, second priority & Routine task counter
10.	fpt_{state}, spt_{state}&$state$	First, second priority & Routine task internal states

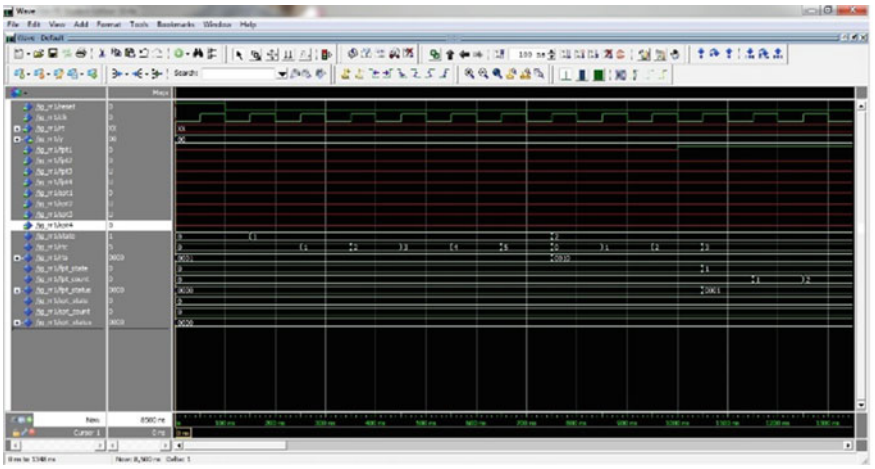

Fig. 5 Routine task active and *fpt* activation

"sptstatus" to "0001". The "sptcount" continues to count till count value 15, indicating the minimum time duration required for execution of task.

On 4200th ns, as disclosed in Fig. 7, it is observed that, t^{fpt2}_{req} & t^{spt4}_{req} are simultaneously activated, updating *"*fpt_{status}*"* &*"*spt_{status}*"* to *"0010"* and *"1000"*. As per the discussion in mode 1, *"fpt"* tasks are served first and then *"spt"* tasks are served, by updating *"*fpt_{status}*"*&*"*spt_{status}*"*, accordingly.

Upon completion of executing the "fpt"&"spt" task completely, the routine task "rt" is reloaded. The "rtc" which was freeze to 3, start counting to complete the execution of the routine task t^{2}_{rt} and subsequent routine tasks are executed continuously in loop till any request t^{i}_{req} is detected. This is indicated in the Fig. 8 below.

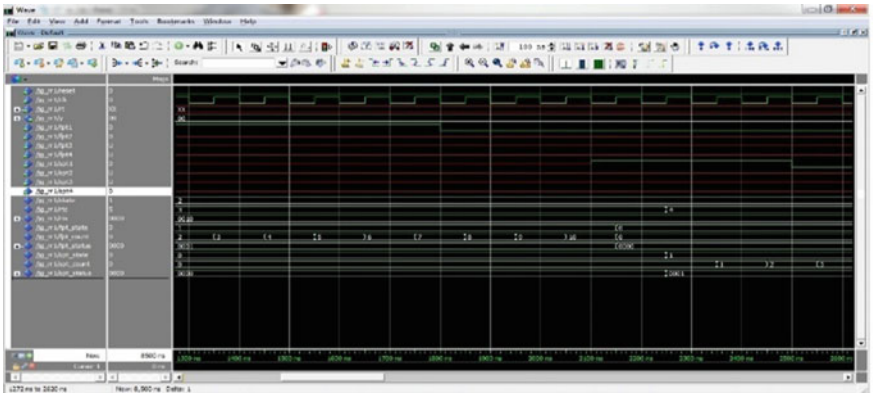

Fig. 6 *fpt* completion and *spt* activation

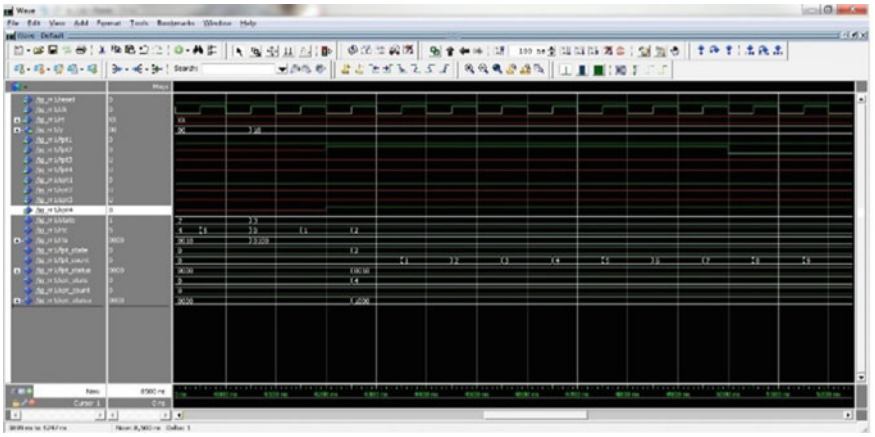

Fig. 7 t_{req}^{fpt2} & t_{req}^{spt4} Simultaneous activation

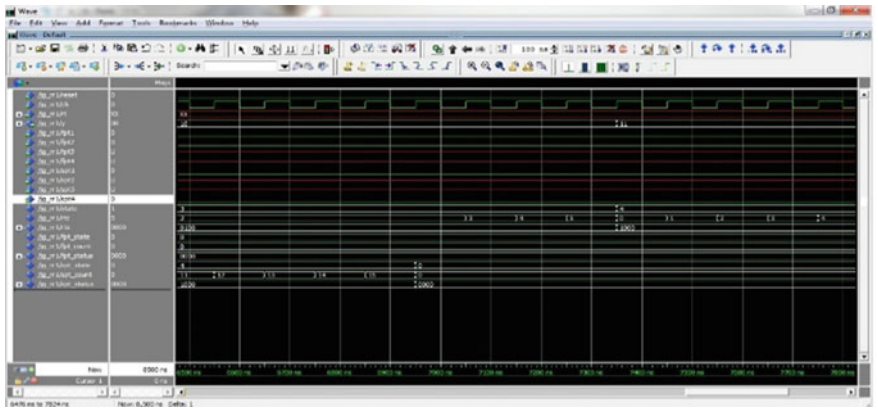

Fig. 8 t_{rt}^{2} completion and subsequent execution

In case, if the system is operated in mode 2, as discussed before, as shown in the Fig. 9 below, at 14400th ns, t_{req}^{fpt1} & t_{req}^{spt1} is observed, simultaneously. To serve these requests, the system freeze the routine task execution to current values and from next edge of the clock, *"fpt_{status}"*&*"spt_{status}"* are updated to *"0001"* and *"0001"*. Soon as the task execution is completed after 15500th ns for t_{req}^{fpt1} and after 16000th ns the routine task status values are restored and *"rt"*execution is initiated.

4 Cogent Analysis

In the proposed system, it is assumed that, for completion of "fpt" minimum 10 clock duration is required, for completion of "spt" tasks minimum 15 clock duration is required and for completion of routine task minimum 5 clock duration period is required. With this assumption the proposed system is described using Very High Speed Integrated Circuit Hardware Description Language (VHDL). The description is targeted to different FPGAs. After implementation of the system using VHDL and targeting device FPGA, for mode 1 and mode 2, same amount of hardware resources is required, hence, time of execution, frequency of operation and power consumption are naturally same. However, it is found that there is significant difference between task switching time.

4.1 Understanding Timing Analysis Parameter

In order to precisely calculate the task completion time and task switching time of in the proposed system, details timing analysis is required. Since the system is

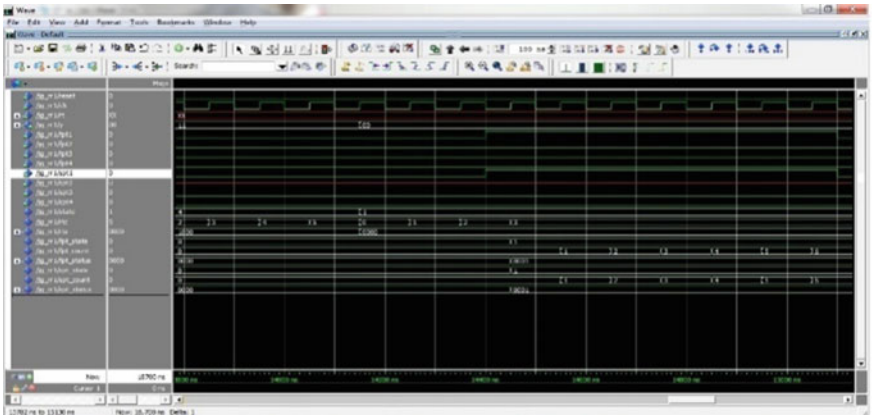

Fig. 9 System performance in mode-2

hardware dependent, it is obvious that, the time required to complete the task depends on the technology library used for implementation of the said system. The technology library used in development of the FPGA device evolve according to the technological revolution. Hence, when the same HDL description is synthesized targeting to different device platform, deflection in the parameters like estimated frequency, minimum time reported, power utilization and resources used for implementation. Significantly, in our system, we are focusing on the time parameter, following observations are found on different device platform.

It is evident from the Table 2 that, minimum amount of time is reported if the virtex-6 (Low Power) device is targeted for implementation. Most significantly, it can be noted that, actual time required for logic implementation is far less than the routing time. The routing time is introduced since in FPGA architecture different library components are connected together to describe architecture inside FPGA device. Even in most sophisticated form of description of VHDL, it is not possible to optimize the routing delay, after certain level. Hence to get most tight optimization of the proposed system, the system is implemented using Cadence-ASIC tool. The device is compiled using 180, 90 and 45 nm technology library and outstanding optimization is the outcome. Figure 10 indicates the timing analysis on Cadence-ASIC tool.

Table 2 Timing analysis on different device platform

Sr. No.	Device	Logic delay (ns)	Logic delay (%)	Routing delay (ns)	Routing delay (%)	Total delay (ns)
1	Spartan 6	1.342	34.1	2.592	65.9	3.934
2	Spartan 6 (Low power)	0.590	25.6	1.712	74.4	2.302
3	Virtex 6	0.590	25.6	1.712	74.4	2.302
4	Virtex 6 (Low power)	0.439	21.0	1.647	79.0	2.086

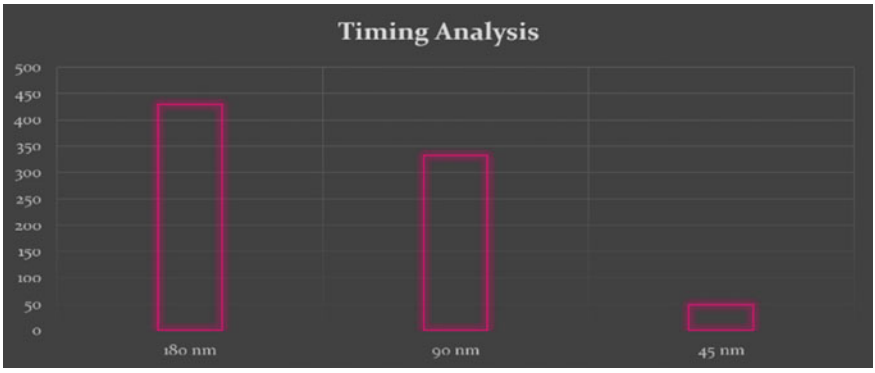

Fig. 10 System implementation on Cadence-ASIC tool

Table 3 Task completion time on different device platform

Sr. No	FPGA vendor	One clock period (ns)	Task completion time (t_{cmp}^{fpt}) (ns)	Task completion time t_{cmp}^{spt} (ns)	Task completion time t_{cmp}^{rtn} (ns)	Average task completion time t_{cmp}^{avg}
1	Spartan 6	3.934	39.34	59.01	19.67	39.34
2	Sparta6 (Low Power)	2.302	23.02	34.53	11.51	23.02
3	Virtex 6	2.302	23.02	34.53	11.51	23.02
4	Virtex 6 (Low Power)	2.086	20.86	31.29	10.43	20.86
5	Altera Stratix4	1.925	19.25	28.875	9.625	19.25
6	Lattice IspXPGA	9.40	94	141	47	94
7	QuickLogic Quick MIPS	16.513	165.130	247.695	82.565	165.130
8	ASIC	0.429	4.29	6.435	2.145	4.29
9	ASIC	0.331	3.31	4.965	1.655	3.31
10	ASIC	0.0486	0.486	0.729	0.243	0.486

4.2 Task Completion Time

Consider one clock cycle period is *'t'*. The task completion time, for task *'i'* is *'ω'*, so actual task completion time "t_{cmp}^{i}" can be calculated as "$t_{cmp}^{i} = t * \omega \ominus$". Considering the reported time duration of one clock cycle from synthesis report and Cadence-ASIC Report, task completion time can be computed as below, in Table 3.

From the above Table 3 it is evident that, the minimum task completion time can be achieved using ASIC 45 nm technology. The average task completion time t_{cmp}^{avg} for the system is 0.486 ns. The best t_{cmp}^{avg} can be obtained if the system is designed using tightly optimized ASIC at 45 nm technology. Highest t_{cmp}^{avg} reported by Quick Logic Quick MIPS Device which is 165.130 ns.

4.3 Task Switching Time

In the proposed system, the task switching time "tsw" is defined as the time laps between task service request *"trq"* generation and task execution. The proposed system is configured in two ways, viz mode 1 and mode 2, as discussed in task handling section.

- **Task Switching Time in Mode 1:**

Subsequent Fig. 11 indicates the task switching time in mode 1. As shown in the figure, the best-case task switching time is 0.0486 ns for 45 nm ASIC. The best switching time indicates the no other tasks are active at the moment when service request is raised by the other task, except routine task. On other side 247.697 ns is reported as worst case switching time. Worst case switching time indicates, the amount of longer duration, medium priority task to complete their execution.

- **Task Switching Time in Mode 2:**

The subsequent Fig. 12 indicates the task switching time for any task at any moment. In mode 2, since priority is removed and all task for which service request has been raised, treated concurrently, at any moment, the task activation or switching time will be same as one clock cycle duration.

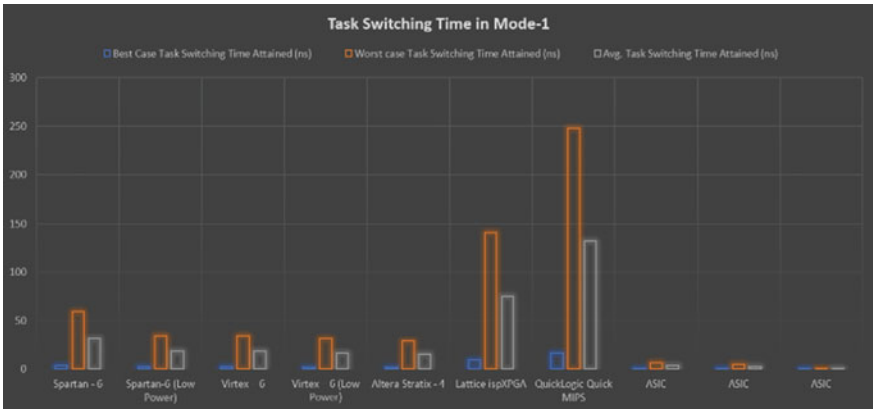

Fig. 11 Task switching time in mode-1

4.4 Comparative Analysis

Worst case task switching time are reported by various authors. As disclosed in the Table 4 below, it is evident that, the proposed system which is implemented using ASIC 45 nm technology, huge time difference is observed, as indicated in the table. Further the different other parameters like estimated frequency of operation, resources required for implementation on different platform and power analysis are also tightly optimized in system designed using ASIC 45 nm technology.

Further, since the Application Specific Integrated Circuit is tightly optimized with respect to the different constraints, it has negligible routing delays. Hence when the performance of the proposed system is compared with the one which is designed around FPGAs like Xilinx Virtex, Kintex and Spartan series recent FPGAs, which are fabricated on 18 nm surface technology, the superior performance is observed.

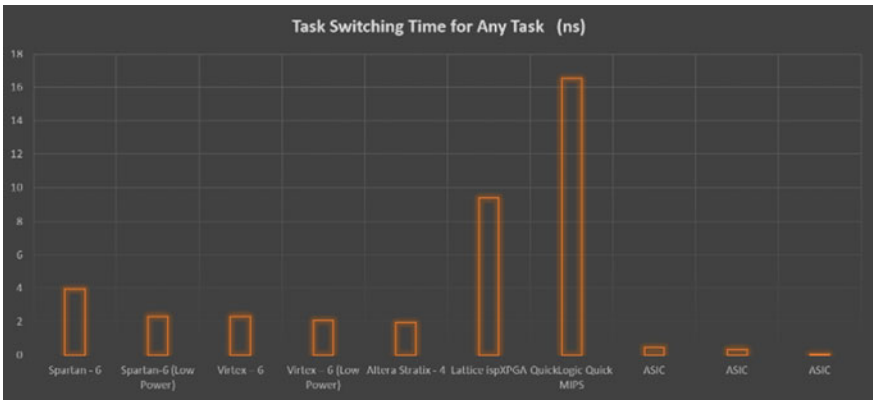

Fig. 12 Task switching time for any task in mode 2

Table 4 Cogent analysis with previously reported database

Sr. No.	Citation (References)	Worst case switching time (ns)
1.	1	355000
2.	3	120500
3.	4	7500
4.	10	6 e+8
5.	16	27430000
6.	Proposed technique	0.729

5 Conclusion

A dynamic scheduling algorithm for handling multiple tasks in reconfigurable architecture environment is proposed. The proposed system is exhibited considering different tasks group into three different categories. These tasks are operated, according to the service request raised, in two modes. In mode 1, first priority is assigned to the group 1 and then to the group 2. In case of mode 2, multiple tasks are operated concurrently. For implementation of the system, minimum time duration is considered. For implementation, the system is described using HDL, synthesized using Xilinx tool and for tight optimization, system is further implemented using Cadence-ASIC tool. After implementation the system performance is compared with the previously reported data base with respect to the task switching time. It is found that, the proposed system is operating at much faster rate when considered with ASIC 45 nm technology.

References

1. Cai X, Hu W, Ma T, Ma R (2018) A hybrid scheduling algorithm for reconfigurable processor architecture. In: 13th IEEE conference on industrial electronics and applications (ICIEA), June 2018. https://doi.org/10.1109/iciea.2018.8397812
2. Park H-W, Kim W, Yoo D, Ryu S, Kim J (2013) A scalable scheduling algorithm for coarse-grained reconfigurable architecture. In: IEEE international conference on consumer electronics (ICCE), March 2013. https://doi.org/10.1109/icce.2013.6487011
3. Noguera J, Badia RM (2002) HW/SW codesign techniques for dynamically reconfigurable architectures. IEEE Trans Very Large Scale Integr (VLSI) Syst 10(4):399–415
4. Ka C-C (2015) Performance-oriented partitioning for task scheduling of parallel reconfigurable architectures. IEEE Trans Parallel Distrib Syst 26(3):858–867
5. Popp A, Moullec YL, Koch P (2009) Scheduling temporal partitions in a multiprocessing paradigm for reconfigurable architectures. In: NASA/ESA conference on adaptive hardware and systems, November 2009. 10.1109/AHS.2009.43
6. Lin CY, Wong N, Kwok-Hay So H (2010) Automatic system architecture synthesis for FPGA-based reconfigurable computers In: International conference on field-programmable technology, January 2010. https://doi.org/10.1109/fpt.2009.5377691
7. Maestre R, Kurdahi FJ, Femandez M, Hermida R, Bagherzadeh N (2002) Optimal vs. heuristic approaches to context scheduling for multicontext reconfigurable architectures. In: Proceedings 2000 IEEE symposium on field-programmable custom computing machines (Cat. No.PR00871), August 2002. https://doi.org/10.1109/fpga.2000.903424
8. Khuat Q-H, Chillet D, Hübner M (2015) Dynamic run-time hardware/software scheduling for 3D reconfigurable SoC. International Conference on ReConFigurable Computing and FPGAs (ReConFig14), February 2015. https://doi.org/10.1109/reconfig.2014.7032512
9. Benoit P, Becker J, Sassatelli G, Torres L, Robert M, Cambon G (2005) Run-time scheduling for random multi-tasking in reconfigurable coprocessors. In: International conference on field programmable logic and applications, October 2005. https://doi.org/10.1109/FPL.2005.1515817
10. Noguera J, Badia RM (2002). Dynamic run-time HW/SW scheduling techniques for reconfigurable architectures. In: Proceedings of the tenth international symposium on hardware/software codesign. CODES 2002 (IEEE Cat. No.02TH8627), August 2002. https://doi.org/10.1145/774789.774831

11. Pan Z, Earl Wells B (2008) Hardware supported task scheduling on dynamically reconfigurable SoC architectures. IEEE Trans Very Large Scale Integr (VLSI) Syst16 (11):1465–1474
12. Huang M, Narayana VK, El-Ghazawi T (2009) Efficient mapping of hardware tasks on reconfigurable computers using libraries of architecture variants. In: 17th IEEE Symposium on Field Programmable Custom Computing Machines, October 2009. https://doi.org/10.1109/FCCM.2009.20
13. Valizadeh A, Saheb Zamani M, Sadeghian B, Mehdipour F (2006) A reconfigurable architecture for implementing multiple cipher algorithms In: IEEE International Conference on Field-Programmable Technology, January 2006. https://doi.org/10.1109/fpt.2005.1568574
14. Nemer E, Goubran R, Mahmoud S (2002) A non-deterministic scheduling and allocation model for mapping algorithms on configurable architectures. In: Conference proceedings on canadian conference on electrical and computer engineering. Engineering innovation: voyage of discovery, August 2002. https://doi.org/10.1109/ccece.1997.614779
15. Yin C, Yin S, Liu L, Wei S (2010) Temporal partitioning algorithm for a coarse-grained reconfigurable computing architecture In: Proceedings of the 2009 12th international symposium on integrated circuits, INSPEC Accession Number: 11105340, February 2010
16. Huang M, Simmler H, Serres O, El-Ghazawi T (2009) RDMS: a hardware task scheduling algorithm for Reconfigurable Computing. IEEE international symposium on parallel & distributed processing, July 2009. https://doi.org/10.1109/IPDPS.2009.5161223
17. Laskowski E (2004) Program structuring algorithms for dynamically reconfigurable parallel systems based on redundant connection switches. In: Third international symposium on parallel and distributed computing/third international workshop on algorithms, models and tools for parallel computing on heterogeneous networks, December 2004. https://doi.org/10.1109/ISPDC.2004.43
18. Kojima T., Amano H (2018) A configuration data multicasting method for coarse-grained reconfigurable architectures. In: 28th international conference on field programmable logic and applications (FPL), December 2018. https://doi.org/10.1109/fpl.2018.00048
19. Gajjala Purna KM, Bhatia D (2002) Temporal partitioning and scheduling for reconfigurable computing. In: IEEE symposium on FPGAs for custom computing machines (Cat. No. 98TB100251), August 2002. https://doi.org/10.1109/fpga.1998.707939
20. Tuhin MAA, Norvell TS (2008) Compiling parallel applications to coarse-grained reconfigurable architectures. In: Canadian conference on electrical and computer engineering, July 2008. https://doi.org/10.1109/CCECE.2008.4564838
21. Wang D, Cao Y, Yan M, Li S (2007) Mapping applications on coarse-grained reconfigurable systems using architecture template modeling. In: 10th IEEE international conference on computer-aided design and computer graphics, December 2007. https://doi.org/10.1109/cadcg.2007.4407954
22. Ben Chehida K, Auguin M, Raimbault S (2015) Architecture and application partitioning for reconfigurable system design. In: 11th european signal processing conference, INSPEC Accession Number 15024531, March 2015
23. Banerjee S, Bozorgzadeh E, Dutt N, Noguera J (2007) Selective band width and resource management in scheduling for dynamically reconfigurable architectures. In: 44th ACM/IEEE design automation conference, June 2007. https://doi.org/10.1109/dac.2007.375268

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Using Face Recognition to Find the Culprit from a Video Footage and Crime Mapping

Ch. Sushma, K. Padmini, and P. Sunil

Abstract Recently face credibility in the group transmission information access society attracts ample publicity. Through a lot of video, areas such as group security, compartmentalization and retrieval of content data, and video compression benefit from face credibility technology as a result of "people" square degree in the centre of focus. Face detection is that the freshest analytical room within the technical vision. It is a technology employed at some stage in a type of packages recognizing human faces in digital images [1]. In several regions of science such as technology, research underneath this area is growing. Face detection is one of a few the important talked regarding in technology. Localization of human faces is considered because the main and, in addition, the initial stage of face detection analysis is taken into account. In home video, for instance, police paintings etc. Localization of the face is often said as extraction of the pattern of popularity method of victimization of face expression. Every MATLAB and Open CV is used frequently to generate these prototypes and systems. Throughout this paper we have conducted our Open CV assessment victimization as a result of victimization, it finally ends up with a sluggish additional use of it and assets in the picture procedure and less encoding and crime visualization make it easier to see the wrongdoer from many locations.

Keywords Face detection · Face extraction · Face recognition · Open CV · Gmplot

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_62

1 Introduction

Face Recognition Program can be a computer program, identifying individuals from a photograph or a video footage is used to. It is in the foreground applied to protection capabilities that the song of the UN company reaches a certain specific facility or occurs in a certain location. It should no longer be as precise as a bio metric scanner or an iris scanner, but it is very easy to implement. This face-recognition system operates with data wherever image of the square measure of the people is saved. This method involves a number of algorithms for portraits, whether or not the face of the man or woman in personal or footage matches any portrait of records. Perhaps one of those algorithms saves people's images in grayscale data format. A further algorithmic rule searches for a name. The algorithmic rule contrasts with the data whether or not a specific space or size or face fits form is or is not. The effect of these algorithms being combined is that this computer. One of the easiest ways to develop a basic Face Recognition Program is to use OpenCV [1].

2 Basic Steps

Face recognition requires three basic steps that support face detection, face recognition, and face extraction [8]. Every system has to encapsulate the picture and thus handle the very critical functions further as a report to determine the vicinity of the face [2]. It keeps records of various functions such as pores for the popularity of the picture captured (Fig. 1).

The popularity of the face takes a picture from a film or digital camera as input and outputs the photograph subject described. Facial functions can include regions inside the face, facial structure changes, face cuts, and shaped and stylised angles. Face extraction consists of capturing capabilities from digital camera. Face detection consists of extracting the background and concentrating on the foreground eliminating any items other than the region of the face, but the tool still has a few disadvantages because it cannot identify the pinnacle count that can be present due to overlapping of faces or incorrect identification of two faces.

Fig. 1 A generic face recognition system

3 What Is OpenCV?

OpenCV is an open supply library transfer framework written in C++ which was developed with the support of Intel. OpenCV is used for Face Recognising device, movement sensor, cellular robotics etc. This library is supported in maximum of the operating machine I E. Windows, Linux, Mac, open BSD. This library may be used in python, java, ruby, C#etc.

OpenCV provides the subsequent three face recognisers::

A. Eigenface recogniser
B. Fisher face recogniser
C. LBPH face recogniser

A. **Eigenface Recogniser:** The Eigen face Recognizer algorithm [2] takes into account the fact that not all parts of a face are equally important and useful. When we appear in an individual, we understand the man or woman's distinct characteristics, such as eyes, nose, lips, forehead, and how they differ from each other. The aim is to change (mathematically speaking, this variation is variance).
B. **Fisherface Recogniser:** Fisher face Face Recognizer [2] is an advanced version of Eigen faces, as a set of rules for face recognition. This suddenly appears to all the educational faces of all the people and uncovers the ingredients from all of them together. By taking photos of all the key additives together, you concentrate on the characteristics that reflect all the people in the training data.
C. **Local Binary Patterns Histograms (Lbph) Face Recogniser:**

All Eigen faces and Fisher faces are influenced by the use of light, so perfect light conditions are not available at all times in actual life. In order to overcome this downside, LBPH [3] face recognizer is an upgrade. LBPH set of rules attempts to find a photo's local structure by comparing each pixel to its neighbouring pixels. With a lot just on the horizon, it's going to be interesting to see where we're taking this upward trend of facial recognition technology.

The popularity of the LBPH face is used in this assignment, which is the function create LBPH Face Recognizer() [4]. LBP works on snap shots from a grey scale. A neighbourhood is chosen around the current pixel for each pixel in a grey-scale photograph and the use of the neighbourhood for the pixel is measured as LBP charge.

4 Real Time Face Recognition Software

This task is divided into two parts:

A. developing a database
B. training and testing.

A. **Creating a Database:** For face popularity, take images of the person after strolling create_database.py script. This produces a Train folder in the Server folder that automatically holds the face to be identified. The call from Train can be alternated to the name of the person.

The face snap shots must have one-of- a-kind expressions when constructing the database, which is why a 0.38-second delay is given inside the code to create the set of information. We take about 45 photographs/photos in this example and extract the image, convert it into grey scale, and store it with its call in the database folder.

B. **Training and Testing:** Next is executed preparation and the prestige of the nose. Face to rec.py code does all. Local Binary Patterns Histogram (LBPH) is the set of rules used right here. Face detection is the way one or more human faces are identified or contained in a body or photograph. Haar-like characteristic set of rules is used for face detection with the aid of Viola and Jones. In hair features, certain common properties are presented by all human faces. Using hair characteristics, these regularities can be matched [5].

5 Two Common Properties of Human Faces Are

1. The area of the eye is darker than the peak cheeks [5].
2. The surface of the nose bridge is shinier than the eyes.

6 Composition of Two Properties Forming Matchable Facial Features Are

1. Location and size together with eyes, mouth and bridge of nose [5].
2. Value for directed pixel size gradients.

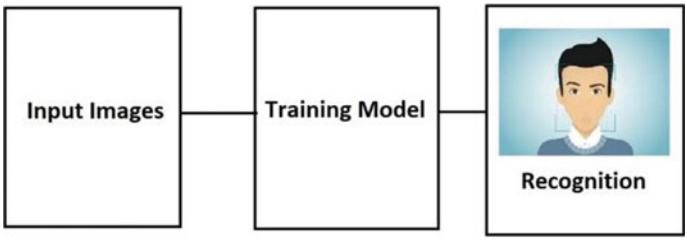

Fig. 2 Processing scenario

7 Face Recognition with Python and OpenCV

Faces are made of lots of quality traces and capabilities that must be matched. The face recognition using Python, spoil the mission of identifying the face into lots of smaller, bite-sized tasks, every of which is easy to stand Recognition Python is the brand new trend in Machine Learning techniques. OpenCV makes use of Machine Learning algorithms to Faces are made of lots of look for faces inside a picture (Fig. 2).

A. **Database for Faces:**

This application asks someone to give records of a specific I d, name, age, gender and crook. Instead, instead, it gathers twenty pictures of the character's faces that convert it to Scale Grey. It saves all that person's data in details or updates if they exist. Here cv2 is that sqlite3 is the openCV library and the data usage jointly.

The cascade commonly called as a classifier named as haarcascade_frontal-face_default.Xml that is used primarily for face-recognition.

B. **Face Trainer:**

This technique trains the faces in this feature, and saves the facts in a yml format. The library that is used as os is available in python i.e. it already exists as a built in python library. The other two numpy and pillow libraries must be allowed to be put in manually.

C. **Face Recognition:**

This item takes pix of faces, converts them to gray Scale format, then compares images to data pictures. When discovered safe, all the details on the computer are suggested. Though identification of the right face is not feasible for the teacher.

8 Directory Structure

The structure of sample listing [7] in OpenCV is as below (Fig. 3):

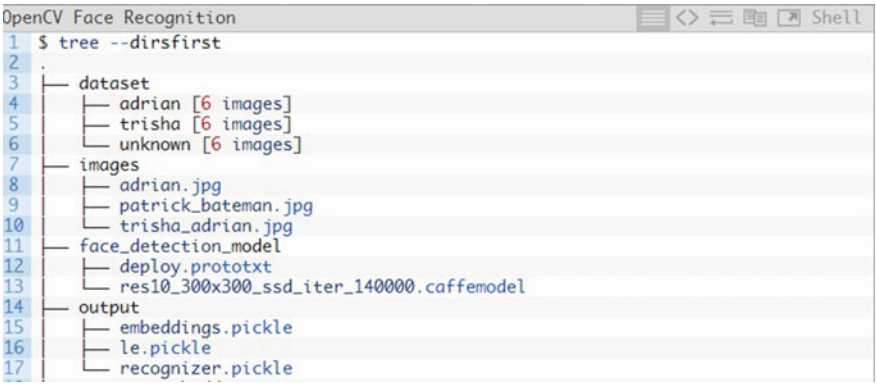

Fig. 3 A model for directory system

Inside the root folder, it has 4 directories:

- ***dataset/:*** contains our face pix grouped into subfolders with the aid of name.
- ***Pic/:*** includes 3 reference photos that we will use to check how our model works.
- ***Face detection model/:*** includes a pre-trained deep-seated Caff research model supplied with OpenCV to face-face.
- ***Output/:*** Includes pickle files for my output. You can also shop your production documents here if you are working with your own dataset.

We need to put in Code Dependencies and import the necessary Modules before we start the real coding:

A. **Code dependencies**

Download the following dependencies:

1. OpenCv 3.2.0
2. Python v3.5
3. NumPy-which enables Python computing. This consists of a versatile implementation of N- dimensional arrays that we can use as an entry to OpenCV functions for feeding statistics.

B. **Required Modules**

Import the following modules [7]:

- ***cv2:*** This is the Python OpenCV framework used to detect face and to popularize face.
- ***Os:*** We will use this Python module to review our training directories and the names of files.
- ***Numpy:*** This module converts Python lists to numpy arrays as OpenCV face recognizer requires them for the cycle of face credibility.

9 Crime Mapping on Google

Google Maps also contains icons for landmarks, places of interest, and major businesses.

Moreover, the various icons are clickable and an image, address, telephone number will be carried up.

This new Google Maps feature is the right details for CrimeReports.com users. Adding the new location icons would make getting a tangible sense of the area and proximity of crimes plotted on the Crime report map less complicated. This increased spatial focus will lead to better knowledge about where crimes are taking place with respect to physical landmarks and businesses.

gmplot is a matplotlib [9]-like tool for generating HTML and JavaScript to make all the details that users want on Google Maps pinnacles.

Installing gmplot command:

Pip set up gmplot;

10 Facial Detection Algorithms

A. **A simple face detector-and an algorithm of Adaboost:**

Adaboost is an ensemble that receives algorithmic information. In 1997, Adaboost was invented by Freund & Schapiro. For that achievement, they won the Gödel prize in 2003. In 2001, Adaboost transformed into face detection implemented (with some modifications) by Viola and Jones. It requires a set of classifiers–known as inexperienced rookies (like a thumb rule) or base learners. They are combined to create a robust classifier. What's a good classifier? One to produce good results on unknown facts • Face detection calls for a binary classifier (face rather than non- face). Adaboost has many types of beauty, but we stick to the2-elegance scenario. What are the features we need to select? Different capacities can show various effects. Adaboost is a strategy that uses multiple (vulnerable) classifiers-each based on different capabilities. B) Combine these various (weak) classifiers into one strong classifier.

The prone newcomers (thumb guidelines) have much less than 50% error-charge, i.e. We should be marginally better than random guessing as a start. If the thumb rule has an extra error of more than 50%, simply invert its symbol.

Finding after which combining several basic (vulnerable) thumb policies is less difficult than locating one (accurate) complex rule.

The law is as follows:

$H(x) = \alpha 1\ h1(x) + \alpha 2\ h2(x) + \alpha 3\ h3(x) + \ldots..$

Where

H-robust classifier, x-Feature vector,
α-weights and h-weak classifier.

B. **Face detection using Haar cascades:**

Object detection using primarily dependent Haar characteristic cascade classifiers is an effective method of object detection proposed by Paul Viola and Michael Jones. It is a method based on machine learning in which a cascade function is trained from a number of high-quality and negative photographs. In other pic it is then used to strike objects. Here, facial recognition will work. Originally, the set of rules requires a lot of good pictures (face photographs) and negative images (face pictures) to teach the classifier. We'd then like to derive functions from it. Nonetheless, features are not numerical data derived from images that can be used to separate one picture from another; for example, a histogram (distribution of intensity values) is one of all the capabilities that can be used to identify various image characteristics even when searching the image, such as the dark or bright image, the variety of depth of the photograph, etc. We're going to use hair functions to face up.

11 Face Recognition Applications

Face Recognition is a well-researched issue, and is commonly used in both business and academia. A crook in China, for example, transformed into caught because a Face Recognition system in a mall recognized his facial and triggered an alarm. The main purpose of the face recognition technique is to capture the crime where it occurs and whom it does otherwise we can simply say that in order to live a peaceful life, we can eliminate the crimes and theft in the world. There are many more exciting applications [10], and use Face Recognition instances:

A. **Facial authentication**: Apple has launched Face ID for iPhones facial authentication. Some of the leading banks tend to use lockers with Facial Authentication.
B. **Customer Service**: Some of Malaysia's banks have built systems that use Face Recognition to identify financial institution's valuable customers so that the financial institution can provide the personalized service. By retaining these customers and keeping them satisfied, banks are thus able to generate more revenue.
C. **Insurance Underwriting:** Most insurance companies use Face Recognition to match the person's face with the proof provided in the Photo ID. The underwriting process thus becomes a whole lot quicker.

12 Conclusion

To sum up, Face Recognition is an exciting trouble with plenty of strong instances of use that can profoundly help society in many dimensions. The machine that recognizes the face is far from fine. This is not nearly as good as an experiment on retina or so. And the main problem is that it misidentifies people every so often. It also becomes less straightforward to strike a face from a photograph or video of low resolution. This thing works best and forms a certain angle from a person's side view the maximum amount of time the face detection fails. Even with some facial expression such as Smile, face recognition may not be suitable. Although it is true that this machine has all the problems it is having, it can be very useful in some cases. It is not always easy to deal with crowds in which direct contact with each person is necessary. In this case, it is not possible to use extra easy solutions such as fingerprint or biometric check. And another fact is that the use of face-recognition technology in digital camera surveillance crime has declined in certain locations such as bank robbery. This generation if nicely built can be totally beneficial to humanity. We might assume that a set of rules for face detection is better if it has two main capabilities, precision and speed [8]. There is considerable trade-off between the two.

References

1. Emami S (2010) Face Detection and Recognition using OpenCV, Article. http://shervinemami.info/faceRecognition.html. Published
2. Belhumeur P, Hespanha J, Kriegman D (1997) Eigenfaces vs. Fisherfaces: recognition using class specific linear projection. IEEE Trans Pattern Anal Mach Intell 19(7):711–720
3. Ahonen T, Hadid A, Pietikainen M (2004) Face recognition with local binary patterns
4. Rodriguez Y (2006) Face detection and verification using local binary patterns. Ph.D thesis, Ecole ´ Polytechnique F´ed´erale De Lausanne, October 2006
5. Kanade T (1973) Picture processing system by computer complex and recognition of human faces. Ph.D thesis, Kyoto University, November 1973
6. Brunelli R, Poggio T (1993) Face recognition: features versus templates. IEEE Trans Pattern Anal Mach Intell 15:1042–1052
7. OpenCV http://opencv.willowgarage.com
8. Saini N, Kaur S, Singh HA (2013) Review: face detection methods and algorithms. International Journal of Engineering Research & Technology (IJERT) 2(6). www.ijert.org. ISSN 2278-0181
9. Hunter JD et al (2007) Matplotlib: a 2D graphics environment. Comput Sci Eng 9(3):90–95
10. Hsu H-J, Chen K-T (2015) Face recognition: issues, limitations and applications. In: Proceedings of the first workshop on micro aerial vehicle networks, systems, and applications for civilian use, DroNet 2015. ACM, New York, pp 39–44

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Comparison of Texture Based Feature Extraction Techniques for Detecting Leaf Scorch in Strawberry Plant (Fragaria × Ananassa)

Kirti, Navin Rajpal, and Mukta Arora

Abstract This paper presents a comparison among the techniques which use the texture features as a basis of detection the diseases among the captured leaf images of the Strawberry Plant. Local Binary Pattern, Complete Local Binary Pattern and Local Ternary Patterns are used to extract the features and a comparison of accuracy is shown among them. LBP is used because its features remain unchanged even if the monotonic gray-scale changes like, the effects that are caused due to illumination variations, are present in the image, Complete Local Binary Pattern is used since it conveys more discriminant information of local structure which is ignored by LBP & Local Ternary Patterns are used since it is more robust to noise than LBP which may improve the accuracy of the system. The set of images are taken from Plant Village Dataset. The image dataset contains the healthy leaf images and the Leaf Scorch Diseased Leaf Images.

Keywords Disease detection · Feature extraction · Pattern recognition · Texture features · LBP · CLBP · LTP

1 Introduction

The Plant Protection is necessary for the yield and for other numerous factors like, the effect of disease on the quality of the crop, increase in the cost of control of the disease, loss of income, etc. The detection of the disease can help in preventing the

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_63

potential emerging epidemics which can affect and cause chronic crop loss and can affect highly large areas [1].

The fruit crops are one of the highest valued crops and hence need more care and prevention from the diseases which can harm the yield and can affect the economy badly. So, there is a need of preventing the crops from the diseases by detecting it and by taking the appropriate measures to save the yield. It has been seen that it is not possible manually to detect the disease on time or it takes a large piece of economy to arrange the human resources to do the work. Hence, it is needed to develop a system which can detect the disease with least manual intervention and with a high accuracy [2].

One of the important Fruit crops is, Strawberry Plant also known as Fragaria × ananassa. This plant has a high value in market but also, many diseases has been found which can harm this plant. One of the most common diseases found in this plant is The Leaf Scorch Disease (Diplocarpon Earliana), it infects leaves, runners, flowers, fruit and calyx. Infected leaves initially appear to have numerous purplish-brown blotches. Lesions join together and may turn bright red. Leaves eventually turn brown, dry up and curl up at the edges giving a burned or "scorched" appearance [3].

Image processing techniques are being used to capture, analyze and process the images of the field or the part of the plants to detect the diseases. Color, Shape, Texture, etc. are used as a basis for the extraction of the features and further analyzed for taking out the similar patterns from the images, which further used to classify between the healthy and diseased leaves.

2 Related Work

There are various features are used by many authors to extract the features and to analyze them. The The segmentation of the image is done using Inverse DCT and Gray level co-occurrence matrix (GLCM) are extracted and used by S. Aasha Nandhini, R. Hemalatha et al. [4] as features and Support Vector Machine was used as a classifier which estimated the accuracy for detecting as 98.5% and the accuracy of classifying as 98.4%. Gittaly Dhingra, Vinay Kumar et al. [5] used features like, Color & shape & position, texture, HAAR & SIFT and passed them to the Artificial neural networks & Naives Bayes classifier and further Fuzzy logic analysis & AdaBoost algorithm are performed, which estimated an accuracy of 98%–100%. K-means clustering, DWT, SIFT, GLCM are used to detect rice plant leaves diseases and classification is done using KNN, ANN, Naïve Bayes, SVM for achieving 90–98% accuracy, by T. Gayathri Devi, P. Neelamegam et al. [6]. Mohammed Ghazal, Ali Mahmoud et al. [7] used Dice similarity coefficient, Absolute surface difference, Bidirectional Hausdorff distance as features for accurate segmentation of leaf images and estimated the accuracy of 91.38%. K-means, Watershed, Barbedo's Histogram based segmentation & Indices Based Intensity Histogram Segmentation are used to segment leaf blight disease by S. Kalaivani, S.

P. Shantharajah et al. [8] achieving and accuracy of 98.79%. Parminder Kaur, Husanbir Singh Pannu et al. [9] used Fractional order Zernike moments (FZM) along with Multi-SVM along with radial basis kernel function (RBF) achieving an accuracy of 97.34%. Multiresolution analysis, Gradient vector diffusion are used by Derek Kelly, Avimanyou Vatsa, Wade Mayham et al. [10] to Extract complex lesions. Mónica G. Larese, Pablo M. Granitto et al. [11] found local leaf vein patterns using Scale-invariant feature transform (SIFT) alongwith SVM with an accuracy of 91.49%. Marek Schikora, Balram Neupane et al. [12] weighed squared sum of the individual channels and binarize the solution to obtain the globally optimal segmentation and classified using SVM with an accuracy of 95.8%. Namita Sengar, Malay Kishore Dutta et al. [13] identified & quantified powdery mildew disease in cherry leaves using Binary mask of ROI and achieved classification of 99%. The color index of the area where the disease is prominent i.e. Lesion (LCI), the ratio of the area where infection is appearing (RIA) and the index representing how severe the rust is (RSI) are used by Sourabh Shrivastava, Satish Kumar Singh et al. [14] alongwith an accuracy of 88.9%. Sourabh Shrivastava, Satish Kumar Singh et al. [15] used BIC, CCV, CDH, LBP, SSLBP, LAP and SHE alongwith SVM and KNN classifiers to achieve an accuracy of 95%.

From the above discussion, it is observed that the texture features can be used to extract the useful information from the captured images with high accuracy [21–23]. There are 3 types of features (texture) are used in this approach i.e. Local Binary Pattern (LBP), Complete Local Binary Pattern (CLBP) and Local Ternary Pattern (LTP). A comparison between the three is shown in this paper which depicts the accuracy among these features.

3 Database and Methodologies

3.1 Image Dataset

The Plant Village Dataset is used while performing this approach [24]. A set of 400 RGB images are chosen from the dataset with a resolution of 256 × 256. Out of 400, 280 images are used for training the system and for testing purpose rest 120 images are considered. The captured images consist of single leaf which are captured using a monochrome background mainly white/light colored as shown in Fig. 1.

3.2 Methodology

The below mentioned is the flowchart of the approach Fig. 2:

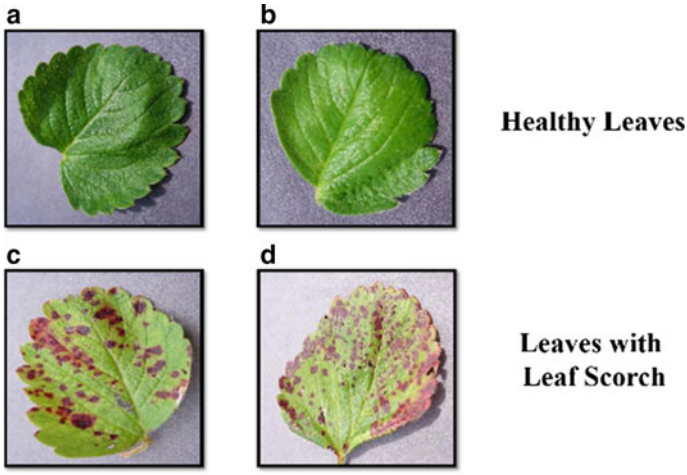
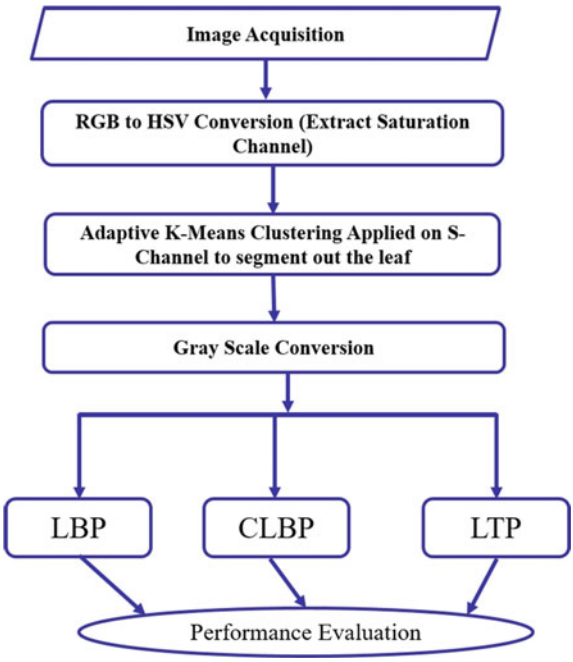


Fig. 1 **a** & **b** Plant village dataset containing healthy leaf, **c** & **d** Leaves having the disease Leaf Scorch

Fig. 2 Proposed approach



The Proposed Approach is as follows: the input image is loaded into the system. Since the images are in RGB format, it is needed to convert the image into HIS format for further processing [16]. The following formulae are used to convert the 256 × 256 resolution RGB images into HSV format, using Eq. 1–9:

$$R' = \frac{R}{255}, \tag{1}$$

$$G' = \frac{G}{255}, \tag{2}$$

$$B' = \frac{B}{255} \tag{3}$$

$$K_{max} = max(R', G', B') \tag{4}$$

$$K_{min} = min(R', G', B') \tag{5}$$

$$D = K_{max} - K_{min} \tag{6}$$

Hue calculation:

$$\mathrm{H} = \begin{cases} 0, & D = 0 \\ 60 \times \left(\frac{G'-B'}{D} mod 6\right), & K_{max} = R' \\ 60 \times \left(\frac{B'-R'}{D} + 2\right), & K_{max} = G' \\ 60 \times \left(\frac{R'-G'}{D} + 4\right), & K_{max} = B' \end{cases} \tag{7}$$

Saturation calculation:

$$\mathrm{S} = \begin{cases} 0, & K_{max} = 0 \\ \frac{D}{K_{max}}, & K_{max} \neq 0 \end{cases} \tag{8}$$

Value calculation:

$$\mathrm{V} = K_{max} \tag{9}$$

The Saturation has been extracted by using the above-mentioned formulae. The operation of segmenting the green part (leaf part) from the image is done by applying Adaptive K-means Clustering [17]. The Adaptive K-means Clustering choose K value as 2 and increase till 10 progressively. At the initial stage, it develops 2 clusters (since K = 2) and try to segment the image. Then the maximum connected domain algorithm is applied to get the results of the segmentation. The results came out to be the correct values of K the it is considered that the K value has been chosen correctly, else, the K-value will be increased until the correct values are obtained. Then, the segmented image obtained from Adaptive K-means Method is converted into gray scale image Fig. 3 and 4.

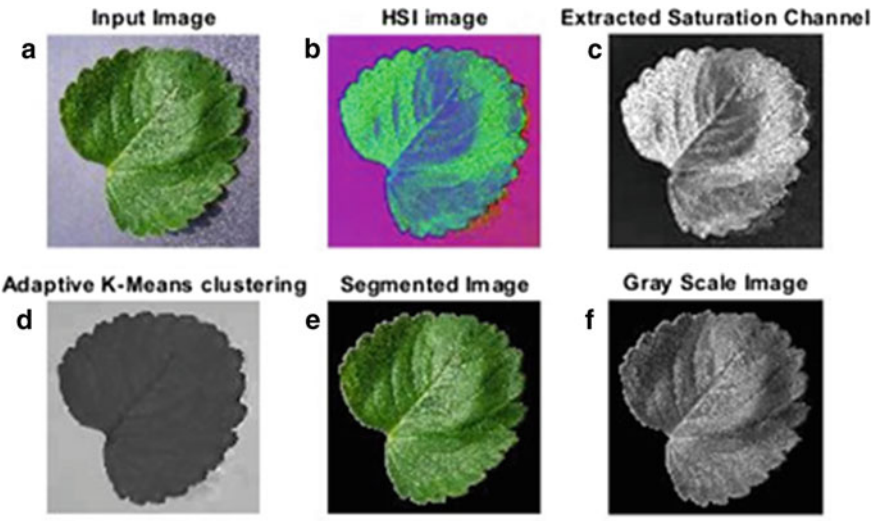


Fig. 3 **a** Input RGB Image of healthy leaf **b** RGB to HSI conversion **c** Extracted saturation channel **d** Adaptive K-means clustering applied on saturation channel **e** Segmented image **f** Gray scale conversion

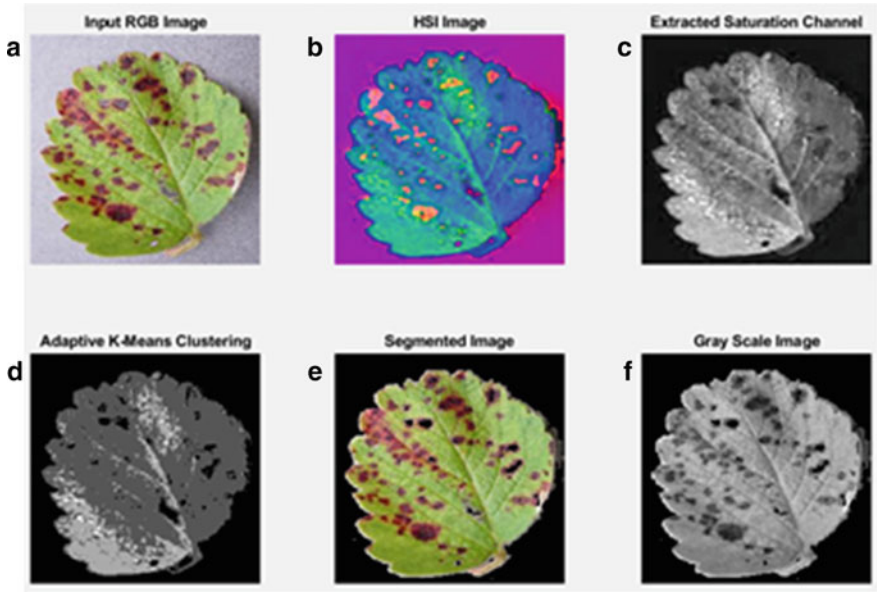


Fig. 4 **a** Input RGB image of leaf with disease leaf scorch **b** RGB to HSI conversion **c** Extracted saturation channel **d** Adaptive K-means clustering applied on saturation channel **e** Segmented image **f** Gray scale conversion

4 Feature Extraction

The three techniques used to extract the texture features are as follows:

4.1 Feature Extraction Using LBP

Local Binary Patterns are said to have a robust nature since the variance in the illumination conditions can not affect the results of LBP and hence it has been called as a powerful technique to extract texture features. The LBP is applied on the whole image. The gray scale image obtained from the previous steps is used as input to the LBP descriptor. The image is partitioned into certain number of cells and the following function is performed on each cell [18]:

$$LBP_{R,N}(x,y) = \sum_{i=0}^{N-1} M(s_i - s_c)2^i, M(x) = \begin{cases} 1, & x \geq 0 \\ 0, & otherwise \end{cases} \quad (10)$$

where N shows the neighborhood and R shows the radius from center of cell or the center pixel.

The radius R corresponds to the distance of the center pixel to the neighboring pixels. The neighborhood N, refers to the no. of pixels in the cell around the center pixel. The difference matrix is generated by calculating the difference between each pixel in the cell and the center pixel of the cell. The threshold matrix is computed by assigning 0 to the negative values and 1 to the positive values. The LBP Code is generated using the threshold matrix which is a binary code. The binary digits are multiplied with the power of 2 (i.e. 2^N) and the number generated is assigned to the center pixel as shown in Fig. 5. LBP Code for each cell is computed and a feature vector is generated by concatenating the results of each cell which will be used further for classification purpose.

4.2 Feature Extraction Using CLBP

The CLBP is another variant of LBP but it conveys more discriminant information of local structure which is ignored by LBP & Local Ternary Patterns are used since it is more robust to noise than LBP which may improve the accuracy of the system. Complete LBP is also known as Local Difference Sign-Magnitude Transform (LDSMT) since there are two matrices that are obtained first, Sign Matrix (s_p: helps in estimating the local information more than the magnitude part) which is computed using a Local threshold Matrix [19]. The local threshold matrix is computed by taking the difference of the neighboring pixels (i_p) and the center pixel (i_c), using

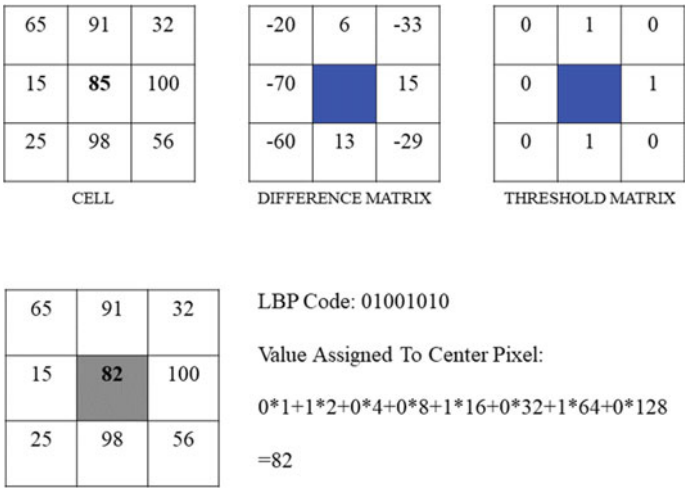


Fig. 5 Local binary pattern computation

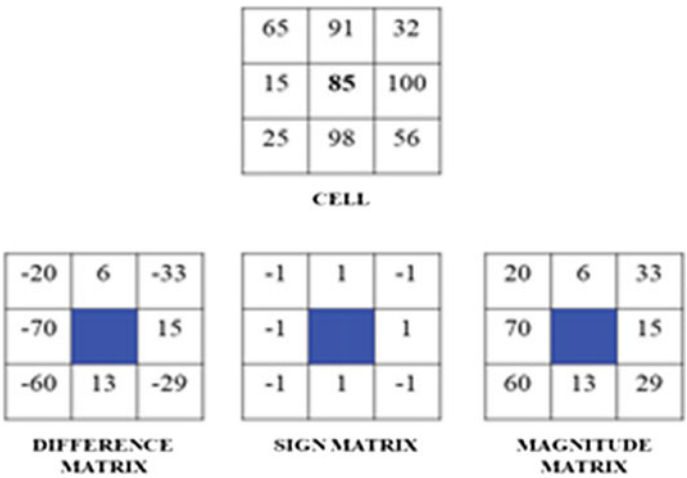


Fig. 6 CLBP computation

Eq. 11. The difference values which are negative have assigned value '−1' and positive values have assigned value '1' as shown in Fig. 6.

$$s_p = \left(i_p - i_c\right),\ m_p = \left|i_p - i_c\right| \tag{11}$$

The second matrix, i.e. Magnitude Matrix (m_p) is obtained by taking the local difference values without their signs.

The value for center pixel is computed using coding in Binary after applying thresholding globally. The estimated binary coded value for center pixel, Sign matrix and Matrix are combined/fused to get a feature vector which is used further for the classification purpose.

4.3 Feature Extraction Using LTP

The Local Ternary Patterns i.e. LTP is another extension of LBP but LTP uses 3 values when assigning the binary values. A threshold (t) is decided which is used to decide a range $[c-t, c+t]$, as shown in Fig. 7 which is computed by taking the difference of center pixel (c) and the threshold value and the Local Difference Matrix is obtained [20].

The Ternary Code Matrix is obtained by assigning the values which are greater than or equals the center pixel are assigned '1', the values lie between the range decided are assigned '0' and the values less than the center pixel are assigned '−1', using Eq. 12.

$$LTP_{R,N}(x,y) = \sum_{i=0}^{N-1} M(s_i - s_c)2^i, M(x) = \begin{cases} 1, & x \geq t \\ 0, & -t < x < t \\ -1, & x < -t \end{cases} \tag{12}$$

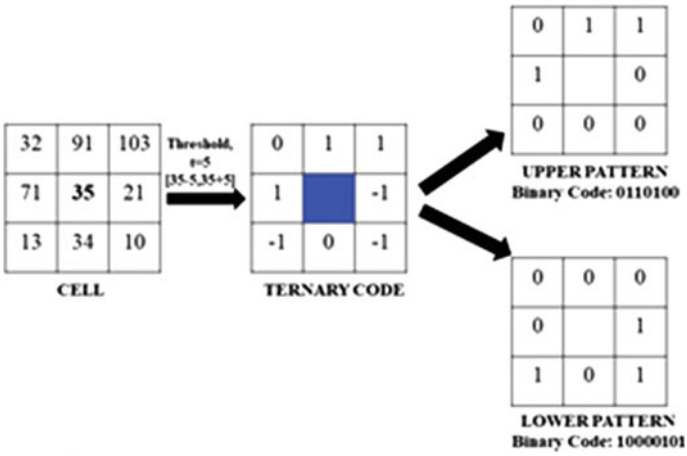
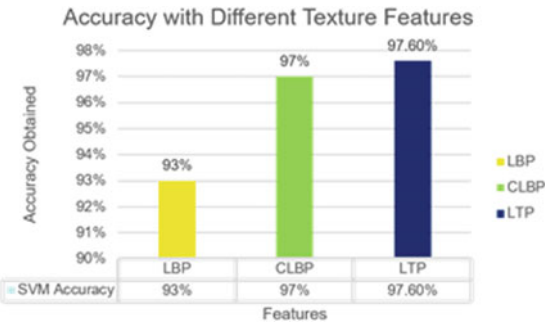


Fig. 7 LTP computation

Table 1 Accuracy obtained with different texture features



5 Results and Discussion

All the three techniques are used to extract features and obtain feature vectors. The obtained feature vectors are then passed into SVM (Support Vector Machine) classifier. Support Vector Machine is a classifier which is used for the supervised Learning, i.e. The training is done first to make the system learn that these are the features for the pattern which are to be detected and then the testing is done. The accuracy obtained usually with SVM is very high when used with texture features.

The results are as follows:

The accuracy obtained when the LBP is used came out to be 93%. The higher number of accuracy results are obtained when CLBP and LTP are used, i.e. 97% and 97.60%, as can be seen in Table 1.

6 Conclusion

A set of 400 images are used from which 280 images are used for training the system and 120 images are used for testing purpose. Three different Texture features are used for extracting the texture features from the images of the Strawberry Plant Leaf images. The Local Binary Patterns (LBP) along with its variants Complete Local Binary Patterns (CLBP) and Local Ternary Patterns (LTP) are used as features. The CLBP and LTP features performed better than the LBP features. CLBP and LTP provided higher accuracy than the basic version of LBP.

References

1. Savary S, Ficke A, Aubertot J-N, Hollier C (2012) Crop losses due to diseases and their implications for global food production losses and food security. Food Secur 4(4):519–537
2. Chaivivatrakul S, Dailey MN (2014) Texture-based fruit detection. Precis Agric 15(6):662–683
3. Dhanvantari BN (1967) The leaf scorch disease of strawberry (Diplocarpon Earliana) and the nature of resistance to it. Can J Bot 45(9):1525–1543
4. Aasha Nandhini S, Hemalatha R, Radha S, Indumathi K (2018) Web enabled plant disease detection system for agricultural applications using WMSN. Wirel Pers Commun 102(2):725–740
5. Dhingra G, Kumar V, Joshi HD (2018) Study of digital image processing techniques for leaf disease detection and classification. Multimedia Tools Appl 77(15):19951–20000
6. Gayathri Devi T, Neelamegam P (2018) Image processing based rice plant leaves diseases in Thanjavur, Tamilnadu. Cluster Computing 22:1–14
7. Ghazal M, Mahmoud A, Shalaby A, El-Baz A (2019) Automated framework for accurate segmentation of leaf images for plant health assessment. Environ Monit Assess 191:191–491
8. Kalaivani S, Shantharajah SP, Padma T (2019) Agricultural leaf blight disease segmentation using indices based histogram intensity segmentation approach. Multimedia Tools Appl 79:1–15
9. Kaur P, Pannu HS, Malhi AK (2018) Plant disease recognition using fractional-order Zernike moments and SVM classifier. Neural Comput Appl 31:8749–8768
10. Kelly D, Vatsa A, Mayham W, Kazic T (2016) Extracting complex lesion phenotypes in Zea mays. Mach Vis Appl 27(1):145–156
11. Larese MG, Granitto PM (2016) Finding local leaf vein patterns for legume characterization and classification. Mach Vis Appl 27(5):709–720
12. Schikora M, Neupane B, Madhogaria S, Koch W, Cremers D, Hirt H, Kogel K-H, Schikora A (2012) An image classification approach to analyze the suppression of plant immunity by the human pathogen Salmonella Typhimurium. BMC Bioinf. 13(1): 171
13. Sengar N, Dutta MK, Travieso CM (2018) Computer vision based technique for identification and quantification of powdery mildew disease in cherry leaves. Computing 100(11):1189–1201
14. Shrivastava S, Singh SK, Hooda DS (2015) Color sensing and image processing-based automatic soybean plant foliar disease severity detection and estimation. Multimedia Tools Appl 74(24): 11467–11484
15. Shrivastava S, Singh SK, Hooda DS (2017) Soybean plant foliar disease detection using image retrieval approaches. Multimedia Tools and Applications 76(24): 26647–26674
16. Dhaware CG, Wanjale KH (2017) A modern approach for plant leaf disease classification which depends on leaf image processing. In: International conference on computer communication and informatics (ICCCI–2017), Coimbatore, INDIA, 05–07 January 2017, pp 1–4
17. Zheng X, Lei Q, Yao R, Gong Y, Yin Q (2018) Image segmentation based on adaptive K-means algorithm. EURASIP J Image Video Process 2018:68
18. Heikkila M, Pietikainen M, Schmid C (2009) Description of interest regions with local binary patterns. Pattern Recognit 42:425–436
19. Guo Z, Zhang L, Zhang D (2010) A completed modeling of local binary pattern operator for texture classification. IEEE Trans Image Process 19(6):1657–1663
20. Rassem TH, Khoo BE (2014) Completed local ternary pattern for rotation invariant texture classification. Sci. World J. 2014, Article ID 373254, p 10. https://doi.org/10.1155/2014/373254
21. Ansari MD, Ghrera SP (2018) Intuitionistic fuzzy local binary pattern for features extraction. Int J Inf Commun Tech 13(1):83–98
22. Ansari MD, Ghrera SP (2016) Feature extraction method for digital images based on intuitionistic fuzzy local binary pattern. In: 2016 International Conference System Modeling & Advancement in Research Trends (SMART), November 2016. IEEE, pp 345–349

23. Ansari MD, Koppula VK, Ghrera SP (2019). Fuzzy and entropy based approach for feature extraction from digital image. Pertanika J Sci Tech 27(2)
24. Mohanty SP (2018) PlantVillage Dataset. https://github.com/spMohanty/PlantVillage-Dataset. Accessed 26 Aug 2020

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Robotic Application in Stress Management Among Students in India

K. S. Madhusudan. and GeeVarghese

Abstract This paper is trying to explore the use of robots, particularly in the educational sector with special reference in managing stress among student in India. As stress, anxiety, depression and in severe cases lead to the suicides had become common among student therefore, the mental health of student is as-most important in-order to bring an inclusive environment for learning. Robots can be an effective apparatus for students in hassles, stress-free learning environment, which will, in turn, reduce the stress and its negative impact in the long run. At present only a few start-ups have started this initiative and in future, we can hope that government too can follow it towards building a knowledgeable stress-free academic environment for learning and development.

Keywords Robot in education · Robot and stress · Student stress · Robot learning

1 Introduction

Robots are perceived by the students to be effective in dealing with their academic problems Singapore and japan are among them as an example. Even startups are now ready in India to impart practical training in robotic in the form of hardware, and actual projects for companies, practical training kit product to school and colleges are given. Few startups namely phi robotics education, Edurobo, Jay robotics are some of the startups looking to tap this opportunity and they are changing the way robotics are perceived by students in schools and colleges today. Startups have started delivering practical training in robotics through different hardware, companies with actual projects [1–3].

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_64

2 Development of Robotics in Educational Sector in India

Implement the concept of STEM learning. This project is based on "Learning by doing", hence, it encourages the student to solve problems, enhance their decision-making ability, scientific curiosity and comprehend. This program engages the student in dynamic activities by using their experience, thus they discover an exciting and important link with the external world. RoboGenius Lab can be integrated with a different type of school curricula such as CBSE, ICSE, IB and state board. The performer involves the following aspects

- Lesson plans with specific learning outcomes
- Activity guide which helps the teacher to ensure effective delivery of content.
- RoboGenius Labs gives a complete manual and training for effective execution and implementation. By this RoboGenius lab help students to reach a level next in education as literates them in technology and make studies stress-free learning.
- Evaluation forms this help to track the performance of the student and corrective action needed for improvement

3 Advantages of Robots in Teaching

- It helps in preparing students for the future as a confident individual without subjecting them to stress it makes learning enjoyable and stress-free.
- It creates a competent and skilled person for demanding job market.
- Practical usage of science, engineering and arithmetic are fun when robots are used for such purpose which makes enhance students learning and avoids academic stress among students.
- Robots will enhance analytical and logical skill which will, in turn, have competitive advantages.
- It will develop teamwork and co-operative skills.
- It will help with a SWOT analysis of student which will in-turn help students in self-branding.
- Robots will create a knowledgeable leader for tomorrow (Table 1).

Table 1 Startups in India

S. No	Name of Start-ups	Founder	Place of operation	Products
1.	Jay-Robotics	Subdir Reddy	Hyderabad	RoboGuru
2.	Edurobo	Sreeker Reddy	Hyderabad	Training course in robotics
3.	Robosoft	Syed Rose Farooq,	Mumbai	DIY Kits in Robotics
4.	Phi Robotics	Pranay Kishore	Mumbai	Phi Robotics solution, Phi Educational store

Source: Secondary data

4 Students Academic Stress in India

In India academic stress is common among student due to the increased competition in the job market and perception toward education, since from childhood a student is subjected to a different stream in which he/she is not actually interested and finally such forced reinforcement towards students give rise to stress which further leads to complication such as anxiety depression and in adverse cases it leads to suicides. According to the National crime record bureau, approximately 7% of suicides account for students in the total suicide cases in India. Moreover, 82% of the student show a high level of stress before examinations [4–10].

5 Reasons for Stress Among Students

- Putting too much burden on the student for multitasking actual in which he/she is not interested and finally not able to cope up with it.
- The student to student interaction had gone down, which might act as a stress-buster due to the digital era, most of the time a student spends in a virtual world and stress became accumulated over time and leads to negative impact.
- Parents are expecting from their children's which is not within their interest, capability and talent.
- There is an incompatibility between the physical and mental growth and the academic environment.

6 Cases Supporting Academic Stress Among Students in India

- A student with a suicide note wrote that he is ending this life due to academic stress.
- A girl had chopped her hand under the wheels of a train and died later due to excessive bleeding. This was because she had done badly in Mathematics and was scolded by parents' at the house.
- A girl recently pointed out that parent needs to be counselled since she was studying medicine due to her parents' demand, whereas she was interested in studying history.

7 Secondary Data Supporting the CASE

Inference: When the research was conducted in the age group 12–18 at Jaipur in India. It was found from the above Figs. 1 and 2 that about 13% are stressed before one month of the exam, whereas about 82% were stressed before one week of the exam.

Inference: From the above Figs. 3 and 4 it is inferred that about 7% of suicides account for students on total suicides committed, whereas 27% of suicides occurring nationwide due to unemployment.

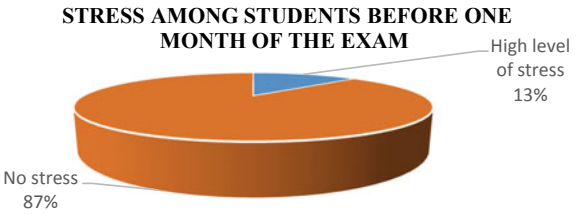

Fig. 1 Source: Secondary data

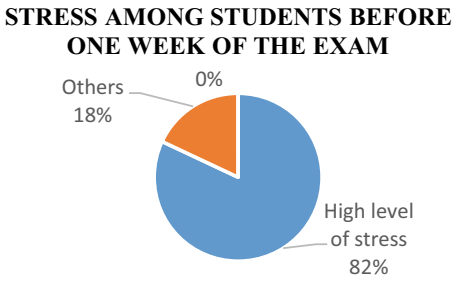

Fig. 2 Source: Secondary data

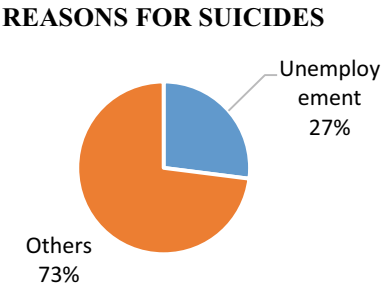

Fig. 3 Source: Secondary data

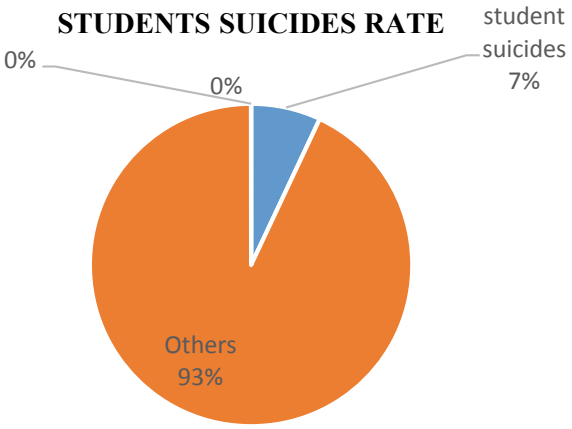

Fig. 4 Source: Secondary data

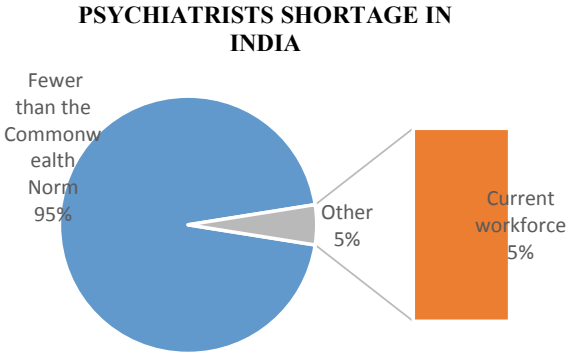

Fig. 5 Source: Secondary data

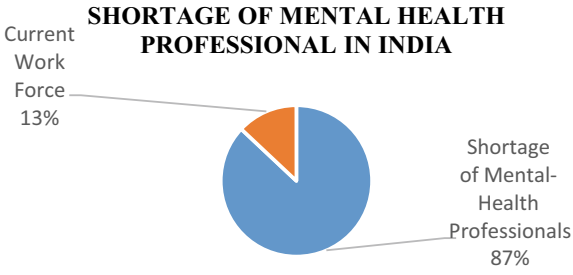

Fig. 6 Source: Secondary data

Inference: From the above Figs. 5 and 6 it is inferred that about 95% of shortage in psychiatrists in India and there is about 87% of shortage in mental health professional across the country.

8 Conclusion

Robots are used in various industries for different uses. Now this is the correct time that robots can be used for real human benefits, therefore, usage of robots in education sector will not only help in the delivery of lectures effectively even it will have good impact on learning of students, having said that, some of the startups have started exploring this niche marketing even government too can take initiatives in order to tap its potential to a greater extent, which will help in building mentally stable and healthy learning environment, where both educational service providers(Schools/Colleges) and the educational service consumers (students) will have a win–win scenario.

References

1. Adarsh VS (2015) Startups are trying to introduce robotics in school curriculum (startups are changing the way robotics is perceived by students in schools and colleges today). https://tech.economictimes.indiatimes.com/news/startups/roboTics-startups-Indianschools/46195445/, Accessed 20 June 2018
2. In school solutions robogenius stem lab. https://robogenius.in/, Accessed 19 June 2018
3. Vinay (2017), Benefits of robotics in education. https://www.indiaFirstrobotics.com/benefits-of-robotics-in-education/sioninthisfield/, Accessed 21 June 2018
4. Intishab S (2016) A week before exam, 82% students show high stress. https://timesofindiaindiatimes.com/city/jaipur/A-week-before-exam-82-students-show-high-stress/articleshow/53444585.cms/, Accessed 21 June 2018
5. Nair M, (2014) Is Exam the sole factor causing stress among student in India? https://www.mapsofindia.com/my-india/education/is-exam-the-sole-factor-causing-stress-among-students-in-india/, Accessed 21 June 2018
6. Saha D (2017) https://www.hindustantimes.com/health-andfitness/every-hour-one-student-commits-suicide-in-india/story7UFFhSs6h1HNgrNO60FZ2O.html, Accessed 29 June 2018
7. Madhusudan KS (2019) A study on mobile-learning an innovative approach for a stress-free learning environment in engineering colleges in around Chennai. Int J Innov Technol Exploring Eng 8(5):1031–1034
8. Madhusudan KS et al (2019) In competencies among engineering students as an antecedents in stress among engineering students in around Chennai. Int J Recent Technol Eng 8(1):113–117
9. Syahmaidi et al (2019) Needs analysis of designing online computer-assisted training to improve pedagogical competencies in engineering education. Int J Eng Adv Technol 8 (6):4619–4624
10. Madhusudan KS et al (2019) Social robots a strategic antidote for stress among engineering students in around Chennai. Int J Recent Technol Eng (IJRTE) 8(4):2316–2319

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Periodical Fruit Quality Identification—A Broad View

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Abstract Now a days to maintain the health in polluted environment is very crucial part of our routine life. If the persons are not focusing on their health they will be suffering from different types of diseases. Therefore, to maintain the good health we need to visit the nearest hospital or multispecialty or super specialty hospitals to diagnose the disease and further its treatments. To maintain the body energetics and healthy doctors are always preferred to suggest eating some fruits. Fruits plays a very important role to keep the body and health in proper condition. Therefore, in this paper fruit quality identification is studied. It is observed through the study there are so many researchers has worked on the finding the defects of fruit with different types of techniques. Overall periodically studied the work on fruit quality identification on the basis of color, texture and classification techniques.

Keywords Fruit grading · Fruit quality · Image processing · Size detecting

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_65

1 Introduction

India is an agricultural nation. The production from the farm is in second position in the world. It is observed that near about 60% Indians are directly or indirectly depends on the business which are on agricultural products. It plays very important role in Indian economy. Farmers mostly depend on the yield of agricultural products, therefore, there is a need to focus on agriculture products which can be in good quality. To scale the economic situation of current poor or low land holder farmers, there is a need to export their products in demanding market in a good quality [1]. One of the major farm products is fruit. Fruits are very useful to our health. Physicians always suggest the best quality fruit to the patients to recover from the diseases. Fruits contain different types of vitamins, proteins, etc. which can be helpful to our body. Hence there is a need to provide good quality fruit in the market. Mainly fruits are eaten to maintain the health and additionally it provides pleasure [2]. Important fact to check the fruit quality is to analyzed organoleptic property but instead of it agronomic research works are concentrated on increase of yield, protection from diseases, storage resistance and transportation tolerance, etc. [3–6]. Probably 20–40% crops qualities lost postharvest in the emergent nations. It is because of decline, machine oriented damage, biological syndromes, at the time of harvest, during storage and transport. Figure 1 shows the some samples of defective fruits. These are the defects are shown on Apple fruit.

Fig. 1 Defects in fruits [7]

2 About Quality Fruit

Quality is an indication of the grade of superiority of any item or any customer oriented things. It is a characteristic which is designed by the humans to compare the similar type of product. It may be vary from product to product or any item such as fruit quality can be measured on the basis of sensing like appearance of fruit, texture, etc. or it can be sensed by a tongue (i.e. Taste), nose (i.e. Aroma). Apart from these appearance based quality of fruit, some of the properties can be examined through nutrition's, chemical, and mechanical or defects on functional components [8, 9]. Judith A. Abbott (1999) has worked on "Quality measurement of fruits and vegetables" says that humans can observe the quality, but sensors or devices are able to measure the various factors related to the quality which are useful to decide the exact quality of it [8]. According to Shewfelt (1999) quality parameters can be decided on the basis of product or customer requirements [10].

3 Feature Extraction Methods

3.1 Color Feature

Color image consists of three important colors like Red, Green and Blue. These colors having different intensity levels. By using this color intensity as features it is processed and according to that results were taken by the various researchers. Zou Xiaobo [11] has classified the apple fruit into four grades like Reject, Class-I, Class-II, and Extra. They have developed organization feature parameter (OFP) method and compared their results with BP-ANN with SVM classification. The mechanism behind the OFP is Genetic Algorithm. Overall accuracy is 95% of the fruit surface color. Guo Dong [12] has segmented the image on the basis color with the help of hierarchical prototype learning (HPL) (Figs. 2 and 3).

Fig. 2 Color based segmentation [13]

Fig. 3 Edge detection through color [13]

For prototype generation self-organizing map (SOM) and simulated annealing (SA) was used. Color space is even very useful in the identification of internal structure or defects in pickles using a hyper spectral camera [14, 15]. Most of the people were attracted towards the fruits because of colors, hence, color is a very important factor while deciding the quality of fruits. Every time only the surface color of the fruit is evaluated for grading the fruit quality [16]. There are plenty of fruits are available in the market which are red in color like apple, pomegranate, tomato, etc. Audrey Darrigues, et al. [17] has developed a tool which can work on phenotype and genotype based classification of various fruits like Potato, Cucumber, Red plum, Muskmelon, Carrot, Strawberry. Even they have created the tomato analyzer to find the phenotype. In computer vision, colors are represented in RGB and HSV color space.

RGB color space is used combination of red, green and blue in different ways which can reproduce the colors. Even in the display it uses various combinations of the intensity level of each color, the value of intensity color from 0 to 255. By the formation of various additive color intensity it produces near about 16,777,216 various shades of colors. Most of the old displays were used 16 or 256 colors only with very few memories. HSV color space is advanced version it is known by hex-cone color. The working of the HSV color space is similar to CMYK or RGB but there is a slightly different. (H) Indicates the hue i.e. pure color. We have to consider the color wheel which can work upon the pure color value between the 0 to 1 and values is calculated the corresponding position of wheel in which the fractional values are considered for the representation of color for example red color refers 0 value whereas yellow color uses 1/6 value and green color uses 1/3 value and so on. Then (S) is a saturation of white color. Representation of pure red color saturation of white color value is 1. (V) is the representation of darkness of the color. The black color is shown 0 values. For the formation of light color the wheel should be away from the black. Sometimes the value of V is replaced by the brightness, then this representation is called as HSB [18]. H.D. Cheng and others has shown the advantages of color based segmentation by using various color space like CIE spaces, HIS, YIQ, Munsell, Hybrid color space, Nrgb (Normalized rgb), etc. with different type of algorithms [19]. Guy Rosman has shown the color based

image segmentation and processing with various approaches [20]. With the help of color of blueberry fruit identified the current growth stage of that fruit in a natural environment [21]. Sometimes watershed algorithms are used in combination with color for the segmentation of image for grading fruits [22]. While deciding the qualities by various grading factors, sometime ripeness of fruit is also considered in the Neural Network models are used for the recognition of the color [12, 23, 24]. Whenever, we are processing the color by the manually by our eyes or through the system of sensors, it is divided into three different approaches based on color spacer i.e. Hardware-Orientated (H/W-O), Human-Orientated (H-O) & instrumental space. H/W-O color space is able to generate the colors. Most of the general color space are comes under this category, such as R-G-B, Y-I-Q, and C-M-Y-K. The H-O color spaces are constructed on hue and saturation. HSI, HSL, HSV and HSB come under this category. Here shade, tone tint type of perceptions are as per the ideas of artistic people. This type of representation of color is not sensitive to small differences of colors which works like a human vision, hence, it is not suitable during the processing of production of colors [25]. To get the most accurate fine detail information of the colors instead of the normal RGB based camera multispectral and hyperspectral sensors were used [14, 26, 27].

3.2 Texture Features

Texture features are given the outline of the original scene. There is plenty of object recognition system were developed on the basis of texture based features. Jun Zhao has developed a system which can work on texture properties of fruits which are on the tree. They have recognized the fruit on the tree with the help of texture features [28]. S. Arivazhagan, et al. [29] has shown the comparative study of various fruits, fruit color and texture features gives 86%. Ravikant Sinha has identified the infection with the help of texture features on the basis of color [30]. Texture features are used to calculate the prediction of yield of apple fruit [31, 32].

As per the objective or requirement texture feature evaluation categories into three classes (Szczesniak et al., 1963)— fundamental, empirical, and imitative [33]. For the selection of the specific texture of a specific surface various kinds of statistical methods has been used (Gonzalez & Woods 2008) [3, 34, 35]. To find out the shapes like circle or other types of shapes in texture Hough transformation or Gabor, Tamura texture feature extraction techniques are used [36]. For automatic quality detection, texture plays a vital role [37–39]. To detect the quality of the fruit through the computer vision very first criteria is the identification of texture [40]. Recent development in the domain of the fruit quality determination survey indicates the authenticity for the use of texture features [41–44]. Megha. P. Arakeri [45] extracted the texture features through color processing on the gray image like contrast, Correlation, Energy, Homogeneity, etc. In short 12 texture features were extracted from a color image. Fruit colors can be used for recognition of fruits [46].

4 Classification Approach

There are various approaches can be used to classify the object. A statistical approach like distance measurement, Template matching, Artificial Neural Networks, etc. According to the use of classification techniques can be categorized into three main broad categories supervise, unsupervised and the combination of the both approaches. Before the actual classification we have to extract the features from feature extraction techniques like the Partial—Least—Squares—Regression (PLS or PLSR), MLR- (Multivariate—Linear—Regression), ANN, PCR(Principal—Component—Regression), PCA (Principal–Component-Analysis) [47]. There is a need to develop a strong feature extraction technique and classification techniques which can classify the data more accurate. K-means, Support Vector Machine, Back Propagation, RGB to other color conversions, template matching, watershed, Euclidian distance or other distance measurement techniques, etc. are highlighted by the Sandesh Raut and Amit Fulsunge [48, 49]. Multi-Layer Perceptron Neural Networks [3], Fuzzy and neural network can be a good approach for segmentation and analysis of quality identification [50]. Grading can be decide by the classification approach [16], on the basis of multiple features [51]. Total number of fruit can also be calculated [52] using deep learning approach. Specific fruit is either rip or not can be checked using Decision Tree Classification [53].

5 Conclusion

Fruits plays a very important role to keep the body and health in proper condition. Quality is an indication of the grade of superiority of any item or any customer oriented things. It is a characteristic which is designed by the humans to compare the similar type of product. In this paper studied fruit quality identification in the last two decades and gives overall periodically studied the work on fruit quality identification on the basis of color, texture and classification techniques. There are various approaches can be used to classify the object. Statistical approach like distance measurement, Template matching, Neural Network, etc.

Acknowledgements We would like to acknowledge Siddharth Arts, Commerce and Science College, Jafrabad and Dr. G.Y. Pathrikar College of CS & IT, Aurangabad for providing the infrastructure and other support during this work.

References

1. Wasule SM (2018) Quality determination and grading of tomatoes using Raspberry Pi. Int J Recent Innov Trends Comput Commun 6(7):86–89
2. Sereke F (2012) Research collection: theses, a methodology for assessing the quality of fruit and vegetables. Dr. Thesis
3. Vesali F, Gharibkhani M, Komarizadeh MH (2011) An approach to estimate moisture content of apple with image processing method. Aust J Crop Sci 5(2):111–115
4. Al Ohali Y (2011) Computer vision based date fruit grading system: Design and implementation. J King Saud Univ Comput Inf Sci 23(1):29–36
5. Cubero S, Aleixos N, Moltó E, Gómez-Sanchis J, Blasco J (2011) Advances in machine vision applications for automatic inspection and quality evaluation of fruits and vegetables. Food Bioprocess Technol 4(4):487–504
6. Quinton JN (2011) Encyclopedia of Agrophysics, vol 32, no 3. Springer
7. Chithra P (2017) Defect identification in the fruit apple using k-means color image segmentation algorithm. Int J Adv Res Comput Sci 8(8):381–388
8. Abbott JA (1999) Quality measurement of fruits and vegetables. Postharvest Biol Technol 15:207–225
9. J Pang et al (2016) Spectral analysis of Chinese medicinal herbs based on delayed luminescence. Evidence-Based Complement. Altern. Med. 2016(Dl):1–8
10. Mwangi G, Fieguth P, Garbe CS (2015) Thermography spatial resolution enhancement by non-rigid registration with visible imagery. In: Proceedings - International Conference on Image Processing, ICIP 2015, vol 2015, pp 2542–2546, December 2015
11. Xiaobo Z, Jiewen Z, Yanxiao L (2007) Apple color grading based on organization feature parameters. Pattern Recognit Lett 28(15):2046–2053
12. Dong G, Xie M (2005) Color clustering and learning for image segmentation based on neural networks. IEEE Trans Neural Networks 16(4):925–936
13. Lak MB, Minaei S, Amiriparian J, Beheshti B (2010) Apple fruits recognition under natural luminance using machine vision. Adv J Food Sci Technol 2(6):325–327
14. Ariana DP, Lu R (2010) Evaluation of internal defect and surface color of whole pickles using hyperspectral imaging. J Food Eng 96(4):583–590
15. Xu H, Ying Y (2011) Spectra coupled with color features to determine sugar content of fragrant pears using LS-SVM. In: 2011 IEEE/SICE International Symposium System Integration. SII 2011, pp 197–201
16. Gay P, Berruto R, Piccarolo P (2002) Fruit color assessment for quality grading purposes. In: 2002 ASAE Annual International Meeting/CIGR XVth World Congress, vol 0300, no 02, pp 1–9
17. Darrigues A, Hall J, van der Knaap E, Francis DM, Dujmovic N, Gray S (2008) Tomato analyzer-color test: a new tool for efficient digital phenotyping. J Am Soc Hortic Sci 133 (4):579–586
18. Phakade SV, Flora D, Malashree H, Rashmi J (2014) Automatic fruit defect detection using HSV and RGB color space model. Int J Innov Res Comput Sci Technol 2(3):67–73
19. Cheng HD, Jiang XH, Sun Y, Wang J (2001) Color image segmentation: advances and prospects. Pattern Recognit 34(12):2259–2281
20. Rosman G, Tai XC, Dascal L, Kimmel R (2012) Polyakov action minimization for efficient color image processing. In: Lecture Notes Computer Science (including Subseries Lecture Notes Artificial. Intelligence Lecture Notes Bioinformatics), vol 6554, no PART 2, pp 50–61
21. Li H, Lee WS, Wang K (2014) Identifying blueberry fruit of different growth stages using natural outdoor color images. Comput Electron Agric 106:91–101
22. Deepa P, Geethalakshmi SN (2012) A comparative analysis of watershed and color based segmentation for fruit grading. Int J Soft Comput Eng 2(3):11–15
23. Bhargava A, Bansal A (2018) Fruits and vegetables quality evaluation using computer vision: a review. J King Saud Univ - Comput Inf Sci 1–15

24. Krishnan RP, Sofiah S, Radzi M (2009) Color recognition algorithm using a neural network model in determining the ripeness of a Banana. System 11–13
25. Castro W, Oblitas J, De-La-Torre M, Cotrina C, Bazan K, Avila-George H (2019) Classification of cape gooseberry fruit according to its level of ripeness using machine learning techniques and different color spaces. IEEE Access 7:27389–27400
26. Narvaez FY, Reina G, Torres-Torriti M, Kantor G, Cheein FA (2017) A survey of ranging and imaging techniques for precision agriculture phenotyping. IEEE/ASME Trans Mech 22 (6):2428–2439
27. Li J et al (2016) Multispectral detection of skin defects of bi-colored peaches based on vis-NIR hyperspectral imaging. Postharvest Biol Technol 112:121–133
28. Tow J, Katupitiya J (2005) On-tree fruit recognition using texture properties and color data. In: 2005 IEEE/RSJ International Conference on Intelligent Robots and Systems, IROS, pp 3993–3998
29. Arivazhagan LGS, Newlin Shebiah R, Selva Nidhyanandhan S (2010) Fruit recognition using color and texture features. J Emerg Trends Comput Inf Sci 1(2):90–94
30. Ravikant Sinha PP (2012) Infection analysis using colour feature texture using image processing. Int J Eng Res Appl 2(4):1861–1866
31. Guo W, Nishioka K, Ymamoto K, Fukatsu T, Ninomiya S (2015) Image-based field plant phenotyping approaches for modern agriculture. In: 54th Annual Conference of the Society of Instrument and Control Engineers of Japan, SICE 2015, pp 1212–1215
32. Stajnko D, Rakun J, Blanke M (2009) Modelling apple fruit yield using image analysis for fruit colour, shape and texture. Eur J Hortic Sci 74(6):260–267
33. Barrett DM, Beaulieu JC, Shewfelt R (2010) Color, flavor, texture, and nutritional quality of fresh-cut fruits and vegetables: Desirable levels, instrumental and sensory measurement, and the effects of processing. Crit Rev Food Sci Nutr 50(5):369–389
34. Ortega-Garcia J et al (2003) MCYT baseline corpus: a bimodal biometric database. In: IEE Proceedings - Vision, Image, Signal Processing, vol 150, no 6, p 395
35. Gonzalez R, Woods R (2008) Digital Image Processing
36. Sengupta S, Lee W (2012) Identification and determination of the number of green citrus fruit under different ambient light conditions. In: International Conference on Agricultural
37. Satpute MR, Jagdale SM (2017) Automatic fruit quality inspection system. In: Proceedings of International Conference on Inventive *Computation* Technologies, ICICT 2016, vol 1 (2017)
38. Capizzi G, Lo Sciuto G, Napoli C, Tramontana E, Woźniak M (2015) Automatic classification of fruit defects based on co-occurrence matrix and neural networks, vol 5, pp 861–867
39. López-García F, Andreu-García G, Blasco J, Aleixos N, Valiente JM (2010) Automatic detection of skin defects in citrus fruits using a multivariate image analysis approach. Comput Electron Agric 71(2):189–197
40. Askar A, Treptow H (1993) Quality Assurance in Tropical Fruit Processing. Springer, Cham
41. Eliášová M, Kameník J, Saláková A, Pavlík Z, Pospiech M, Tremlová B (2017) The effect of PSE and non-PSE Adductor and Semimembranosus pig muscles on the occurrence of destructured zones in cooked hams. J Food Qual 2017:12–15
42. Zheng C, Sun DW, Zheng L (2006) Recent developments and applications of image features for food quality evaluation and inspection - a review. Trends Food Sci Technol 17(12):642–655
43. Phakade SV et al (2017) Quality measurement of fruits and vegetables. J Food Eng 5(2):1–5
44. Rai A, Arpitha V, Varkhedi MM, Chethan K (2019) Food quality research based on various image processing techniques. Int J Recent Technol Eng 8(2(8)):1825–1827
45. Arakeri MP, Lakshmana (2016) Computer vision based fruit grading system for quality evaluation of tomato in agriculture industry. Procedia Comput Sci 79:426–433
46. Thendral R, Suhasini A, Senthil N (2014) A comparative analysis of edge and color based segmentation for orange fruit recognition. In: Proceedings of the International Conference on Communication and Signal Processing, ICCSP 2014, pp 463–466

47. Magwaza LS, Opara UL, Nieuwoudt H, Cronje PJR, Saeys W, Nicolaï B (2012) NIR spectroscopy applications for internal and external quality analysis of citrus fruit-a review. Food Bioprocess Technol 5(2):425–444
48. Raut S, Ingole K (2017) Review on fruit disease detection using image processing techniques. Int Res J Eng Technol 4(4):22–24
49. Habib T, Majumder A, Jakaria AZM, Akter M, Shorif M, Ahmed F (2018) Machine vision based papaya disease recognition. J King Saud Univ Comput Inf Sci 32:300–309
50. Swarnalakshmi R, Kanchanadevi B (2014) International journal of computer science and mobile computing a review on fruit grading systems for quality inspection. Int J Comput Sci Mob Comput 3(7):615–621
51. Patel HN (2011) Fruit detection using improved multiple features based algorithm. Int J Comput Appl 13(2):1–5
52. Chen SW et al (2017) Counting apples and oranges with deep learning: a data-driven approach. IEEE Robot Autom Lett 2(2):781–788
53. Wajid A, Singh NK, Junjun P, Mughal MA (2018) Recognition of ripe, unripe and scaled condition of orange citrus based on decision tree classification, pp 2–5

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SMS Spam Filtering Using Machine Learning Technique

Arvind Kumar Vishwakarma, Mohd Dilshad Ansari, and Gaurav Rai

Abstract Sending and receiving SMS is very ordinary thing for any individual's daily life. But when at the moment, we receive undesirable SMS frequently that waste our time and money as well and consequently this moment gives us unpleasant feeling. If undesirable messages are to be sent to a huge volume of recipients erratically have resulted in displeasure by consumers but gives large profit to spammers. There are lots of reasons like high internet speed, very cheap smart phones and user friendly interface of mobile web and mobile applications that attracts a huge volume of mobile phone users. These are the key factors expected to shape the future of the market. This paper focuses on SMS Spam filtering techniques and compared their performance. We compared the machine learning model's performance and finally result indicates that the Logistic Regression model performed well with accuracy reaching up to 96.59%.

Keywords Spam filtering · Machine learning algorithms · SMS spam · Classification · Mobile phone spam

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_66

1 Introduction

By the augmentation of mobile communication technology and the spreading out of smart phones, SMS has been evolved as the most significant communication methods due to most fundamental and general operations of smart devices. Now these days, smart phones are available at very low price so, every commoner having this mode of communication. High internet speed, very cheap smart phones, user friendly interface of mobile web as well as mobile applications, which has shown remarkable growth of mobile phone users. Due to increasing dependency on mobile phone for daily purpose task like everyday communications, mobile application and most important financial transactions, so it attracts reasonable intruders or attackers. Fraud like SMS Phishing that implies financial fraud and spam are grouping at a rate of over 500% year over year. Spam messages have direct negative effects on the communication channel like huge traffic, exponentially decrease computational power and storage space, which lead to financial problems. Content based and non-content based approach, these are two types of major categories of SMS Spam filtering methods to detect SMS spam [1–3]. Artificial Neural Network [4, 5], K-Nearest Neighbor algorithm [6, 7] and Logistic Regression algorithm [8] are content based.

The remaining content of this paper is organized as follows. Section 2 offers an overview along with related works in the field of SMS spam filtering. Three models which have been used for spam filtering are elaborated in Sect. 3. A short description is given in Sect. 4 about SMS spam collection. In Sect. 5 we can observe the performance of all three models on the basis of common parameters. Finally, Sect. 6 presents the conclusions.

2 SMS Spam Filtering an Overview

Unwanted text messages generally of commercial nature sent to your mobile phone are known as SMS Short Message Service (SMS) Spam. In the last ten to fifteen years advertisement through SMS has been increased intensively and therefore, spam messages introduced problems for users. Although, there are many spam detection techniques developed to preserve the accuracy of result. A number of SMS can vary by having number of characters, alphabets, numerals and a few symbols. An average number of messages shows a clear pattern. Almost every spam messages request to the users to share credentials, visit some URL.

2.1 Relevant Works

There are lots of papers have been published about email spam classifiers (e.g. [9–17]) that shows a significant work have been done in this field but still few studies

are available about SMS spam filtering in the literature. In this section, we present some of related works done to this topic.

Gómez Hidalgo et al. [18] used SMS spam datasets: English (82 spam and 1,119 ham) and the Spanish (199 spam and 1,157 ham) test databases. They applied number of machine learning techniques to check the efficiency. Basically they used several Bayesian based classifiers to detect SMS spam. And their result indicates that Bayesian filtering technique performed well to classify SMS spam.

Cormack et al. [19] concluded that some modifications are needed in terms of adaptation to email filtering techniques to get effective performance on SMS spam filtering. Basically, they used the following algorithm in order to SMS spam filtering (e.g. Logistic Regression, SVM, Bogofilter and Marcov Compression) and concluded that more large dataset is required in order to find the clear result.

Cormack et al. [20] examined the problem of content based SMS spam filtering in context of SMS, blog comments and email information. They analyzed that due to lack of sufficient number of words in short messages performance can be improved by expanding the number of features.

After applying number of approaches, Dynamic Markov Compression shows best result on spam SMS.

Liu and Wang [21] used English and Chinese datasets and applied online text classification method. The conclusion was that word-level index model is better than document-level index.

Lee and Hsieh [22] used CAPTCHA and secret sharing to check user participation and to complete the authentication process for identity verification. And they applied several machine learning methods and concluded that SVM acts as a baseline for other comparison and study because it performed well.

Vallés and Rosso [23] compared the result of plagiarism detection tools and well-known CLUTO framework. They have used the SMS spam collection [24] to carry out their experiments. And the conclusion was that this tool nicely sieved a significant number of duplicate spam SMS messages. Moreover, machine learning algorithms have been applied in other applications areas [25–27].

3 Learning-Based Methods for Spam Filtering

Recently, there are number of machine learning methods available and all are introduced by researchers in order to spam SMS detection process. Here, we are going to compare the performance of different machine learning models that have been employed for detection of spam SMS. High level accuracy is the performance criteria for all considered models. Firstly, we have introduced some well known classification models.

3.1 Methods of Classification

In the following, we have applied some well-known classification methods used in spam filtering applications.

- **K-Nearest Neighbors (KNN)**

KNN is one of the simplest supervised learning algorithm, which is mainly used in the classification of data. It basically, classifies a data point based on how its neighbors are classified. We have chosen the Euclidean distance to compare the training data samples sets and the test data samples sets. A positive integer k is specified along with a test sample. So by observing all distances, we find the nearest neighbors that have the minimum Euclidean distance. According to the Euclidean distance formula, the distance between two points in the plane with coordinates (x, y) and (a,b) is given by

$$D = \sqrt{(x - a)^2 + (y - b)^2} \tag{1}$$

- **Logistic regression**

Logistic regression is a supervised learning method for classification and deals with probability to measure the relation between dependent and independent variables.

The data should linearly separable. We need to transform the data points using the sigmoid or logit function, which is given by:

$$Sigmoid(z) = \frac{1}{1 + e^{-z}} \tag{2}$$

where, e = Euler's number $\sim$ 2.71828

This function transforms each input value to range between 0 to 1. After running the sigmoid or logit regression model, we then calculate the estimated probability, i.e. the probability of success. X is an input features and will be combined linearly using weights to predict an output value (Y). The logistic probability function can be given as follows:

$$Y = \frac{e^{(\beta 0 + \beta 1 * x)}}{1 + e^{(\beta 0 + \beta 1 * x)}} \tag{3}$$

where $\beta 0$ is the bias and $\beta 1$ is the coefficient for the single input value (x) and the predicted output is Y.

- **Artificial Neural Network**

Biological neurons is the base of Artificial Neurons. Artificial network can be considered as abstraction of biological neurons. The hardware of artificial neurons known as artificial neural network. There is a fixed threshold for each neuron, and if the net incoming input to the neurons is greater than threshold then the neuron fires. It is machine learning adaptive system. Artificial neural network is trained with back propagation algorithm and input is provided to the two layers feed forward fashion. The equation represents the interval activity of the neuron is given in the following formulas (4), (5), (6), (7):

$$z_{inj} = b_j + \sum_{i=1}^{n} x_i w_{ij} \tag{4}$$

$$z_j = f(z_{inj}) \tag{5}$$

$$y_{in} = b_0 + \sum_{j=1}^{n} z_i v_j \tag{6}$$

$$y = f(y_{in}) \tag{7}$$

where Z_{inj} the net input to each node of hidden layer. b_j, x_i and w_{ij} are the bias, input vector and weight between the input and the hidden layer respectively. Zj is the output of each hidden layers node. y is the output of the network. b0, vj is the bias of the neurons of the output layer and weight between the output and the hidden layer respectively.

4 The SMS Spam Assortment

For any scientific research, reliable data are very essential thing. And the lack of representative data can really affect the processes of evaluation and comparison of methods. Recent studies generally suffer due to unavailability data set in general. But there are some available dataset of legitimate SMS messages that can be considered as real samples of spam SMS. We found this Collection at http://www.dt.fee.unicamp.br/~tiago/smsspamcollection that is publically available. This dataset is having a total of 5,574 instances and among them; there are 4,827 ham messages and 747 spam messages. As per our knowledge, it is the largest available corpus that currently exists (Tables 1, 2, 3 and 4).

Table 1 Examples of messages present in the SMS spam corpus

Your unique user ID is 1172. For removal send STOP to 87239 customer services 08708034412	Spam
Wif my family booking tour package	Ham
Please call our customer service representative on 0800 169 6031 between 10am-9 pm as you have WON a guaranteed £1000 cash or £5000 prize!	Spam
Yup. Anything lor, if u dun wan it's ok…	Ham
I liked the new mobile	Ham
I've reached already	Ham
Yar but they say got some error	Ham

Table 2 Basic statistics

Msg type	Text count	Unique	Top	**Freq**
Ham	4827	4518	Sorry, I'll call later	30
Spam	747	642	Please call our customer service representative…	4

Table 3 Tokens appearance frequency in ham messages

Token	Number of hams msg	% of Hams
It	464	9.61
U	678	14.05
To	1219	25.25
A	880	18.23
Me	639	13.24
In	737	15.27
My	600	12.43
And	685	14.19
For	443	9.18
That	421	8.72
Of	454	9.41
I	1619	33.54
The	867	70.96
Is	603	12.49
You	1264	26.19

Table 4 Tokens appearance frequency in spam messages

Token	Number of spams msg	% of Spams
Call	329	44.04
Your	227	30.39
The	167	22.36
Or	177	23.69
Txt	145	19.41
2	142	19.01
Is	140	18.74
Have	127	17.00
For	177	23.69
On	119	15.93
From	124	16.60
U	218	29.18
2	467	62.52
Free	157	21.02
A	294	39.36

5 The Performance Measurement Parameters and Comparison

This section will illustrate important parameters to measure the power of spam filtering algorithms. Basically, we have used orange tool that is an open source data visualization and analysis tool. Work flow and separate word cloud of ham and spam instances are included in this paper. Figure 1 shows work flow and Fig. 2 and 3 represents word cloud of ham and spam respectively. Area under the ROC curve (AUC), Precision, Recall, and Accuracy are different parameters to check the performance of the used models. If curve covers large area then it shows significantly good performance. And to understand other three criterions, we should know about some terms such as TP, FP, TN and FN.

We have two classes as ham and spam, ham means legitimate SMS, whereas spam is known as unwanted SMS.

TP means True Positive: The number of Ham messages that classified correctly.

FP means False Positive: The number of Spam messages that classified correctly.

TN means True Negative: The number of Ham messages that classified incorrectly as spam messages.

FN means False Negative: The number of Spam messages that classified incorrectly as Ham messages.

Now, performance measurement parameters are as follows:

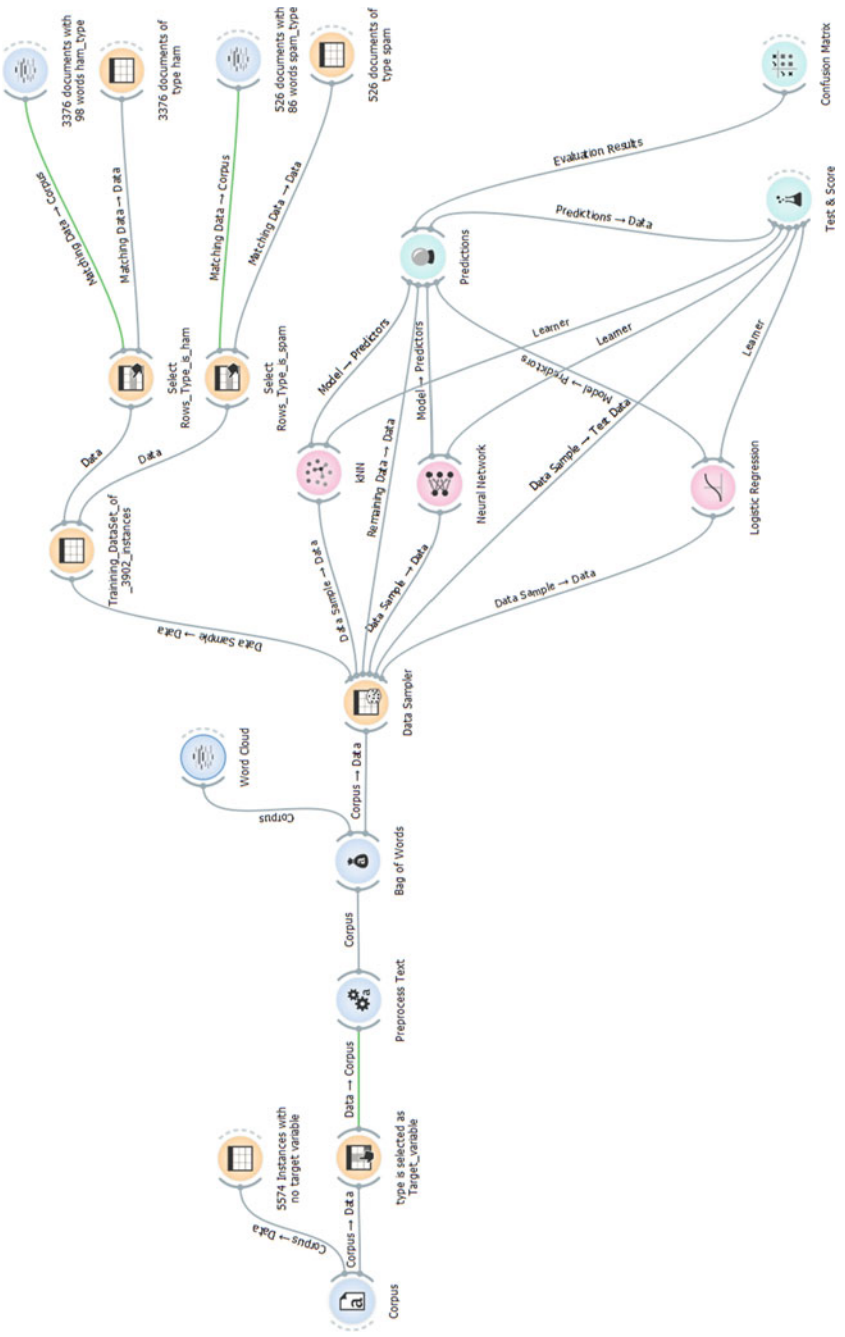

Fig. 1 Work flow

Fig. 2 Word cloud: total 98 words of ham type documents

Fig. 3 Word cloud: total 86 words of spam type documents

$$Spam\,Recall = \frac{\mathrm{TP}}{\mathrm{TP} + \mathrm{FN}}$$

$$Spam\,Precision = \frac{\mathrm{TP}}{\mathrm{TP} + \mathrm{FP}}$$

$$Spam\,Accuracy = \frac{\mathrm{TP} \;+\; \mathrm{TN}}{\mathrm{TP} + \mathrm{TN} + \mathrm{FN} \;+\; \mathrm{FP}}$$

In this paper, we use Recall, Precision, Accuracy and Area under the ROC curve (AUC) parameters for comparing the performance of the methods.

Table 5 Parameters of each classifier

Classifier	Parameter	TP	FN	FP	TN
Logistic regression	Regularization type: Ridge (L2)	1450	12	45	165
Neural Network	Hidden layers = 100, Activation: ReLu, Iteration = 200	1434	28	33	177
KNN	No. of Neighbours = 5, Metric = Euclidean	1447	15	55	155

Table 6 Measurements

Model	AUC	CA	F1	Precision	Recall	Accuracy %
Logistic regression	0.967	0.951	0.972	0.955	0.990	96.59
Neural Network	0.952	0.955	0.974	0.969	0.979	96.35
KNN	0.915	0.937	0.964	0.947	0.982	95.81

In order to perform experiments, we have used following classification methods, namely; Artificial Neural Network, Logistic, and KNN. The considered parameters of each classifier are given in Table 5.

In Table 6, that is comparative measurements clearly shows that Logistic regression performed well in comparison to k-nearest neighbors and artificial neural network model.

6 Conclusion and Future Scope

In this work, we compared the accuracy shown by machine learning models and result indicate that the Logistic Regression algorithm performed well and shows AUC 0.967, accuracy 96.59% that means it is the most efficient technique in this scenario about filtering of spam messages. The SMS spam collection is public available data set and we used it for our experiment.

References

1. Huang WL, Liu Y, Zhong ZQ (2009) Complex network based SMS filtering algorithm, pp. 990–996
2. Clerk J, Maxwell A (1892) Treatise on Electricity and Magnetism, vol 2, 3rd edn. Clarendon, Oxford, pp 68–73
3. Wang C, Zhang Y, Chen X, Liu Z, Shi L, Chen G, Qiu F, Ying C, Lu W (2010) A behavior-basedSMS antispam system. IBM J Res Deve 54(6):3-1
4. Haykin SS (2009) Neural Networks and Learning Machines. Prentice Hall, Upper Saddle River
5. Rokach L (2010) Ensemble-based classifiers. Arti Intell Rev 33:1–39

6. Healy M, Delany S, Zamolotskikh A (2005) An assessment of case-based reasoning for short text message classification. In: Proceedings of 16th Irish Conference on Artificial Intelligence and Cognitive Science, pp 257–266
7. Duan LZ, Li A, Huang LJ (2009) A new spam short message classification. In: Proceeding of the 1st International Workshop on Education Technology and Computer Science, pp 168–171
8. Zheng X, Liu C, Zou Y (2010) Chinese short messages service spam filtering based on logistic regression. J Heilongjiang Inst Technol 4(24):36–39
9. Gómez Hidalgo JM (2002) Evaluating cost-sensitive unsolicited bulk email categorization. In: Proceedings of the 17th ACM Symposium on Applied Computing, Madrid, Spain, pp 615–620
10. Zhang L, Zhu J, Yao T (2004) An evaluation of statistical spam filtering techniques. ACM Trans Asian Lang Inf Process 3(4):243–269
11. Cormack G (2008) Email spam filtering: a systematic review. Found Trends Inf Retrieval 1 (4):335–455
12. Almeida TA, Yamakami A, Almeida J (2009) Evaluation of approaches for dimensionality reduction applied with naive bayes anti-spam filters. In: Proceedings of the 8th IEEE International Conference on Machine Learning and Applications, Miami, FL, USA, 2009, pp 517–522
13. Almeida TA, Yamakami A, Almeida J (2010) Filtering spams using the minimum description length principle. In: Proceedings of the 25th ACM Symposium on Applied Computing, Sierre, Switzerland, 2010, pp 1856–1860
14. Almeida TA, Yamakami A, Almeida J (2010) Probabilistic anti-spam filtering with dimensionality reduction. In: Proceedings of the 25th ACM Symposium on Applied Computing, Sierre, Switzerland, 2010, pp 1804–1808
15. Almeida TA, Yamakami A (2010) Content-based spam filtering. In: Proceedings of the 23rd IEEE International Joint Conference on Neural Networks, Barcelona, Spain, 2010, pp 1–7
16. Almeida TA, Almeida J, Yamakami A (2011) Spam filtering: how the dimensionality reduction affects the accuracy of naive bayes Classifiers. J Internet Serv Appl 1(3):183–200
17. Almeida TA, Yamakami A (2012) Facing the spammers: a very effective approach to avoid junk e-mails. Exp Syst Appl 39:6557–6561
18. Gómez Hidalgo JM, Cajigas Bringas G, Puertas Sanz E, Carrero García F (2006) Content based SMS spam filtering. In: Proceedings of the 2006 ACM Symposium on Document Engineering, Amsterdam, The Netherlands, 2006, pp 107–114
19. Cormack GV, Gómez Hidalgo JM, Puertas Sanz E (2007) Feature engineering for mobile (SMS) spam filtering. In: Proceedings of the 30th Annual International ACM SIGIR Conference on Research and Development in Information Retrieval, New York, NY, USA, 2007, pp 871–872
20. Gómez Hidalgo JM, Cajigas Bringas G, Puertas Sanz E (2007) Spam filtering for short messages. In: Proceedings of the 16th ACM Conference on Conference on information and Knowledge Management, Lisbon, Portugal, 2007, pp 313–320
21. Liu W, Wang T (2010) Index-based online text Classification for SMS spam filtering. J Comput 5(6):844–851
22. Lee J, Hsieh M (2011) An interactive mobile SMS confirmation method using secret sharing technique. Comput Secur 30(8):830–839
23. Vallés E, Rosso P (2011) Detection of near-duplicate user generated contents: the sms spam collection. In: Proceedings of the 3rd International CIKM Workshop on Search and Mining User-Generated Contents, 2011, pp 27–33
24. Almeida T, Gómez Hidalgo J, Yamakami A (2011) Contributions to the study of SMS spam filtering: new collection and results. In: Proceedings of the 2011 ACM Symposium on Document Engineering, Mountain View, CA, USA, 2011, pp 259–262

25. Rashid E, Ansari MD, Gunjan VK, Khan M (2020) Enhancement in teaching quality methodology by predicting attendance using machine learning technique. In: Modern Approaches in Machine Learning and Cognitive Science: A Walkthrough, pp. 227–235. Springer, Cham
26. Goel AK, Chakraborty R, Agarwal M, Ansari MD, Gupta SK, Garg D (2019) Profit or Loss: a long short term memory based model for the prediction of share price of DLF group in India. In: 2019 IEEE 9th International Conference on Advanced Computing (IACC), pp. 120–124. IEEE
27. Agarwal M, Bohat VK, Ansari MD, Sinha A, Gupta SK, Garg D (2019) A convolution neural network based approach to detect the disease in corn crop. In: 2019 IEEE 9th International Conference on Advanced Computing (IACC), pp. 176–181. IEEE

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A Review on IOT Technology Stack, Architecture and Its Cloud Applications in Recent Trends

Mandla Alphonsa

Abstract The Internet of Things (IoT) senses, gather and transmit data over the internet without any human interference. This technology is a mixture of embedded technology, network technology and information technology. On various advancement of huge network and the broadcasting of (IoT), wireless sensored networks are considered to be part of the huge heterogeneous network. IoT architecture is the system of various rudiments like sensored networks, protocol, actuators, cloud service and layers. Internet of Things can also be called as an event-driven model. The IOT device is connected to gateway through Radio Frequency, LORA-WAN, Node MCU Pin-out. This review paper describes all protocol stack including its types of sensors in IOT their applications in real time environment and its architecture. In this paper we come together with the two different technologies Cloud Computing and IoT to observe the most common features, and to determine the benefits of their integration. The Cloud IoT prototype involves various applications, research issues and challenges.

Keywords Cloud compute · Internet of Things · Actuators · Sensors · Cloud service models · LORA-WAN · Node MCU · IoT gateway

1 Introduction

IoT fills the gap between the physical and the digital world. The IoT technology stack is based on the various key aspects like Device hardware, device software, communication, cloud platform and cloud applications. IoT includes a large range of equipment for Routers, bridges, sensors etc. [2]. Hardware components of IoT will vary from low-power boards; single-board processor like the Raspeberry Pi, Arduino Uno which are essentially smaller boards which can be plugged into main boards to progress and increase its functionality by bringing out specific functions

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_67

Fig. 1 IoT technology stack

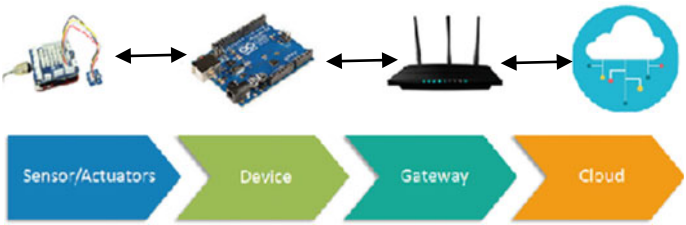

Fig. 2 IoT architecture

or features [8]. The IoT software encompass a broad range of programming languages.

The communication is done by means of protocols Lo-Ra WAN, WIFI, Bluetooth etc. Lo-Ra WAN is a low-power WAN (LPWAN) technology [1]. It's a widen spectrum modulationed techniques which derived by chirp spread spectrum technology. Cloud application platform is used to access software applications from everywhere. The Cloud application is basically a software program where local components and cloud based components work together. The architecture of IoT consist of Things i.e., the objects those are attached to the Internet by the means of embed sensored and the actuators which has ability for sensing the environments nearby and collecting data which passed on to the IoT gateway [12]. The second stage consists of gateways and Internet of Things data attainment system which collects the huge amount of data which is unprocessed, converting unto digital streaming, filtering and pre-processes and so readily to analyze.

2 Literature Survey

The Internet of Things (IoT) is arising technology. By surveying the paper regarding IoT protocol related IETF standards paper shows application layer protocols will focuses basically on message exchange between the internet and applications. This paper mostly summarizes about Internet of things and cloud platform. It also provides a brief discussion of different challenges of IoT including scalability and Mobility. The other survey papers focuses on different layers like transport layer used or provide security in application layer protocols [12]. The

Internet layer protocols like RPL (Routing for low power and lossy network) and LoWPAN. The main parts of IOT System are Sensors, Network Connectivity and Data Storage Applications. In this literature survey we incorporate the Internet of Things oriented architecture which capables for the improvement of the perceptive of linked tools, technologies, the methodologies for the ease of the developer requirement. The architectures presented are proposed for solving the day to day and real time life problems by building and deploymentation of powerful Internet of Things concept. Sensor is a device that is able to detect changes in an environment [11]. A Few common sensors that are widely adopted in everyday life include Ultrasonic sensors, pressure sensors, light sensors, gas sensors, etc. A Sensor can be described using three things. Range i.e., minimum and maximum values of the phenomenon that the sensor can measure, second Sensitivity and the third Resolution. Things include both sensing areas and actuators.

The sensing areas converts environmental information to digital information. Actuators convert digital information to environmental information [9]. The Data includes the data language how the sensors are connected to board and actuators are connected to cloud. Communication platform is used for reaching the internet through gateways and transfer the data [6].

2.1 Internet of Things Gateway

Internet of Things Gateway enables IoT communication usually device-to-cloud communications or device-to-device communications [4]. The gateway of IoT is basically a hardware device which is used for housing the application software which performs various vital tasks. This gateway facilitates the connections between the various data sources and the destinations. The Internet of Things gateway is physical device or else the software program which serve as the connection point between the controllers and cloud, sensored and intelligent devices [8]. The complete information which is going to the cloud, or vice versa, goes through the gateway, that can be either a software dedicated hardware appliance. IoT Gateway will also be referred to as a control tier or intelligent gateway [16].

The main features of IOT Gateway include

- Facilitates communication to non-internet connected devices.
- Achieves Device to Device communications
- Enables features of Networking and hosts live data
- Enables the Data visualization and data analytics
- Enables Device configuration management
- Enables to Manage user access and network security features
- Examines Data caching, buffering and streaming
- Data pre-processed, cleansed, filtered and optimized.

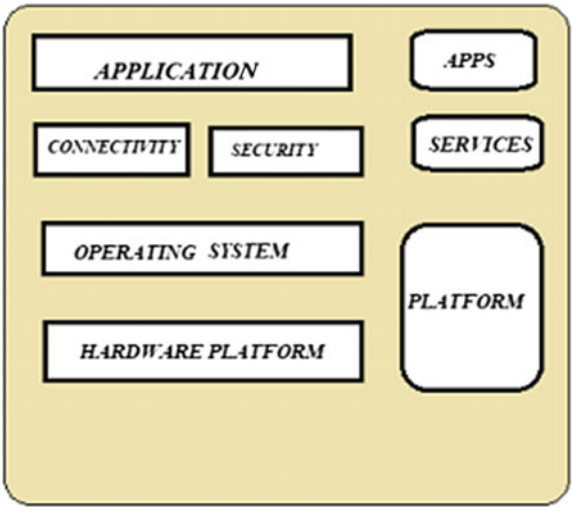

Fig. 3 IOT gateway architecture

2.2 Cloud IoT

The integration between Cloud services and IoT will allows the coordination among Cloud Services and IoT. Cloud service requests the IoT service which includes several basic elements of IoT [7]. The Internet of Things is an absolute of tools to connecting, processing, storing, and analyzing data both at the edge and in the cloud. This platform consists of fully managed cloud services, scalable, integrated software stacks for edge and on-premises compute with ML capability for need of IoT [7]. Cloud Platform brings, scale of infrastructure, device management, networking and a wide range of storage and analytics products which can be used to make the most of device-generated data. Internet of Things cloud platform can built on the top of the generic cloud those from Google Microsoft, Amazon or IBM. The various Networking operators such as Vodafone, AT &T and Verizon may be offering their own IoT platforms with focus on connectivity of the network [10]. Cloud for Internet of Things can be working based on the three cloud services, which are Iass, Paas and Saas.

2.3 IoT Cloud Systems

This application along with the Application Program Interfaces and other interfaces manages the data and the commands to and from the sensors or the gateways [15]. Few protocols such as, COAP, MQTT, Websocket and AMQP are used to develop a secure and powerful interface which facilitates seamless communication between the sensors and cloud.

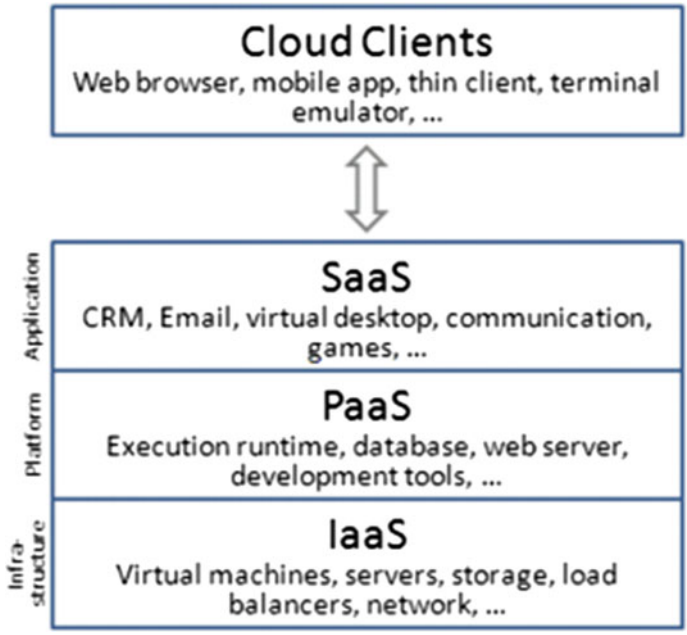

Fig. 4 Cloud service models

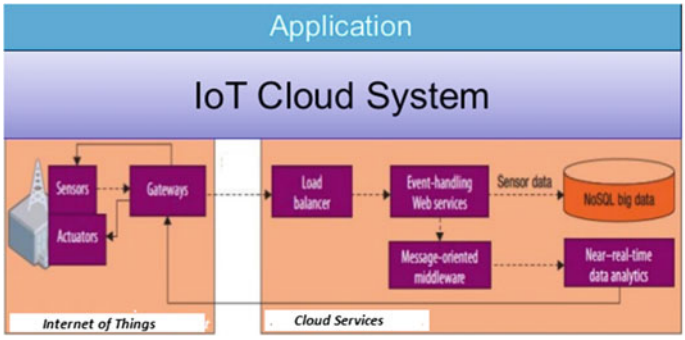

Fig. 5 IoT cloud system

2.4 Cloud Platforms for IoT

1. IBM Watson Internet of things Platform

IBM Watson is a prevailing platform which is backend by the hybrid cloud PaaS development platform and IBM'S Bluemix [18].

2. Amazon Web Services IoT Platform

Amazon web services has successfully made it much more simpler for the developers for gathering the information from devices which are connected to the Internet and the sensors [15]. It will help to collect and send data to the cloud and will analyze that information provided with the ability to manage devices.

3. Cisco Internet of things Cloud Connect

Cisco Internet Of Things Cloud Connect is nothing but simple mobile application based on cloud platform [14]. It mainly offer the solution to Telecom operator which provides the unique Internet of Things experience.

4. Oracle Internet of things Platform

The Oracle will offer real-time analyzation of data, point-point managing techniques, IoT tremendous speed of messages wherever the client will able to catch the time-time notifications to the device [10]. Oracle Internet of Things cloud services are a one of the service provide by cloud i.e., PaaS.

5. SALESFORCE Internet of things CLOUD

The Salesforce Internet of Things Cloud is a power-driven with Salesforce boom gathering the information from applications, device, browsers, and clients for triggering events for real time responses. Salesforce combining with Internet of Things providing improved customer services.

3 Applications of Internet of Things

IoT applications will enable the interaction between human to the device and device to the device in a reliable and vigorous manner [3]. Smart houses packed with connected products are loaded with abilities to make our lives convenient and highly comfortable [9].

Wearable IoT devices, namely fitness trackers and smart watches are the most prominent examples of Internet of Things (IoT) [11]. The healthcare Wearable technology includes electronic devices that consumers can wear, like Fitness bits and smartwatches, and are designed to gather the data of corresponding users personal health and physical exercise for fitness [17]. IoT devices became part of a smart city infrastructure that can warfare the strain of city growth, from traffic control to environmental issues [5]. Smart Grid is part of framework of IoT, which is used to remotely monitor and manage everything from traffic signs, road warnings, traffic congestion, lighting, parking spaces, and early detection of things like power fluctuations as the result of extreme weather congestions [13].

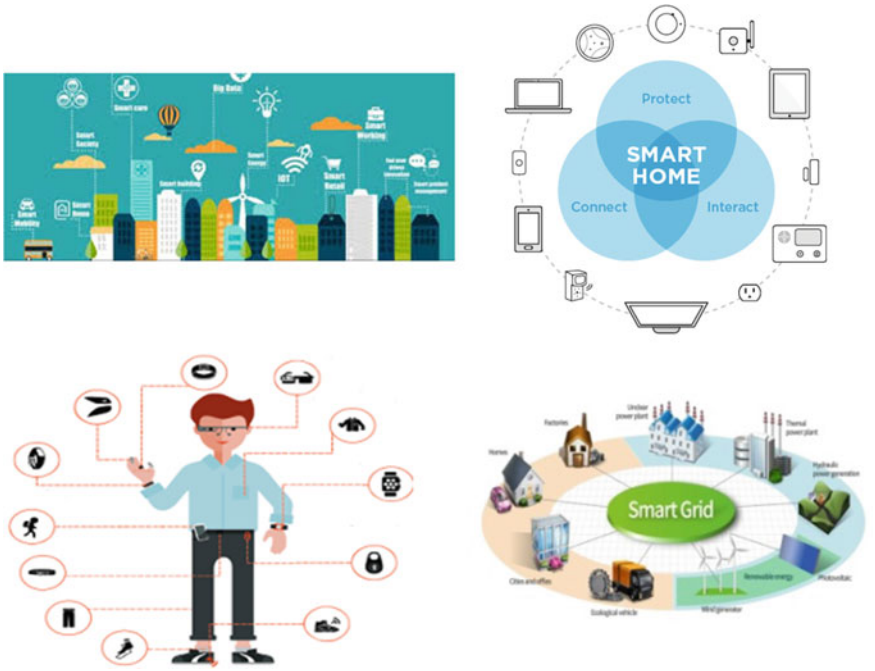

Fig. 6 IoT applications

4 Several Aspects of IoT Systems

Vastly distributed: Systems which are based on IoT will cover all the infrastructure and work environment. Broad circulation and applications of data stored in centralized environment.

Scalable: Scalability for adding numbers of resources which are connected to the network [18], in terms of the networking, volume of information which is associated with the host system, its movement and speed and the amount of power required for processing [6].

Cloud compute: Systems based on IoT commonly entail the use of platforms of Cloud Computing platform. This compute platforms propose the probability to use huge volumes of resources in terms of storing capacity and also the capability for elasticity and scalablility.

Real time Process: Systems based on IoT will function in producing the real time responses which are timely [19].

Big Data: Systems based on IoT are the best examples for processing of the Big Data depending on the analysis of huge volumes of data. For example, to extract patterns from historical data that can be used to drive decisions about future actions. IoT systems are thus often classic examples of "Big Data" processing.

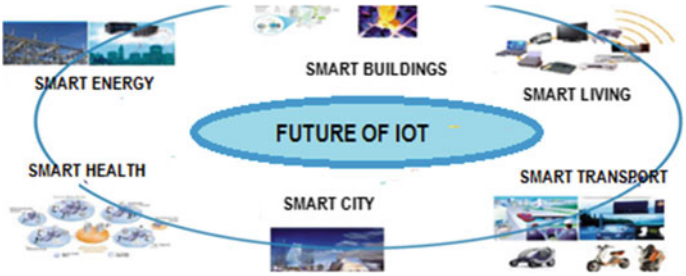

Fig. 7 Future of IoT

Diversed systems: Systems which are diversely build with circuits using actuators and also networks involved and varying processing components.

5 Conclusion

Internet of Things is a vibrant area of IT. Vast Technologies based on Internet of Things will be configured very soon wrapping up extensive varieties of areas like public and private contexts globally. The systems of Internet Of Things have several challenges like namely scale, speed, safety and privacy. Cloud compute platform propose the capability for the usage of huge quantities and volumes of components in context of the storage with capability for bringing scalable as well as flexible processed networks for analyzing the information. Internet Of Things with cloud platform is an enabling paradigm to realize variety of services. IoT offers interesting innovations in making lives easier like in Healthcare firms, Transportations, and Agriculture areas and also Various factors including storage of data, maintaining security and privacy. Both IoT and Cloud interrelates in a trending environment. The applications with RaspeberryPi, Arduino and various equipments could not be an Internet of Things unless with a specified IoT use cases to work out on a precised complex issues.

References

1. Low-power wide area network technologies for Internet-of-Things: a comparative review. IEEE IoT J (2018)
2. Kamarudin LM, Zakaria A, Gunasagaran R, Kanagaraj E, Alimon MSAM, Shakaff AYM, Razali MHM (2015) Internet of Things: sensor to sensor communication. In: 2015 IEEE Sensors
3. Esmail R, Mohammed FH (2015) Survey on IoT services. Int J Sci Res 4:2124–2127
4. Li H, Chen H, Jia X (2011) An introduction to IoT gateway. In: IET international conference on communication technologies and application (ICCTA 2011). IET, Beijing, pp 610–613

5. Meissner S, Thoma M, Meyer K, Braun T (2012) On survey, IoT-services, classification and enterprise integration. In: 2012 IEEE international conference on green computing and communications, Besancon, pp 257–260
6. Kushalnagar N, Montenegro G, Schumacher C (2007) IPv6 over low-power wireless personal area networks (6LoWPANs): overview, assumptions, problem statement, and goals. RFC 4919
7. CCIoT-CMfg: cloud computing and Internet of Things based cloud manufacturing service system (2014)
8. Kim Y, Tayeb S, Latifi S (2017) A survey on IoT communications and computational frameworks: an industrial perspective. Paper presented at 2017 IEEE 7th annual computing and communication workshop and conference (CCWC), Las Vegas, NV
9. Qahtan MY, Zaidan AA, Zaidan BB et al (2018) A survey on communication components for IoT-based technologies in smart homes. Telecommun Syst 69(1):1–25
10. Ballon P, Conclaves V (2011) Adding value to the network: mobileoperators' experiments with software-as-a-service and platform-as-a-service models. Telematics Inform 28:12–21
11. Ahmed MU, Banaee H, Loutfi A (2013) Data mining for wearable sensors in health monitoring systems: a review of recent trends and challenges. Sensors 13(12):17472–17500
12. Ozdemir S, Çorak BH, Okay FY, Güzel M, Murt Ş (2017) Comparative analysis of IoT communication protocols. Paper presented at International, Silva BN, Khan M, Han, K Internet of Things: a comprehensive review of enabling technologies and challenges. IETE Technical Review, pp 1–16
13. Palaniswami M, Gubbi J, Buyya R, Marusic S (2013) Internet of Things (IoT): a vision, architectural elements, and future directions. Future Gener Comput Syst 29:1645–1660
14. De Pellegrini F, Miorandi D, Sicari S, Chlamtac I (2012) Internet of things: vision, applications and research challenges. Ad Hoc Netw 10:1497–1516
15. Iera A, Morabito G, Atzori L (2017) Understanding the Internet of Things: definition and societal role of a fast evolving paradigm. Ad Hoc Netw 56:122–140
16. Yang X, Zhang H, Zhao W, Lin J, Yu W, Zhang N (2017) A survey on internet of Things: architecture, enabling technologies, security and privacy, and applications. IEEE IoT J
17. Catarinucci L, de Donno D, Mainetti L, Palano L, Patrono L, Stefanizzi ML, Tarricone L (2015) An IoT-aware architecture for smart healthcare systems. IEEE IoT J 2(March (6)):515–526
18. AyyashAl-Fuqaha M, Guizani M, Mohammadi M, Aledhari M (2015) Internet of Things: a survey on enabling technologies, protocols, and applications. IEEE Commun Surv Tutor 17:2347–2376
19. Jara AJ, Singh D, Tripathi G (2014) A survey of Internet-of-Things: future vision, architecture, challenges and services. In: Proceedings of the IEEE world forum on Internet of Things, Seoul, pp 287–292

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Lung Cancer Diagnosis from CT Images Based on Local Energy Based Shape Histogram (LESH) Feature Extration and Pre-processing

Denny Dominic and K. Balachandran

Abstract Lung cancer as of now is one of the dreaded diseases and it is destroying humanity never before. The mechanism of detecting the lung cancer will bring the level down of mortality and increase the life expectancy accuracy 13% from the detected cancer diagnosis from 24% of all cancer deaths. Although various methods are adopted to find the cancer, still there is a scope for improvement and the CT images are still preferred to find if there is any cancer in the body. The medical images are always a better one to find with the cancer in the human body. The proposed idea is, how we can improve the quality of the diagnosis form using pre-processing methods and Local energy shape histogram to improve the quality of the images. The deep learning methods are imported to find the varied results from the training process and finally to analyse the result. Medical examination is always part of our research and this result is always verified by the technicians. Major pre-processing techniques are used in this research work and they are discussed in this paper. The LESH technique is used to get better result in this research work and we will discuss how the image manipulation can be done to achieve better results from the CT images through various image processing methods. The construction of the proposed method will include smoothing of the images with median filters, enhancement of the image and finally segmentation of the images with LESH techniques.

Keywords LESH techniques · Pre-processing · Feature extraction · Histogram · Segmentation

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_68

1 Introduction

Due to poor prognostic methods the diagnosis of the lung cancer has become difficult. The survival is possible only if the detection could make it early [1]. Cancer can be spread through the blood vessels, or lymph fluid and they are surrounded by cancer tissues around the lungs. There is always the possibility of the growth of cancer cells around the chest form the lung nodules. The major two categories of lung cancer are Non-small cell lung cancer and small cell lung cancer.

The four stages of the cancer cells vary by their way of shape and size cancer cells. Smoking is found to be the reason for lung cancer and they are best found though the CT images. Thus, it is necessary to have a best frame work to find out the cancer from the CT images.

The system should be able to pre-process the image and they should be able to make an effort to categories them according to the size and the features that are attributed to it. Local energy map is developed form the histogram that is generated by LESH techniques.

Pre-processing is a must because the images are collected from the different machines and they may differ in their format. Therefore, it is necessary to the desired result will require the pre-processing on the images. The purpose of the paper is to develop an energy map, based on the LESH technique and they should be involved with pre-processing methods with latest pre-processing techniques. The medical images are always with different layers' inner structure and they need to process them with different characteristic to get desired result [1]. Pre-processing is a must, to get the intended result and they shall be of the metrics values, binary numbers, pre-processed images and charts.

The chest computed tomography (CT) scan, has high resolution thus, it is used for lung related diseases. It is difficult to find the small cell malignancy at the early stages. There is always an urgent task to develop a frame work for it because they have to be formulated and they have to be identified. The major areas where the pulmonary nodules develops are difficult to find out because there are in the inner most part of the body and thus the location of the malignancy. The pulmonary nodules are identified based on the shape. Hence, it is an important task to identify the various CT images from various sources.

The important task of this research is that, to know different pre-processing method and developing feature extraction method with the support of the LESH techniques.

2 Literature Survey

LESH technique has been very successful in applying multi-disciplinary fields related to pattern recognition and as part of the lung cancer detection to differentiate many features they are ought to detect [2–4]. The noise in the image is always a

matter of disturbance and they can be separated as in two steps and they are Weiner filtering and Denoising. In the image processing white noise is a problem [5]. IlyaLevner [6] has observed that the topographical and other noises can be reduced using watershed segmentation.

The pixel grouping and watershed segmentations are always used in the image processing and computer vision related research. When the object of the pixels with same proximity are in the same vicinity the image mapping is necessary and this can be done using energy mapping with LESH techniques. Non overlapping region can be used with the help of the natural phenomena and they can be done with segmentation methods. The idea about the quantification for semantic nodule characteristics of sphericity, speculation and clarification have become major concern [7–9]. Hence, the image quantification has to be done with image segmentation. Anywhere in the body the nodule can occur. In the image processing, the idea if there is any occurrence of abnormality has to be found out according to the useful information [10] and it becomes the foundation of image classification.

LESH feature extractions for the similarity of abnormal nodules in the CT images have achieved high classification accuracy. The experiments have done with wavelet and local energy based shape histogram (LESH) and the main features have amalgamated with classifiers and finally the confusion matrix is generated [11].

Ginneken [10] has shown a different approach in executing the rule based and pixel classification approaches. The preferred approach is rule based by most of the research category [12–15], with different steps, the rule can be used for the extraction of the result. LESH features are mainly used for extracting the images and it is calculating the CT image by the histogram from the local energy pattern.

3 Methodology

The images are pre-processed with the support of LESH vector with an aided supported of image extraction, enhancement and finally segmentation techniques. The extractions of the features are done with morphological operation and colorimetric operations (Fig. 1).

The Structure of Image Enhancement is the system which enhances the image using median filter, Gabor filter and watershed segmentation. The enhancement of colour and clarity can be increased by these methods. Nucleuses are achieved by the thresholding methods in the images to segment. At the end of all, the above given

Fig. 1 Structure of Image Enhancement

process, the system will achieve colorimetric and morphological to image of the nucleuses is extracted feature [5]. The extracted morphologic features use average intensity, area, perimeter and eccentricity of the nucleuses. The reasons to select the CT images are, because they are with more accuracy and less distortion. Images are acquires form various health care centres.

3.1 Structure of Image Enhancement

3.1.1 Median Filter

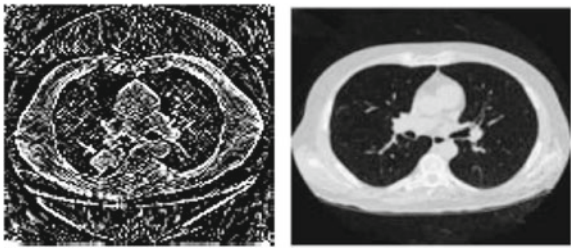
The median filter will allow the high value spatial frequency and it is proved that it will remove the noise from the images. There is always half of the pixels are being affected by the noise removal and this process may result in wrong information about the raw data. Median filter also used for blurring on edges and this process can be applied to the image to enhance the methods that are useful in the process.

Median filtering in a non-linear operation and removes the salt and pepper results from the images. The result contains median value in the neighbourhood around the corresponding pixel in the image. The 0's at the end will pad on the images as shown in Fig. 2.

3.1.2 Gabor Filter

Gabor filter is used to have wider perception about the input image thus it can interpret to final results. Although the spatial and frequency domains still exist for the enhancement but we prefer Gabor filter which can give better results due to its wider perception capacity. Gabor filter has better performed in our research than auto enhancement and Fast Fourier [2].

2D Gabor filters are constructed using the following factors: the wavelength λ of the sinusoidal function and the orientation θ of the normal to the parallel stripes of the Gabor function 4. The spatial aspect ratio γ specifies the ellipticity of the support of the Gabor function.



ZCA_Whitening Original Image

Fig. 2 Zero Component Analysis (ZCA) Whitening

The variance σ of the Gaussian function. The equation for 2D representation of Gabor filter is given as the expansion of the equation, $x' = x\cos\theta + y\sin\theta$; $y' = -x\sin\theta + y\cos\theta$, For $\gamma = 1$, circular is the support. For $\gamma < 1$, the orientation of the parallel stripes of the function is being supported elongated.

3.1.3 Watershed Segmentation

In the watershed segmentation images are segmented into multiple images for better understanding. Thus watershed segmentation is segmented to objects and constituent regions. Thus the segmentation finally segments images into multiple images and as a set of contours extracted from the image [5]. Marker controller is used for watershed segmentation and they convert the segmented images into white or grey images for that matter. In this segmentation approach the frontier and regional methods are combined. The working of the segmentation is explained as the RGB images are converted to grey scale images and then they are processed for edge detection and structural elements and a foreground markers erosion is developed with background markers. Here the regional maxima are developed for watershed segmentation and dilation is done on the final image to get visualization of the images. The Fig. 3 shows the results of watershed segmentation in the Confusion Matrix.

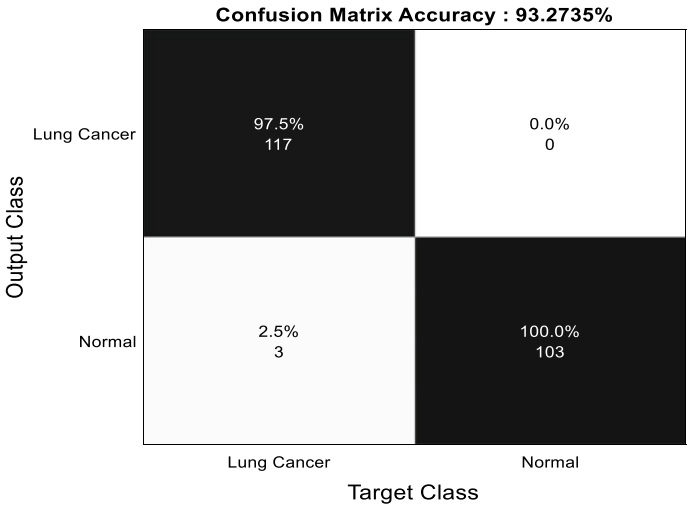


Fig. 3 Confusion Matrix

3.1.4 Feature Extraction Based on LESH

Based on calculating of local energy pattern of the histogram for the image of interest. Local energies are calculated along with different orientations.

Before calculate phase congruency (PC), the Gabor filter is involved with different orientations *o* and scales *s*. Transfer function for log-Gabor is given

$$G(\omega) = \frac{\left(\log\left(\frac{\omega}{\omega o}\right)\right)^2}{2\left(\log\left(\frac{k}{\omega o}\right)\right)^2} \tag{1}$$

where ω_o is central frequency of the filter and $\frac{k}{\omega o}$ is a constant.

Let G_{so}^{even} and G_{so}^{even} be the even-symmetric and odd- symmetric filters at orientation o and scale s. Then convolution with image result of response vector given as

$$[\, e_{so}(z),\ o_{so}(z)], \tag{2}$$

where z = (x, y) represents a location. Hence, the orientation can be computed with the amplitude of the response as

$$A_{so} = \sqrt{(eso(z))^2 + (Oso(z))^2} \tag{3}$$

And sensitive phase deviation measure is given as:

$$\Delta\Phi_m(z) = \cos(\Phi_m(z) - {}^{-}\Phi_m(z)) - |\sin(\Phi_m(z) - {}^{-}\Phi_m(z))| \tag{4}$$

Now, local energy is calculated as:

$$E(z) = \sqrt{(\Sigma(m)Eso(z))^2 + (\Sigma(m)Oso(z))^2} \tag{5}$$

At last, 2D phase congruency for the image is normalized by sum of amplitude computed Fourier amplitude components as

$$PC(z) = \frac{E(z)}{\Sigma mAso + \varepsilon} \tag{6}$$

$$PC(z) = \frac{\Sigma mW(z)[Am(z)\Delta\Phi m(z) - T]}{\Sigma mAm + \varepsilon} \tag{7}$$

where T-noise cancellation factor and W(z)- weighting of the frequency spread. A_m and ϕ_m represent the amplitude and phase angle respectively.

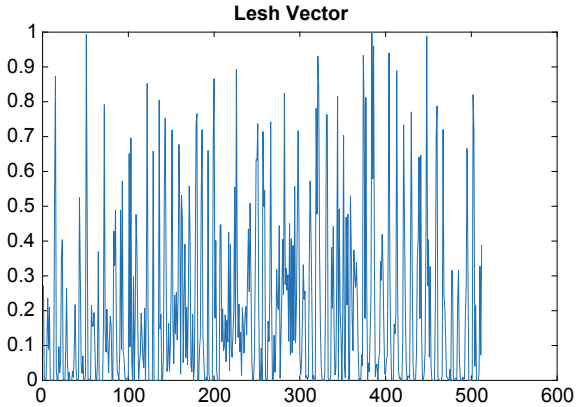


Fig. 4 Lesh Vector

Further, the resultant of LESH feature vector is calculated as follows:

$$H_{r,b=} \Sigma W_r xPC(z) \times \delta_{r-b} \tag{8}$$

$$W_1 = \frac{1}{\sqrt{2\Pi\sigma}} e^{\left[(x-rxo)^2 + (y-ryo)^2\right]/\sigma^2} \tag{9}$$

where W_r- Gausssian weighting function of the delta of the orientation. The histogram of Lesh vector is shows in Fig. 4.

4 Conclusion and Future Scope

This paper has discussed mainly about how the LESH vector can be applied to an image so as to get a better result. It is done based on the local energy patterns that have been developed through the histogram. Different orientations have been used for it to calculate the local energy pattern. The result of the research shows that the image is processed with 2-D log-Gabor filter for better orientation *o* and scales *s*. The image enhancement is done always with the idea in mind that to have better interpretability on the image. Enhancements are usually done on the spatial domain and frequency domain. Watershed segmentation and Gabor filters are always used for accurate results for pre-processing stage and hence to get a better result from the LESH vector. Thus the region of interest is used to find the area of cancer. For the further work the Convolutional neural network can give better result and it will increase the accuracy and detection of cancer nodules with high clarity.

References

1. Cruz-Roa A, Caicedo JC, González FA (2011) Visual pattern mining in histology image collections using bag of features. Artif Intell Med 52(2):91–106
2. Sarfraz MS, Hellwich O (2008) Head pose estimation in face recognition across pose scenarios. In: International Conference on Computer Vision Theory and Applications VISAPP, vol 1, pp 235–242
3. Sarfraz MS, Hellwich O (2008) An efficient front-end facial pose estimation system for face recognition. Int J Pattern Recogn Image Anal 18:434–441
4. Sarfraz MS, Hellwich O (2009) On head pose estimation in face recognition. In: Computer Vision And Computer Graphics. Theory And Applications. Lecture Notes CCIS, vol 24, pp 162–175
5. Chaudhary A, Singh SS (2012) Lung cancer detection on CT images using image processing. In: International transaction On Computing Sciences, vol. 4
6. Levner I, Zhang H (2007) Classification-driven watershed segmentation. IEEE Trans Image Process 16(5):1437–1445
7. Farag A, Ali A, Graham J, Elshazly S, Falk R (2011) Evaluation of geometric feature descriptors for detection and classification of lung nodules in low dose CT scans of the chest. In: 2011 IEEE International Symposium, Paper presented at the Biomedical Imaging: From Nano to Macro, Chicago, IL, USA, 30 March to 2 April 2011
8. Lin P-L, Huang P-W, Lee C-H, Wu M-T (2013) Automatic classification for solitary pulmonary nodule in CT image by fractal analysis based on fractional Brownian motion model. Pattern Recogn 46(12):3279–3287
9. Farag A, Elhabian S, Graham J, Farag A, Falk R (2010) Toward precise pulmonary nodule descriptors for nodule type classification. In: Medical Image Computing and Computer-Assisted Intervention (MICCAI 2010). Springer, Berlin
10. Ginneken BV, Romenyand BM, Viergever MA (2001) Computer- aided diagnosis in chest radiography: a survey. IEEE Trans Med Imaging 20(12):1228–1241
11. Wajid SK, Hussain A (2015) Local energy-based shape histogram feature extraction technique for breast cancer diagnosis. Expert Syst with Appl 42(20):6990–6999
12. Sharma D, Jindal G (2011) Identifying lung cancer using image processing techniques. In: International Conference on Computational Techniques and Artificial Intelligence (ICCTAI 2011), vol 17, pp 872–880
13. Nguyen HT et al (2003) Watersnakes: energy-driven watershed segmentation. IEEE Trans Pattern Anal Mach Intell 25(3):330–342
14. Ansari MD, Ghrera SP (2018) Intuitionistic fuzzy local binary pattern for features extraction. Int J Inf Commun Technol 13(1):83–98
15. Ansari MD, Ghrera SP (2016) Feature extraction method for digital images based on intuitionistic fuzzy local binary pattern. In: 2016 International Conference System Modeling & Advancement in Research Trends (SMART). IEEE, pp 345–349 November 2016

Comparative Evaluation of SMMD Values of Popular Social Media Sites: PGF-A High SMMD Case

B. Malathi and K. ChandraSekharaiah

Abstract In recent years, various social media applications have been using content in different multimedia forms. For the distribution of content as well as social interaction on internet and social media, the multimedia content is extensively used, called as social multimedia. A major trend in the current studies on social multimedia is using the social media sites as a source of huge amount of data for solving various problems in computer science applications. The wisdom of social multimedia lies in the usage of these multimedia elements. A few social media websites along with PGF site are considered here for evaluation of their social multimedia degree (SMMD). PGF is a Peoples' Governance Forum established in 2017 without any iota of personal benefit and with a good cause of shouldering the national responsibility of disseminating the national integration among the students and provide basic awareness of how to use internet positively. This paper presents an evaluation perspective of social multimedia degree (SMMD) in the form of table for "Social Multimedia" applications. The PGF is observed to have high SMMD.

Keywords Web intelligence · Social media · Multimedia · Social multimedia · SMMD (Social multimedia degree) · PGF (Peoples Governance Forum)

1 Introduction

This Social media is considered as the vital component of the web intelligence platform. Multimedia contents are the major constituents of the social media and defining characteristics of intelligent and wisdom web. Social media is used for content creation/generation, distribution and communication among the online communities. In the present day scenario most social media are multimedia enabled

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_69

as they use the combination of contents like text, image, color, audio, video, graphics and animation. The social media use these multimedia contents to provide impact on information in order to grab the attention of users and for effective communication. E.g. Facebook and WhatsApp.

Multimedia is used to describe the content in two or more kinds of media combined into single package. The different content forms like text, graphics, audio, video, animation, colors and other interactive contents are combined in this social multimedia. Multimedia applications can produce and even share content in these multiple forms. It provides user with the advantage of influencing the presentation of their content.

1.1 Elements of Multimedia

Multimedia is a richly presented sensation. When the sensual elements of multimedia like dazzling pictures and animations, engaging sounds, compelling video clips, and raw textual information are weaved together, the thoughts of people's minds can be electrified. The elements of multimedia are text, animation, still images, audio, video, graphics, other forms of animation like GIFs and Visual effects. Multimedia can enhance the design of websites and social media platforms. Text is the fundamental element and may be easily overlooked. It is mostly used for titles, subtitles, headlines, slogans etc. Animation is a sequence of images placed together to give the motion effect. E.g. 2D and 3D. still images are static pictures. Audio includes sound effects, recorded lectures, dialogue or music. It is a great way to catch and focus the user's attention. Video is visual MM combining moving pictures and sound. It can have great impact on social media applications in a very unique and powerful way. Images including photographs, illustrations, drawings, clip art, icons or any other non-text elements on a website or in social media are an example of graphics. Graphic image file rapidly display a sequence of few images to give appearance of fast motion. There is no movement in these types of pictures. Interactive platforms require end-user interaction. VFX – Visual Effects have always been an useful part in giving finishing touch to the videos.

1.2 Multimedia Degree Evaluation

The Initiative for Multimedia degree Evaluation on the social media and websites indicates the intelligence of the later. This offers challenges to researchers working in diverse areas of multimedia technology. The tasks, which are focused on the social and human aspects of multimedia, help the research community tackle those challenges and also support researchers in investigating the diversity of perspectives that naturally arise when users interact with multimedia content.

In this paper, we provide a comprehensive view on usage of multimedia data available over social media on the Internet. In addition, we also provide the details

of the PGF website. The rest of this paper is organized as follows: Sect. 2 provides the brief details of our related work which stands as motivation for this paper. Section 3 illustrates the details of the Peoples Governance Forum and Sect. 4 mentions the websites and social media applications considered in the evaluation of the SMMD. Section 5 provides the comparative evaluation of the SMMD in the popular social media along with PGF in a table structure. Section 6 provides the summary table of the content analysis for the questions posed under social media intelligence. Finally, the paper concludes in Sect. 7.

2 Motivation and Related Work

The literature review is conducted related to our research work and details presented as follows: In paper Web Intelligent Information Systems: A PGF-mediated Social Media evaluation perspective [26], SM approach is followed and achieved SMD = 7 value for PGF which is the highest among compared popular websites. The first ground work related to cyber crimes case study was presented in [1–6]. In a paper entitled Multimedia Information Systems: A Comparison Perspective of Social Web Sites, the authors have tabulated a comparison feature study of a variety of MMISs websites. They concluded that most of the modern web sites use maximum degree of multimedia support. The work in [10, 13–15, 23, 24] depicts the impact of RTI Act to challenge the conditions that were against the pursuing for the field reporting. The research work in [9, 16–18, 21, 25, 26, 29] focuses attention on a cyber remedial forum against the cybercrimes case study to campaign and spread awareness. The research work gained strong ground as in [11, 12], as the cyber forensic evidenceof the cyber crimes was thoroughly captured and presented. Social networking sites could provide solutions to ICT problems as demonstrated in [2, 7, 8, 19]. In this paper, we present a research methodology in order to come up with positive results such as awareness about cybercrimes, national spirit [19, 20, 22], and Mother India Consciousness (MIC) [27–29]. The research work in [26] is that they made use of 6 social media such as YouTube, Twitter, Facebook, ISSUU, Google+, and SoundCloud.

A Peoples' Governance Forum Website is developed with the idea of inculcating national integrity among the students and provide basic awareness of how to use internet positively. It is awareness creation remedial forum. The motivation to this paper is to make campaigning of A PGF through social multimedia and compare it with social multimedia usage of some other prominent social media mentioned in Sect. 4.

3 PGF Website

Peoples' Governance Forum is established in 2017 without any iota of personal benefit and with a good cause of shouldering the national responsibility of disseminating the national integration among the students and provide basic awareness

Fig. 1 Snapshot of a Peoples' Governance Forum webpage

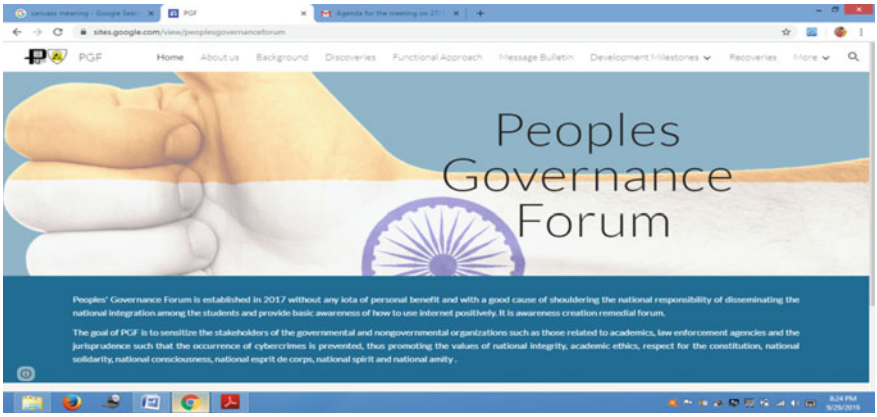

Fig. 2 Snapshot of a Peoples' Governance Forum website

of how to use internet positively. It is awareness creation remedial forum. It is established in association with PAIRS Foundation, Hyderabad. The Founder of PGF is Dr. K. ChandraSekharaiah, Professor in CSE, School of IT, JNTUH, Hyderabad.

The goal of PGF is to sensitize the stakeholders of the governmental and non-governmental organizations such as those related to academics, law enforcement agencies and the jurisprudence such that the occurrence of cybercrimes is prevented, thus promoting the values of national integrity, academic ethics, respect for the constitution, national solidarity, national consciousness, national esprit de corps, national spirit and national amity.

Initially PGF is a webpage shown in the Fig. 1. It has evolved particularly in remedy for FGoT and CGoT. Later a website is developed shown in the Fig. 2 with the menus as Background, Discoveries, Functional Approach, Message bulletin, Development milestones and Recoveries.

The Manifesto of PGF is as follows:

- Imparting patriotism in the students in particular and in the public in general such that they do not perpetrate nation abusive cyber crimes but rather remedy them. This point is incorporated owing to the multiple background cybercrimes that were rampantly prevalent abusive of India in higher engineering academics to which the PGF members were stakeholders.
- Providing guidance and training on cyberethics.
- Taking leading initiatives for university-level academic reforms in Hyderabad in particular and in India in general. The reforms capture national values in academics.
- Taking leading initiatives for policing reforms in Telangana in particular and in India in general. The reforms capture national values in policing.
- Taking leading initiatives for judicial reforms in Telangana in particular and in India in general. The reforms capture national values.
- Following remedial approach and establishing remedial measures towards non-fintech cybercrimes in academic environment.
- Preventing the recurrence of cyber crimes in academic institutions.
- Identifying measures to be taken to sensitize academics against cyber criminal setting.
- Compelling universities and academic institutions to provide national civic education.
- Shouldering the national responsibility of disseminating the national integration among the students.
- Promoting the values of national integrity, academic ethics, and respect for the constitution, national solidarity, national consciousness, love and commitment to the nation among the students.

4 Applications (Websites Considered)

Web has evolved from websites with static pages to dynamic ones and emerged into a new paradigm called participative web. In the beginning of the web, contents were text created usually by the owner of the web sites, or the web masters. These contents usually did not change very much through time since it required effort from administrators. The web that we have today is created by millions of users collaborating one to each other. Many websites are dedicated to social media and these social media sites included multimedia contents for effective communication purpose. Most popular among them are Wikipedia, Facebook, Youtube, Twitter, Instagram, Whatsapp, Blogger, Telegram, LinkedIn and Pinterest. Wikipedia - a collective knowledge generation site, Facebook - a social networking site, YouTube - a social networking and multimedia content sharing site, Twitter - social networking and microblogging site, Instagram - a visual platform designed for customers to post, share, comment and engage through digital media picture,

Whatsapp – instant messaging app to exchange text, image, gif, audio and video messages, Blogger – for publishing thoughts on internet, Telegram – instant messaging app with more security and privacy features, LinkedIn - the professional social networking site and Pinterest – a social network that allows pinning images and videos.

5 A Comparative Evaluation of SMMD on Popular Social Multimedia Sites

We have considered social media mentioned in Sect. 4 and compared the degree of social multimedia in their websites as shown in the Table 1. The criteria for choosing these websites is on the basis of minimum SMMD = 1 value randomly. This motivated us to make campaigning of 'PGF' through social media with the best possible SMMD value as compared to the SMMD values of some other prominent websites. The websites considered are Wikipedia, Facebook, Youtube, Twitter, Instagram, Whatsapp, Blogger, Telegram, LinkedIn, Pinterest and PGF. The elements of multimedia considered are text, images, audio, video and graphics.

Table 1 Websites and their SMMD values

Website	Text	Images	Audio	Video	Graphics	SMMD
Wikipedia	Yes	Yes	No	No	No	2
Facebook	Yes	Yes	Yes	Yes	Yes	5
Youtube	Yes	Yes	Yes	Yes	Yes	5
Twitter	Yes	Yes	Yes	Yes	Yes	5
Instagram	Yes	Yes	Yes	Yes	Yes	5
Whatsapp	Yes	Yes	Yes	Yes	Yes	5
Blogger	Yes	Yes	Yes	Yes	Yes	5
Telegram	Yes	Yes	Yes	Yes	Yes	5
LinkedIn	Yes	Yes	Yes	Yes	Yes	5
Pinterest	Yes	Yes	Yes	Yes	Yes	5
PGF	Yes	Yes	Yes	Yes	Yes	5
PGF Founder	Yes	Yes	Yes	Yes	Yes	5

6 Content Analysis of the Answers by Students on SMI Queries

Students were made to focus on the MIC generation. The main objective of conducting such a study was to achieve Social Media Intelligence (SMI) for the students of JNTUH.

The participants of the survey are the post graduate students of School of Information Technology (SIT) of JNTUH University. The participants' performance is illustrated in the paper and it was verified that the Social Media Intelligence (SMI) of these students is considerably high which is very much impressive.

The set of questions on subject Social Media Intelligence and the content analysis of the answers is as follows:

Q2. (i) Write 2-para summary of technical paper "Cybercrimes: Trends and Challenges".

(ii) Write your website link for the audio file in SoundCloud for the above technical paper.

Q4. KCR Govt of Telangana had the wrong basis of CyberCriminally Seditious Govt of Telangana related to JNTUHJAC in the background. Mention 10 analytical points as a millennial builder of India as an MCA student.

Q5. Write summaries of the Technical papers with the following titles.

(i) A Wolf in Sheep's Clothing-Fake Government of Telangana (FGoT), JNTUHJAC: Why "not Prohibited?" (ii) Cyberpolicing the Multifaceted Cybercriminal, Fake Government of Telangana: What is Sauce for the Goose is Sauce for the Gander.

The answers for above questions by students had been analyzed and tabulated in Table 2 based on the awareness the students had regarding the cybercrimes.

Another set of questions on subject Social Media Intelligence and the content analysis of the answers is as follows:

Q1. Social software can be used to defuse the Fake/Dark Cybercriminal Seditious Government of Telangana (CDFSGoT). List 5 SNSs (Twitter/Facebook/Instagram/googleplus etc.) created by you, that show messages posted in them sharing your knowledge of the CDFSGoT and how to defuse the CDFSGoT. There should be 4 text/audio/video messages/posts in each SNS.
Q3. There are 4 cybercrimes in the CDFSGoT website. Consider 5 persons a, e, i, o, u and write their conversational social media message posts that justify that the 4 cyber crimes are in fact applicable to the case study.
Q4. Consider 3 technical papers (for e.g., as specified by your teacher) that prove that criminal functional/nonfunctional requirements were part of the web application in the CDFSGoT website.

Write in 6 paragraphs the summaries of the 3 technical papers (2 paragraphs per technical paper).

Table 2 Content analysis for first set of questions

Student roll no	Question answered-a	Question answered-b
16031F0001, 002, 003, 004, 005, 008, 009, 011, 012, 015, 016, 017, 018, 020, 022, 023, 025, 030	Question 4: 1. is aware of violation of State Emblem of India (Prohibition of Improper Use) Act, 2005 (SEIPIUA) 2. is aware of sedition law violation 3. is aware of ITAct Identity Theft section violation 4. noted that JNTUHJAC and JNTUH functioned parallelly 5. noted that the students of JNTUH requested as members. i.e. aiding and abetting cybercrimes 6. noted that the cybercriminal website defames JNTUH website 7. a precedence is set for similar cybercrimes in other universities 8. cybercrimes threat in IT world 9. a threat to Indian national fabric (awareness, integrity, unity)	–
16031F0021	Question 5(i): 1. noted the prevalence of JNTUHJAC even now in JNTUHJAC academic environment 2. noted the cybercriminal organizations JNTUHJAC and FGoT, multiple cybercrimes against GoI 3. noted the trickery against JNTU academic community, very large number of students became members of FGoT	Question 5(ii): 1. noted that FGoT (with multiple cybercrimes) and JNTUHJAC as cybercriminal organizations associated with each other & prevailing in JNTUH academics even now 2. noted police failure 3. noted that the two cybercriminal orgs. were not served prohibition orders
16031F0026	Question 5(i): 1. the TCOs were not prohibited unlike the externment of Swami Paripoornananda	Question 5(ii): 1. noted the association between the two cybercriminal organizations prevailing even now in JNTUH academic environment, multiple cybercrimes of FGoT against India, police failure
16031F0028	Question 5(i): 1. noted JNTUHJAC as prevailing even now in JNTUH	Question 5(ii): 1. noted TCOs as cyber criminal org., policing failure
16031F0029	Question 5(i): 1. noted FGoT as a CCO, JNTUHJAC prevailing even now in JNTUH	Question 5(ii): 1. noted TCOs as cyber criminal org., policing failure

The answers for above questions by students had been analyzed and tabulated in Table 3 based on the awareness the students had regarding the cybercrimes.

Table 3 Content analysis for second set of questions

Student roll no	Question answered
16031F0004	Question 3: 1. noted 4 cybercrimes of CDFSGoT, 2500*4 as degree of crime, failure of court and police w.r.t action against it 2. noted PGF (Peoples Governance Forum) significance
16031F0005	Question 3: 1. noted 4 cybercrimes, TCOs, 20,000 degree of crime, PGF webpage
16031F0007	Question 3: 1. noted 4 cybercrimes, TCOs, PGF webpage and website, 20,000 as degree of crime involved in bigdata
16031F0008	Question 3: 1. noted 4 cybercrimes of TCOs, 20,000 as degree of crime 2. noted PGF for cyberpolicing
16031F0009	Question 3: 1. noted the violation of State Emblem of India (Prohibition of Improper Use) Act, 2005 (SEIPIUA) 2. noted the illegal (registrations)accounts in the website, spread of false information through the website 3. defames the JNTUH university and GoT 4. noted threat to society 5. recommended disciplinary action against CDFSGoT (website)
16031F0014, 018, 020, 025	Question 3: 1. noted 4 cybercrimes
16031F0017	Question 3: 1. is aware of the 4 cybercrimes in CDFSGoT as Cheating, Sedition, Identity theft (Sec. 66c, IT Act) and State Emblem of India (Prohibition of Improper Use) Act, 2005 (SEIPIUA) 2. precautions to be taken by cybercrime police for such crimes not to occur
16031F0020	Question 3: 1. noted 4 cybercrimes, need for strong action by GoT
16031F0023	Question 3: 1. noted 4 cybercrimes, PGF and the need for governmental action
16031F0024	Question 3: 1. noted 4 cybercrimes, 2500 cases, 2 sites (2*10,000), total degree of crime
16031F0026, 028, 030	Question 3: 1. noted identity theft (Sec. 66c, IT Act)

7 Conclusion

After the comparative evaluation is made on the SMMD values of illustrative websites, we conclude that the SMMD is very significant in social media campaign. This led us to make use of the social multimedia for campaigning about PGF and for realization of its goals. Thus SMM approach is followed for PGF and achieved SMMD = 5 value which is the highest we have noticed. The high SMMD value PGF is utilized for awareness generation among the stakeholders of academics such as the students, teachers, academic authorities in JNTUH academic environment etc. This has enabled us to sensitize the academic stakeholders thus promoting the values of national integrity, national integration, academic ethics, respect for the constitution, national solidarity and national consciousness. The work has given us a sense of pride for shouldering the national responsibility in this manner because we have undertaken this work justly for the national cause without an iota of personal benefit.

References

1. Usha Gayatri P, Chandra Sekharaiah K. (2013) Encasing the baneful side of internet. In: National conference on computer science & security (COCSS 2013), 5–6 April 2013, Sardar Vallabhbhai Patel Institute of Technology, Vasad, Gujarat, India
2. Santhoshi K, Sekharaiah KC, Lakshmi Kumari N (2018, March 2–3) ICT based social policing for swatch digital India. School of Law, Pondicherry University, Pondicherry
3. Santhoshi N, Sekharaiah KC, Madan Mohan K, Ravi Kumar S, Malathi B (2018) Cyber intelligence alternatives to offset online sedition by in-website image analysis through webcrawler cyber forensics. In: Proceedings of the international conference on soft computing & signal processing (ICSCSP 2018), 22–23 June 2018
4. Usha Gayatri P, Sekharaiah KC (2017) A case study of multiple cybercrimes against the union of India. Presented in NCIST'2017@Manipur Institute of Technology, Manipur University & published in International Journal of Computer & Mathematical Sciences IJCMS, vol 6, issue 3, pp 71–79 (ISSN 2347-8527)
5. Aparna G, Usha Gayatri P, Mounika S, Radhika D, Chandra Sekharaiah K (2016) Reviewing a judicial case study of multiple cybercrimes. In: IndiaCOM2016, International Conference on BVICAM, New Delhi
6. Usha Gayatri P, Chandra Sekharaiah K, Premchand P (2018, March 2–3) Analytics of judicial case study of multiple cyber crimes against the union of India. School of Law, Pondicherry University, Pondicherry
7. Madan Mohan K, Chandra Sekharaiah K, Santhoshi N (2018, July 12–13) ICT approach to defuse the cybercriminal sedition dimension of Telangana movement. In: BVRIT, International conference on research advancements in applied engineering sciences, computer and communication technologies (ICRAAESCCT 2018)
8. Mohan KM, Premchand P, Sekharaiah KC, Santhoshi N (2018) ICT approach to defuse the cybercriminal sedition dimension of Telangana movement. International Journal of Engineering & Technology 7(3.29):360–363
9. Srihari Rao N, Chandra Sekharaiah K, Ananda Rao A (2018) Janani Janmabhoomischa Swargaadapi Gareeyas. In: BVRIT, International conference on research advancements in applied engineering sciences, computer and communication technologies (ICRAAESCCT 2018), 12–13 July 2018 and International Journal of Engineering and Technology (IJET), vol 7, no 3.29, pp 225–231 (2018)

10. Pavana Johar K, Malathi B, Ravi Kumar S, Srihari Rao N, Madan Mohan K, Chandra Sekharaiah K (2018) India abusive Government-of-Telangana (GoT2011): a constitutional IT (an SMI) solution. In: Proceeding of international conference on science, technology & management (ICSTM 2018), Indian Council of Social Science Research, North West Regional Center, Punjab University Campus, Chandigarh, India on 12th August 2018, ISBN 978-93-87433-34-2 & International Journal of Research in Electronics and Computer Engineering (IJRECE), vol 6, issue 3, July–September 2018, ISSN 2393-9028 (Print), ISSN 2348-2281 (Online), pp 1118–1124
11. Tirupathi Kumar B, Chandra Sekharaiah K, Mounitha P (2015) A case study of web content mining in handling cybercrime. Int J Adv Res Sci Eng 04(01). http://www.ijarse.com. ISSN 2319-8354, Special Issue
12. Usha Gayatri P, Chandra Sekharaiah K, Radhika D, Sruthi G, Satish K, Mounika S, Shravani K, Kulshreshtha A (2017) Exploring cyber intelligence alternatives for countering cyber crime: a continuing case study for the nation. In: Proceedings of the International Conference @Bharati Vidyapeeth's Institute of Computer Applications and Management (BVICAM), New Delhi, India
13. Chandra Sekharaiah K (2015) Impact of the RTI act within a public authority organization towards employee- employer engagement: a case study. In: Proceedings of the international conference "enriching employee engagement in organization-role of psychology", 30 Jan–1 Feb 2015
14. Madan mohan K, Chandra Sekharaiah K, Premchand P (2018, March 2–3) Impact of RTI act with in public authority organization toward employee employer engagement: a case study. School of Law, Pondicherry University, Pondicherry
15. Tirupathi Kumar B, Chandra Sekharaiah K, Suresh Babu D (2016, March 4–5) Towards national integration by analyzing the web mining results of a case of cybercrime. In: 2nd international conference on information and communication technology for competitive strategies (ICTCS 2016), Udaipur, Rajasthan, India
16. Shankar MG, Gayatri PU, Niraja S, Sekharaiah KC (2016) Dealing with Indian jurisprudence by analyzing the web mining results of a case of cybercrimes. In: Proceedings of ComNet 2016 International Conference, 20–21 February 2016, Ahmedabad, India
17. Ravi Kumar S, Chandra Sekharaiah K, Sundara Krishna YK, Gouri Shenkar M (2018) Cybercrimes-trends and challenges in achieving Swachch Digital India: a case study. In: MRITCISTCSE 2018, pp 6–8, ISBN 97893 83038 596
18. Ravi Kumar S, Chandra Sekharaiah K, Sundara Krishna YK (2018, March 2–3) Cybercrimes-trends and challenges in achieving Swachch Digital India using a public cloud: a case study. School of Law, Pondicherry University, Pondicherry
19. Madan Mohan K, Chandra Sekharaiah K (2017, March) A case study of ICT solutions against ICT abuse: an RTI Act 2005 success story. In: National Seminar on S&T for National Development, Manipur University, Imphal
20. Srihari Rao N, Chandra Sekharaiah K, Ananda Rao A (2018, March 2–3) An approach to distinguish the conditions of flash crowd versus DDoS attacks and to remedy a cyber crime. School of Law, Pondicherry University, Pondicherry
21. Srihari Rao N, Chandra Sekharaiah K, Ananda Rao A (2018) An approach to distinguish the conditions of flash crowd versus DDoS attacks and to remedy a cyber crime. Int J Comput Eng Technol 9(2):110–123
22. Ramesh Babu J, Chandra Sekharaiah K (2018, January 19–21) Adaptive management of cybercriminal, maladaptive organizations, in the offing, that imperil the Nation. In: ICDMAI, Pune
23. Ramesh Babu J, Chandra Sekharaiah K (2018, March 2–3) Adaptive management of cybercriminal, maladaptive organizations, in the offing, that imperil the Nation. IIT Kharaghpur
24. Pavana Johar K, Malathi B, Ravi Kumar S, Srihari Rao N, Madan Mohan K, Chandra Sekharaiah K (2018) Indiaabusive Government-of-Telangana (GoT 2011): a constitutional IT (an SMI) solution. In: ICSTM 2018

25. Malathi B, Chandra Sekharaiah K, Jayashree H (2016) Analytical trends and practices of web intelligence. ACM. ISBN 978-1-4503-4278-0/16/03
26. Malathi B, Madan Mohan K, Chandra Sekharaiah K (2018) Web intelligent information systems: a PGF mediated social media evaluation perspective. In: IJMTE 2018, ISSN No 2249-7455, ICRTESM 2018, ISBN 978-93-87433-44-1
27. https://sites.google.com/site/chandraksekharaiah/india-against-corruption-jntu
28. https://sites.google.com/site/sekharaiahk/apeoples-governanceforumwebpage
29. https:// https://sites.google.com/view/peoplesgovernanceforum

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Application of FACTS Controllers for Enhancement of Transient Stability

Lokesh Garg and Shagufta Khan

Abstract This paper illustrates the power system transient stability enhancement of an 11-Bus system using FACTS controllers. Here there cases are analyzed on IEEE 11 bus system. The cases are without fault, with fault and post fault system the simulation is done via PSAT software. Simulation results are compared with different series FACTS controllers and it has been observed that UPFC is the best series facts controller foe enhancement of transient stability as compared to other series FACTS controllers.

Keywords FACTS · PSAT · TCSC · Transient stability · SSSC · UPFC

1 Introduction

Power system stability control is a very important aspect in electrical engineering. Whenever there is a fault, sudden open and close of circuit breaker, suddenly change in load then the toque on the generator changes and it effects the stability of the power system. In the last two decades the Flexible AC transmission system (FACTS) devices are becoming more popular. In modern power system there are numerous numbers of generators, transformers, buses, transmission lines and loads [1–8]. Due to nonlinear characteristics of power system components, undesirable oscillations and transients are produced under small and large signal perturbations. In long transmission lines series compensation, shunt compensation, series and shunt compensation schemes are used in order to enhance the transient stability of the system as well as the power transfer capability [1–4, 6]. Shunt, series, series-series, series parallel types of FACTS controllers are used to enhance the transient stability of the interconnected power system [5].

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_70

Among the converter based FACTS devices series FACTS controllers are the popular FACTS devices to increase the amount of energy transported over the line also to increase the transient stability enhancement. The power flow analysis is done using Newton-Raphson method. By changing the firing angle of the inverter the change in reactive power is used for improved the transient stability.

2 Power System Stability

In power system synchronous machines are operating in synchronism under normal condition. For a system to be stable all machines need to be maintaining synchronism under all steady state conditions as well as transient condition. In addition to the above mentioned two stability there is also one more stability known as dynamic stability. Power system stability is categorized into three categories as shown in Fig. 1. Also, the classification of FACTS controllers is shown in Fig. 2.

3 Study System

System under Study: Here IEEE 11 Bus system is used for simulation, here Slack bus is No. 3, slack bus voltage is 1 p.u. and the generator buses are 1, 2 and 4 (Fig. 3).

In the Appendix required date is given such as line data, bus data and generator data. Ratings of modeled generators are taken as 950MVA at 20 at 50 Hz, it has been assumed that the loads have constant impedance and generators mechanical input power is constant. TCSC Data, SSSC Data, UPFC data of 11 Bus systems given in Appendix. Power System Analysis Tool box (PSAT) software is used for the simulation of the result.

3.1 11 Bus Systems During Fault Condition

The stability of the system depends on the occurrence and type of fault, depends on the clearing time, location of fault, and the method used for clear the fault. In order

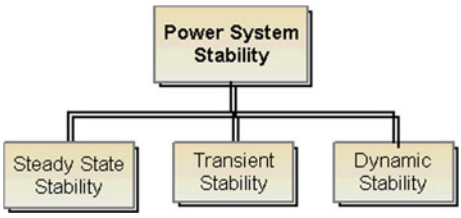

Fig. 1 Power system stability

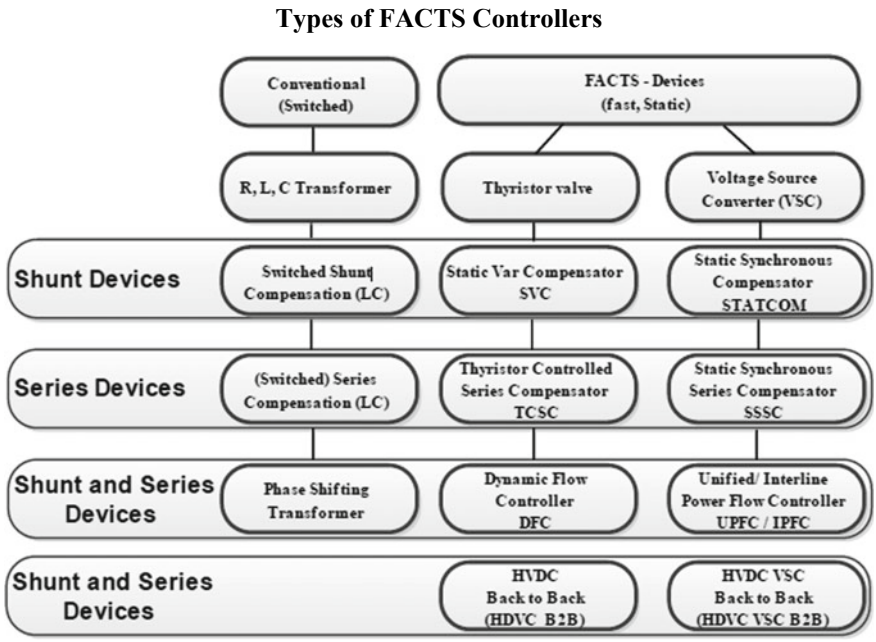

Fig. 2 Classification of FACTS controllers

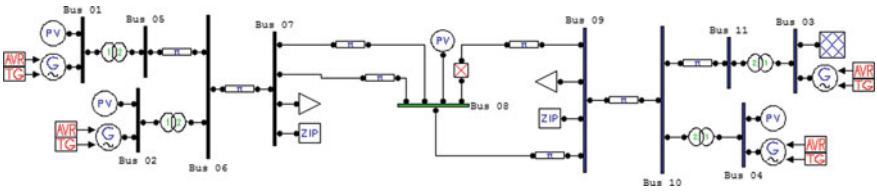

Fig. 3 11 Bus test system pre-fault condition

to create a transient instability a three phase fault is taken at bus no. 7. The introduced fault is a transient fault. Here the fault is occur 1.50 s and clearing time of fault is also 1.50 s (Fig. 4).

3.1.1 11 Bus Systems During Post Fault Condition with TCSC

TCSC are used in the faulty system. TCSC has been place in between bus No. 7 and 8. For simulation purpose 30% series compensation has been used. Rotor speed curve, Voltage on 11 buses in post fault condition is shown in simulation results (Fig. 5).

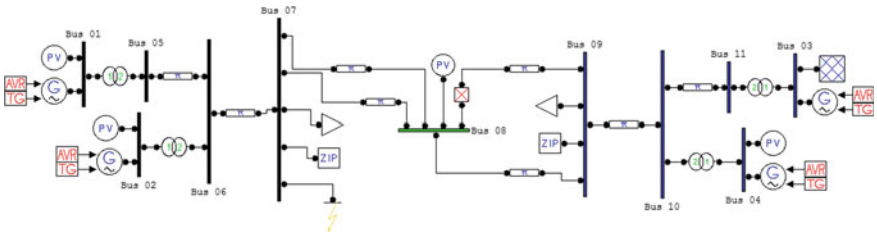

Fig. 4 11 Bus test system fault condition

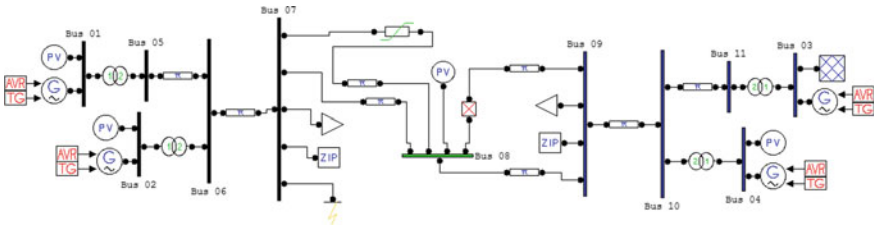

Fig. 5 11 Bus systems with TCSC

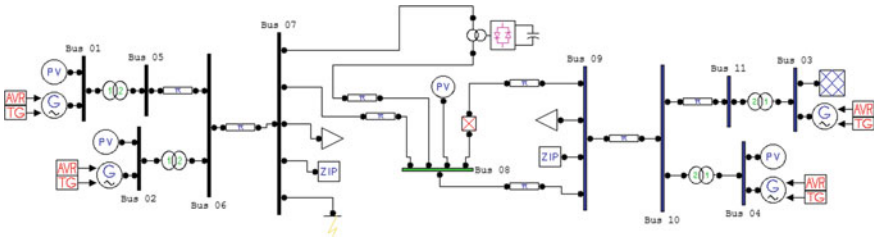

Fig. 6 11 Bus systems with SSSC

3.1.2 11 Bus Systems During Post Fault Condition with SSSC

SSSC are used in the faulty system. SSSC has been place in between bus No. 7 and 8. For simulation purpose 30% series compensation has been used. Rotor speed curve, Voltage on 11 buses in post fault condition is shown in simulation results (Fig. 6).

3.1.3 PSAT Simulation Model Post Fault with UPFC

UPFC are used in the faulty system to maintain the synchronism and also enhanced the transient stability. UPFC has been place in between bus No. 7 and 8. For simulation purpose 30% series compensation has been used. Rotor speed curve, Voltage on 11 buses in post fault condition is shown in simulation results (Fig. 7).

4 Simulation Results

The simulation results for prefault, during fault and post fault conditions for the given model with different FACTS devices are shown in Figs. 8, 9, 10, 11, 12, 13, 14, 15, 16 and 17.

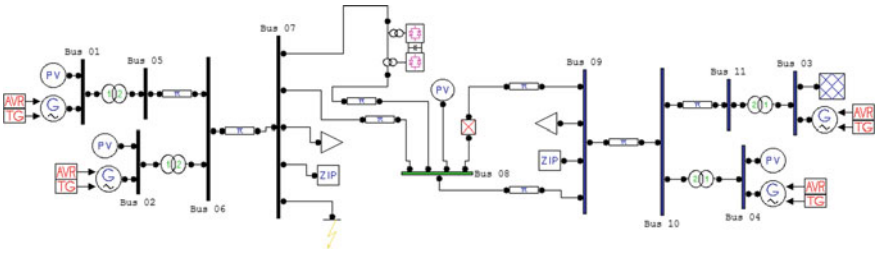

Fig. 7 11 Bus systems with UPFC

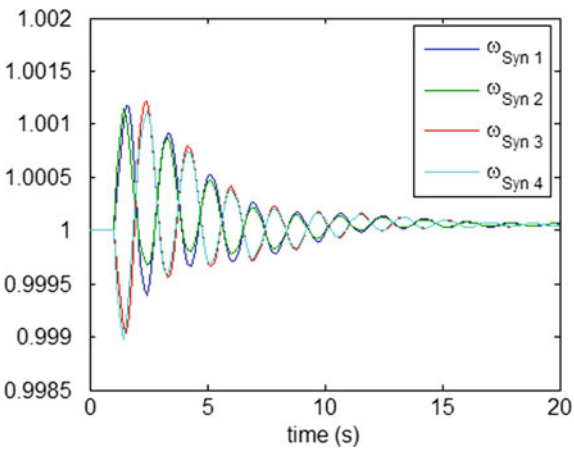

Fig. 8 Rotor angular speed curve pre fault condition

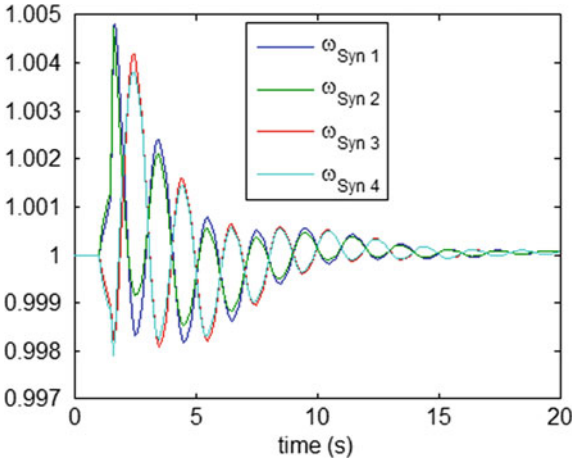

Fig. 9 Rotor angular speed fault condition

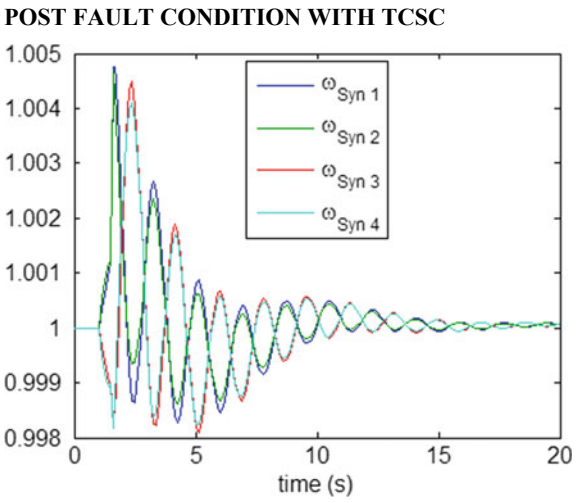

Fig. 10 Rotor angular speed curve with TCSC

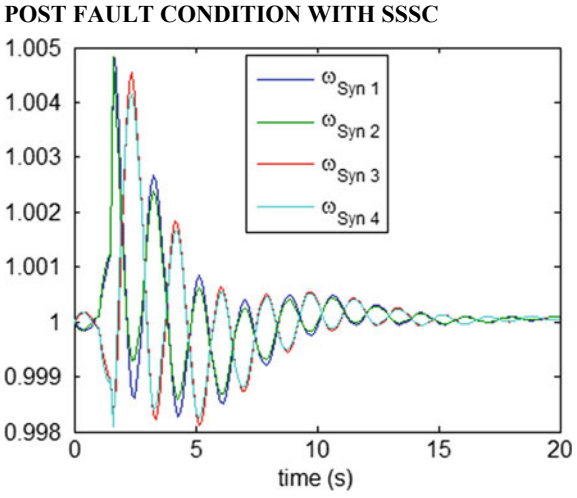

Fig. 11 Rotor angular speed curve with SSSC

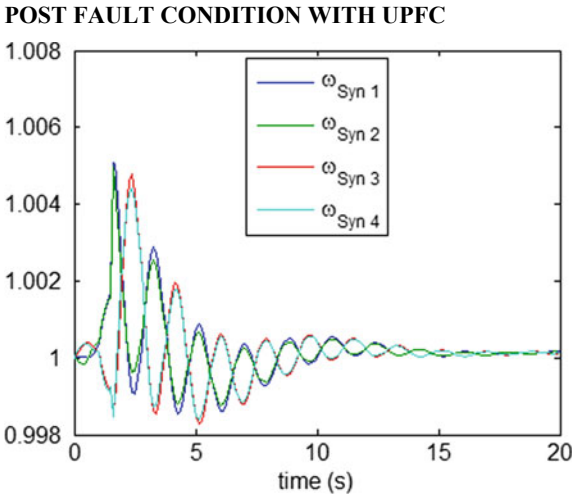

Fig. 12 Rotor angular speed curve with UPFC

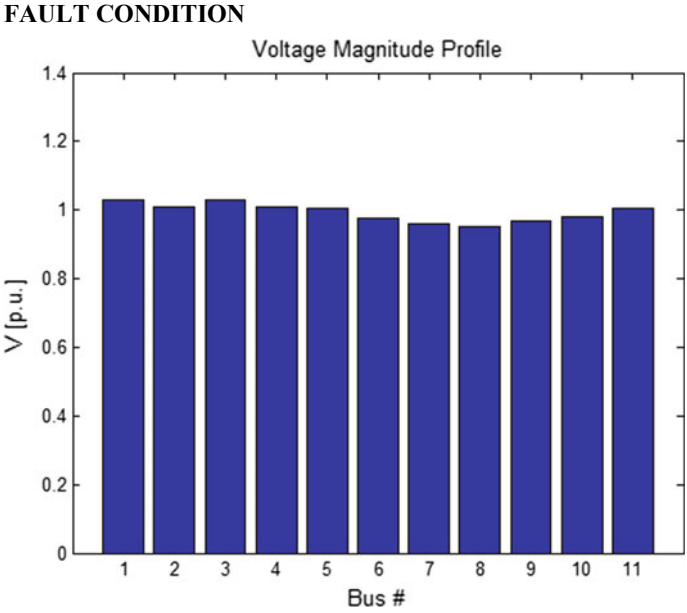

Fig. 13 Voltage on 11 Buses pre fault condition

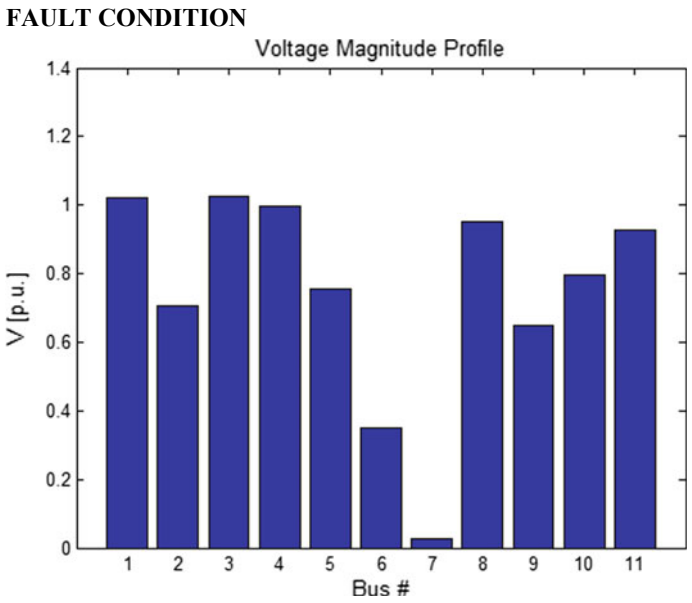

Fig. 14 Voltage on 11 Buses fault condition

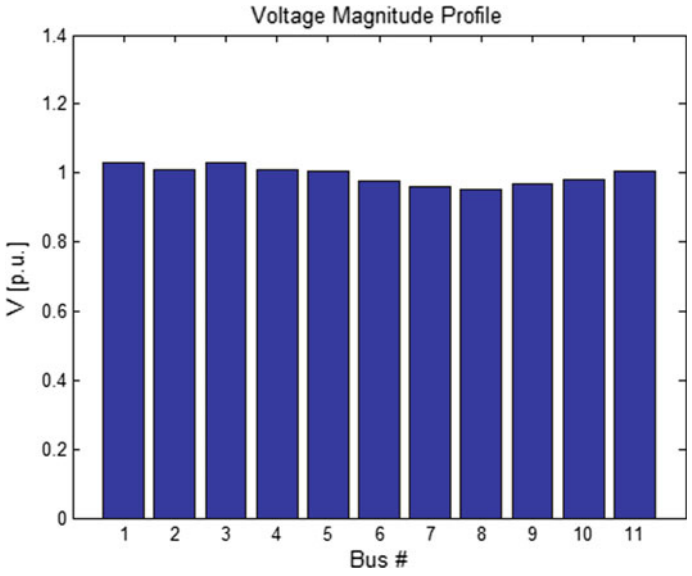

Fig. 15 Voltage on 11 Buses with TCSC

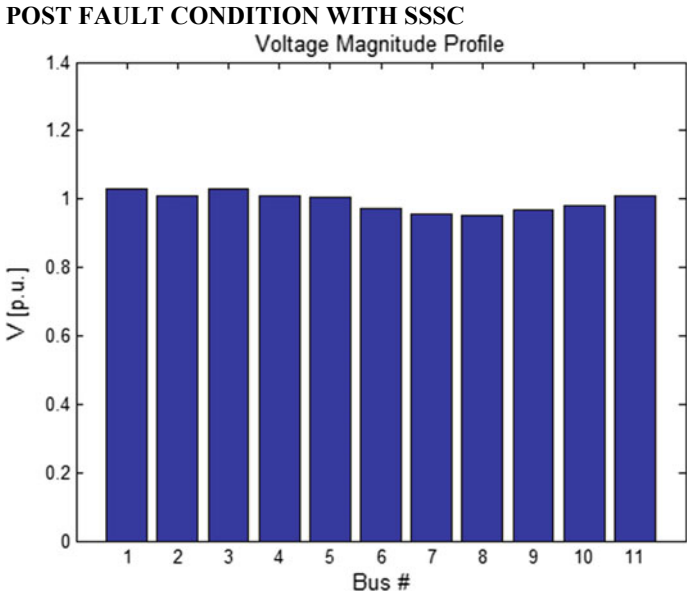

Fig. 16 Voltage on 11 Buses with SSSC

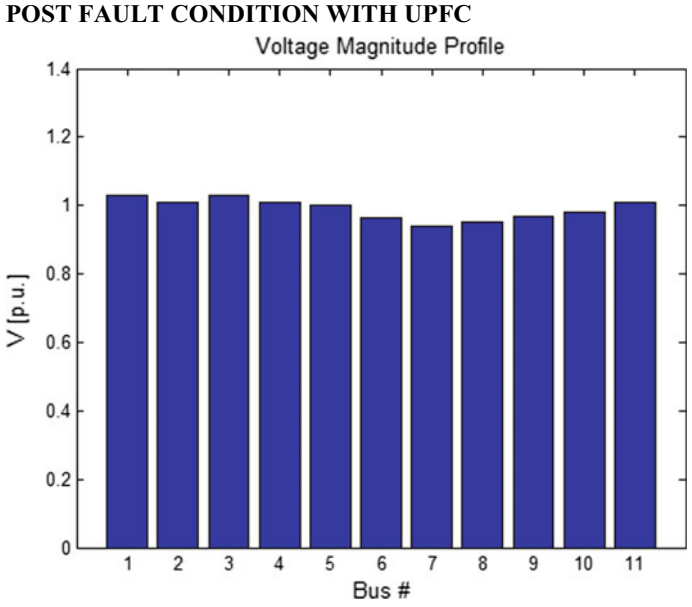

Fig. 17 Voltage on 11 Buses with UPFC

5 Conclusion

This paper illustrates the transient stability enhancement of multi machine system. A three phase fault has been held at 1.50 s and fault has been cleared at 1.50 s. The simulation results using PSAT software shows clearly the impact of TCSC, SSSC and UPFC have enhanced the transient stability of multi machine system. From simulation results it has concluded that the application of FACTS controllers helps in enhancing the transient stability of 11 Bus systems. When we compared these three series FACTS Controllers for the transient stability enhancement it is concluded frm the simulation results that out of TCSC, SSSC and UPFC series Facts controllers UPFC is the best FACTS controller for enhancement of transient stability.

Appendix

Generator data				
	GEN 1	GEN 2	GEN 3	GEN 4
MVA	950	950	950	950
KV	22	22	22	22
HZ	50	50	50	50
Ra (p.u.)	0.0025	0.0025	0.0025	0.0025
X_L (p.u.)	0.2	0.2	0.2	0.2
X_d (p.u.)	1.80	1.80	1.80	1.80
X'_d (p.u.)	0.30	0.30	0.30	0.30
X''_d (p.u.)	0.25	0.25	0.25	0.25
T'_{d0} (s)	8.00	8.00	8.00	8.00
T''_{d0} (s)	0.03	0.03	0.03	0.03
X_q (p.u.)	1.70	1.70	1.70	1.70
X'_q (p.u.)	0.54	0.54	0.54	0.54
X''_q (p.u.)	0.245	0.245	0.245	0.245
T'_{q0} (s)	0.5	0.5	0.5	0.5
T''_{q0} (s)	0.06	0.06	0.06	0.06

11 Bus data						
Bus no.	No. of I/P	No. of O/P	Voltage (KV)	V (p.u)	Angle (rad)	Area
1	2	1	20	1.03	0.323	1
2	2	1	20	1.01	0.154	1

(continued)

(continued)

11 Bus data						
Bus no.	No. of I/P	No. of O/P	Voltage (KV)	V (p.u)	Angle (rad)	Area
3	2	1	20	1.03	−0.1188	2
4	2	1	20	1.01	−0.296	2
5	1	1	230	1.01	−0.2112	1
6	2	1	230	0.9877	0.0366	1
7	1	4	230	1.0	−0.1065	1
8	4	1	230	1.0	−0.337	3
9	1	4	230	0.9899	−0.555	2
10	2	1	230	0.9938	−0.412	2
11	1	1	230	1.013	−0.234	2

Facts controller data			
	TCSC	SSSC	UPFC
MVA	100	100	100
KV	230	230	230
HZ	50	50	50
% series compensation	30	30	30
Regulator time constant	20	0.101	50
V_p max	—	0.351	0.2512
V_p min	—	0.1501	0.1493
V_q max	—	0.001	0.2497
V_q min	—	0.0	0.1498
I_q max	—	00	0.303
I_q max	—	0.00	0.1002
Xc max	0.501	—	—
Xc min	−0.5001	—	—

11 Bus line data					
Line no.	From bus	To bus	Impedance of line (p.u)		Rating in MVA
			R(p.u.)	X(p.u.)	
1	1	5	0.000	0.15	900
2	2	6	0.000	0.15	900
3	3	11	0.000	0.15	900
4	4	10	0.000	0.15	900
5	5	6	0.0025	0.025	100
6	6	7	0.0010	0.010	100

(continued)

(continued)

11 Bus line data					
Line no.	From bus	To bus	Impedance of line (p.u)		Rating in MVA
			R(p.u.)	X(p.u.)	
7	7	8	0.011	0.11	100
8	7	8	0.011	0.11	100
9	8	9	0.011	0.11	100
10	8	9	0.000	0.11	100
11	9	10	0.001	0.01	100
12	10	11	0.0025	0.025	100

References

1. Kamdar R (2014) Transient stability analysis and enhancement of IEEE 9 bus system. Int J Electr Comput Eng 3(2)
2. Sauer PW, Pai MA (1998) Power system dynamics and stability. Prentice Hall, pp 23–35
3. Rajput RK (2008) Power system engineering. Laxmi Publications
4. Wadhwa CL (2006) Power system engineering. New Age Publishers
5. Gyugyi L (1992) A unified power flow controller concept for FACTS. In: IEEE Proceedings-C, vol 139, no 4, pp 323–331
6. Owusu (2018) A direct method for the transient stability analysis of transmission switching events. In: 2018 IEEE power and energy
7. Ravi Kumar SV, Nagaraju SS (2007) Transient stability improvement using UPFC and SVC. APRN J Eng Technol 2(3):38–45
8. Patel SD, Raval HH (2014) Voltage stability analysis of power system using continuation power flow method, vol. 1, issue 9, pp 763–767, ISSN 2347-4718

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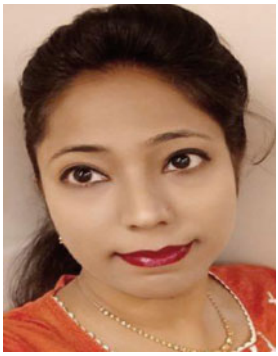

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Cryptocurrency: Threat or Opportunity

Venkamaraju Chakravaram, Sunitha Ratnakaram, Ester Agasha, and Nitin Simha Vihari

Abstract Though a weak currency is a sign of a weak economy and a weak economy leads to a weak nation, here we gave an attempt to study about the cryptocurrency. Cryptocurrency is also known as the digital currency of the 21st Century which moves in the form of cryptographic codes in between people or institutions those who are connected to peer to peer networks (P2P). Blockchain Technology plays a major role in the flow of cryptographic codes among various nodes in the P2P networks to convert into Cryptocurrency in the decentralized ledger environment. This paper investigates the working of cryptocurrency and its impact on economies, especially to list the threats and opportunities to the Indian Economy. Also gave an attempt to differentiate the cryptocurrency and fiat or real currencies on various aspects in the world economy. We used descriptive cum exploratory research methodology to get the desired results in the present research work.

Keywords Blockchain technology · Cryptocurrency · Fiat currency · Economy · Opportunities · Threats

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_71

1 What Is Economy

An area where Purchase, Production, Sales, Trade, Distribution and Consumption of goods and services among various economic agents taken place is known as Economy. These economic agents are main stakeholders of the economy generally known as individuals, business institutions, organizations and Government [1]. Generally, these transactions occur with a price tag mutually agreed and commonly expressed by two parties at a certain currency.

1.1 What Is the Relationship Between Economy and Currency?

Hence, based on the above discussion currency or monetary transactions occupy very limited space in the economy. Currency is known as a medium of exchange in the economy specially to circulate in the form of banknotes, coins, bill of exchanges, drafts, etc., Earlier we have barter system before the introduction of currency. But this barter economy presents many difficulties [1]. We will have to search for the right party to exchange our component with another party for our required component. When we identified the party, he or she may not have interested in exchange product or component. This is the biggest disadvantage of this barter system. Also, there are no standard measurements in the procedure. We cannot subdivide the exchanging commodities also very difficult to store. Hence, all these difficulties are overcome with the introduction of money or currency by the nations in their economies.

1.2 What Is Currency and Cryptocurrency, How It Works? How It Differs from Real/Fiat Currencies

Currency is known as the medium of exchange generally it will be in the form of banknotes, pay orders, bill of exchanges, demand drafts, coins, etc. Currency is a system of money commonly uses for the people of one nation or economy. We will use these currencies as a medium of exchange, to measure the value of the transaction between two parties or entities, to store the value for a long time as assets and to pay or settle the transactions by paying the money [1]. We can rate as good currency when a currency is having the following qualities. It must have general acceptability by the people and institutions living in that country. It must have portability nature with high value to carry easily from one place to another place. The material used to make that currency unit should be easily recognizable or cognizable. The material used to make the currency unit should be durable with a long life to store and use in future. It must of divisibility nature, in case we want to

divide the currency into subunits. Must have homogeneity with equal quality of the material used with equal weights. A Currency must also have to maintain its stability of value in all the times and it should be easy to fold or moulded with malleability nature [1].

2 Cryptocurrency

It is a 21st Century's newly digitalized money, which will be available in the form encrypted cryptographic codes, transferred between peers and confirmed through a computer-based mining process in the decentralized public ledger systems well known as Blockchain Technology [2, 3]. Cryptocurrency also is known as Crypto Coin, Crypto Token, Crypto Money & Crypto Asset. This currency also is known as "DLT Currency, Virtual Currency" or "Digital Currency," operates as a borderless, decentralized medium of financial exchange and value storage backed primarily by user consensus. With the help of Blockchain Technology, Cryptocurrencies are characterized by their nearly anonymous, entirely electronic peer-to-peer (P2P) transactions. These virtual currencies catch the imagination of customers, entrepreneurs, business venture investors or capitalists, philanthropists and software developers (Fig. 1).

Fig. 1 Various cryptocurrencies *Source* Invest Wisely.CA. [15]

These currencies are generated by systems, software solving complex algorithms —called "mining"—which also verifies these transactions. The online or internet-based medium of exchange uses Cryptography as a secured communication to exchange digital exchange of financial transactions. This cryptography was used during the Second World war to pass the quick and important communication or messages between authorities and army defence forces. Cryptography evolved with the combination of both computer science, mathematical elements and its formulas. The first used cryptocurrency was "Bitcoin" which was released in 2009. Cryptocurrency operates on a decentralized public ledger technology known as Blockchain Technology. Below given table (Table 1) is showing the difference between Cryptocurrency and Fiat or Real Currency.

Table 1 Comparison of currencies

Cryptocurrency vs fiat or real currency	
This is generated by computer software with the help of some mathematical formulas and coding	This is created, issued and regulates by Governments or Governmental agencies like Banks, Financial institutions etc.
It works based on the decentralized ledger technology or concept known as Blockchain Technology	It works based on the centralized Ledger accounting system
There is no monitoring or supervising or legally responsible authorities for this currency	Government of the concern nation or Central Banks of concerns nations are the monitoring, supervising and legally responsible authorities for this currency
This will be in the invisible form and will move in between individuals or institutions in the form of digitally coded medium of exchange known as Cryptography	This will be in the visible form will move in-between individuals or institutions in the physical form like currency notes, pay orders, demand drafts, coins and bill of exchanges
Supply of this currency will be in limited and at some point of time it will be exhausted and we can't release	Supply of this currency will be in an unlimited manner, at any time Government can print and release new currency through some financial and economic procedures
The journey of this currency started a decade ago only i.e., from 2009	The journey of this currency started 1500 years ago
Total 2454 currencies are there all over the world [6]	As per the United Nations Organization, there are about 180 fiat or real currencies are in circulation all over the world [7]
11 cryptocurrencies are famous among all 2454 currencies in terms of their trade value and volume	8 real or fiat currencies are famous among all 180 currencies in terms of their trade value and volume
They are, Bitcoin (BTC), Litecoin (LTC), Ethereum (ETH), ZCash (ZEC), Dash (DASH), Ripple (XRP), Monero (XMR), Bitcoin Cash (BCH), Neo (NEO), Cardano (ADA), EOS (EOS) [4]	They are the United States of America Dollar, European Euro, Japanese Yen, Pound Sterling, Australian Dollar, Canadian Dollar, Swiss Franc and Chinese Yuan Renminbi [5]

3 Analysis

3.1 Objectives

Based on the above ready articles and research papers, we found there is a gap in this area. Considering the prosperity of the nation, people and economy, we decided to list the threats and opportunities or new possibilities of cryptocurrency. Especially, we have listed all the points considering the trends and situations of the Indian economy.

Objective One: To list the threats of cryptocurrency to the Indian Economy.

Objective Two: To list the opportunities or new possibilities of cryptocurrency to the Indian Economy.

3.2 Brief About Indian Economy

India is one of the fastest-growing economies in the world. Experts are estimating that the Indian economy will stand in the top three within 10–15 years [8]. At present the Indian economy is the seventh-largest economy by nominal Gross Domestic Product (GDP) and stands as the third-largest economy in terms of its purchasing power parity (PPP) [9]. Indian Rupee is India's Official Currency also known as INR. Reserve Bank of India is managing agency of this currency in Indian on behalf of Government of India. Indian rupee (₹) is one of the oldest currencies in the world introduced in the 6th Century in Ancient India.

3.3 Stand of Govt. India on Cryptocurrency

An Inter-Ministerial Committee (IMC) appointed by Government India has strongly recommended banning all private cryptocurrencies in India. The IMC said, there are 2116 cryptocurrencies are showing their transactions at present in India [10].

3.4 List of Threats and Opportunities

Threats: The appointed Inter-Ministerial Committee (IMC) listing the following threats due to private cryptocurrencies on Indian Economy.

1) With wide entrance and narrow exit, these private cryptocurrency investments are causing for the collateral damage to individuals or organizations to rush to get out.
2) Volatility in the prices of these currencies may create a lot many speculative losses to the investors.
3) These currencies are Intangible, illiquidity natured invested assets, we can't convert them into fiat cash for emergency funds requirements and hampers convertibility and insurability.
4) All these cryptocurrencies are created by private players, not by the sovereigns or Government regulating agencies. Hence, we cannot catch these invisible players to prosecute or summon, incase if anything went wrong.
5) There is no proper intrinsic value, nor considered for these private currencies while introducing into the market.
6) Human errors, like remembering passwords, loss of memory, wrong typing of a single letter in the password also may cause for the permanent loss of this invisible asset some times.
7) There is no any fixed face value or nominal value for these private cryptocurrencies, they are unable to fix their prices as main releasing store value or medium of exchange price and there is no any pricing policy also.
8) Almost all these private cryptocurrencies are showing frequent fluctuations in their price values since inception. These fluctuations are creating unrest and fear in investors.
9) These private cryptocurrencies are not serving the main purpose of currency. Mostly these currencies are inconsistent at essential functions of currency and we cannot replace or convert or exchange with fiat currency immediately with these private cryptocurrencies.
10) There is no any legal jurisdiction in the Globe for these private cryptocurrencies and we can tender these currencies legally.
11) Mostly the people those who wish to convert their black money, illegal earnings or reserves into white, also to do money laundering practices are approaching and investing in these currencies. Finally, these private currencies are arranging an alternative and easiest platform to the criminally minded individuals, organizations to hide their illegal earnings in the form of cryptocurrency assets and to transfer easily out of the political boundaries of the nation.
12) Cyber risks on all sides also one of the threats to this currency. Since this currency is in the form software and mathematical formula or codes in the systems, if anything happened to the computer systems due to virus and hacking, tracing back the lost data and currency very difficult.
13) Lack of regularities on this asset at regulating bodies, tax agencies, controlling bodies from Government side. Estimation of this invisible asset, depreciation loss also difficult to show at the tax authorities while classifying under asset.

3.5 *Opportunities and New Possibilities*

1) **Global Financial System:** The first introduced cryptocurrency in the world has transformed the entire global financial system with its capitalization value of 64 $ billion dollars. The total market value of all cryptocurrencies has crossed its total crypto assets value 824 $ billions [11].
2) **Cost and Time of Transactions:** Since, there are no intermediaries, banks or any other regulating bodies on these currencies to generate and transfer, also since managing by all the network participants (P2P), at a cheaper cost and in less time we can perform the financial transaction easily using its Blockchain Technology. For example, a financial transaction worth approx. 300$ million dollars was performed just for a 4 cents cost ($0.04) on dated 27th July 2018 [12].
3) **Erase or Manipulations are not possible:** Since this Blockchain Technology is a decentralized ledger technology, the transaction happened is visible across the nodes across the networks. There is no possibility to erase or change of figures, words of the transaction.
4) **international Acceptance:** Some of the countries stated accepting these currencies. Recognized by their Governments, encouraging cryptocurrency holders to pay their tax liabilities, other Gov payments with Cryptocurrency.
5) **Payments through Social Media:** With the help of "Kik" messenger app, one can do payments without having a regular bank account. No hassles of currency exchange, payment formalities need to follow, when we are making payments to the abroad clients or individuals and no cost also.
6) **Lending:** Kiva is a lending company offering Bitcoin cryptocurrency as loans to some companies. Bitbond also doing the same [13].
7) **Retirement Benefits Services:** Bitcoin IRA is a company is providing retired individuals with these services. The invested amount in IRA will be converted into Bitcoins and benefits along with tax exemptions are providing to the accounting holders.
8) **Job Opportunities:** There are endless job opportunities through Startup companies in the cryptocurrency era. Plenty of jobs offers are there for content writers and marketers in this field.
9) **Initial Coin Offerings (ICO):** Some of the young entrepreneurs are interested in launching ICOs through their startups. Hence, there a lot of scope for the establishment of startups and enterprises [14, 16, 17].

4 Discussion

Though this cryptocurrency is having many drawbacks or threats, this could completely transform the current economic situation in Indian and abroad countries. Particularly we can use these cryptocurrencies in cross border transfers of financials

at low cost with less time without depending on intermediaries like banks and financial institutions., also we can use this to remit the wages and salaries to our human forces if we wish to introduce this cryptocurrency in our A to Z business operations. However, we can use this technology i.e., in other ecosystems globally. In addition to the possibilities of the cross-chain unification of blockchains, it provides the integration of all financial operations with different cryptocurrencies simultaneously.

5 Conclusion

Cryptocurrencies created an image now in the world markets basis on its Blockchain technology we can reduce the cost of international transactions. Also making these cryptocurrency transactions free and these cryptocurrencies are facilitating cross boarded economies integration. Same time these cryptocurrencies based technologies providing several other benefits as well in addition to the threats and opportunists.

References

1. Sudaran P (2016) Functions of money in the modern economic system
2. Telegraph R (2018) What is cryptocurrency how does it works and why we use it
3. Thomas D (2018) How does cryptocurrency work?
4. Bajpai P (2019) The 10 most important cryptocurrencies other than bitcoin
5. Anonymous (2019) Top 25 most traded currencies
6. Anonymous (2019) All cryptocurrencies. https://coinmarketcap.com/all/views/all/
7. Anonymous (2019) List of circulating currencies
8. Anonymous (2019) About Indian economy growth rate and statistics
9. Anonymous (2019) The economy of India
10. Rahul S (2019) Govt committee recommends a ban on cryptocurrency in India
11. Dante D (2018) Beware of crypto risks-10 risks to watch
12. Anonymous (2019) Cryptocurrency threat to the economy or new possibilities
13. Chalmers B (2017) New opportunities with cryptocurrency
14. Aashish S (2018) How cryptocurrency is creating endless opportunities in the job market
15. Beau H (2019) WTF is cryptocurrency?
16. Chakravaram V, Rao GVS, Srinivas J, Ratnakaram S (2019) The role of big data, data science and data analytics in financial engineering. In: Proceedings of the 2019 international conference on big data engineering. ACM, pp 44–50. https://doi.org/10.1145/3341620.3341630
17. Chakravaram V, Srinivas J, Ratnakaram S (2019) Use of ICTs in financial engineering applications in insurance business. In: ICT analysis and applications. Lecture notes in networks and systems, vol 93. Springer Nature Singapore Pte Ltd. https://doi.org/10.1007/978-981-15-0630-7_27

The Role of Blockchain Technology in Financial Engineering

Venkamaraju Chakravaram, Sunitha Ratnakaram, Ester Agasha, and Nitin Simha Vihari

Abstract This research work is to study and list out the processes and operational areas where Blockchain Technology (BCT) is playing a greater role as a tool in the process of financial engineering (FE) in the insurance business. We studied the use of BCT as one of the InsurTech tools in the design and development of financially engineered insurance products. Here, the development of insurance products covers the design of new and innovative insurance policy models, its attractive features as per the needs and requirements of concerned target customers. Insurance processes cover the management and administration of insurance business i.e., marketing, sales and distribution, the underwriting process and claims management, etc. Financial Engineering is a process of creating a new and innovative insurance model by merging existing policy models OR creating a new and innovative insurance model. FE uses the tools and techniques of Statistics, Financial Mathematics, Econometrics, ICTs which includes, FinTech tools, InsurTech tools like Blockchain Technology, Artificial Intelligence, etc. In this research work, we used descriptive cum explorative research methodology. We have studied the role of BCT as an effective tool in the financial engineering process of the insurance business.

Keywords Blockchain Technology · Financial Engineering · FinTech · InsurTech · Insurance business · Insurance policies

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_72

1 Introduction

One of the fastest-growing sector and industry in the Indian Economy is the Insurance sector. This sector broadly can show in two divisions. One is Life Insurance Sector and the second one is the General Insurance Sector. Total 60 licensed insurance companies are playing a major role and serving the people in India. 24 companies are providing their insurance services in the life insurance sector and 34 companies are providing services in the general insurance sector and the balance two are in reinsurance business and serving to the above listed 58 companies. All these companies are regulating by Insurance Regulatory Development Authority of India (IRDAI) an agency of Government of India. After the Banking Sector, Insurance is the largest sector in the Indian economy which is playing a major role in terms of offering innovative financial and insurance services to the Indian insurance customers. More than 95% of these registered companies are operating as joint-ventured companies with the collaboration of various abroad banking and insurance companies. Financial Engineering is a process of creating innovative financial and insurance models or products in both the banking and insurance sectors. FE considers the competition, needs and customized requirements of the current era customers. The current era customer doesn't have time and patience to refer the multiple apps, broachers, websites or applications to avail his financial and insurance needs. In most of the occasions, the current era customers are expecting tailor-made, customized products for his both financial and insurance needs. Hence, considering these customization challenges, competition from the existing players, also threat of the advanced technologies, all most all insurance companies have started thinking to release new and innovative policies into the market. Hence, Financial Engineering is the only solution provider which can help the insurers in the creation of financially engineered products and processes. Insurance companies consider and imports various tools like Statistics, Financial Mathematics, Econometrics, ICT (Information & Communication Technology) tools like FinTech, InsurTech, etc. The backbone technology of Cryptocurrency is Blockchain Technology comes under one of the advanced tech tools of InsurTech [1–6].

2 What Is Blockchain Technology

2.1 Blockchain Technology

Blockchain is a nascent technology also known as distributed ledger technology (DLT). BCT was used as the main technology in the introduction process of the first cryptocurrency in the year 2009 [3, 4, 7].

2.2 What Is Cryptocurrency

Cryptocurrency is a digital currency which we can avail or see in the form of digital format only. It is completely a private currency and its transaction time is very less at a very cheaper cost. This digital currency uses strong cryptography, hash algorithms to secure all its financial transactions throughout. Almost nearly about 1600+ cryptocurrencies are in operation at present across the world. But only ten currencies are famous among these. All these cryptocurrencies are mostly using C++, JavaScript, Python and Solidity program languages to implement. The first cryptocurrency released in the world was Bitcoin which was released in the year of 2009 by Satoshi Nakamoto released as an open BCT software and a Peer-to-Peer Electronic Cash System. There is no any cryptocurrency without BCT in the world at present. The market capitalization value of all these currencies is more than 100$ billion dollars which are larger than 120+ countries GDP value in the world. Since this cryptocurrency uses distributed ledger technology and no one will take centralized responsibility and legality on these currencies flow and operations. That's why still in India, these cryptocurrencies are not recognized by the Govt. of India. quality plagiarism software/tool (Turnitin/iThenticate) will be used to check similarity that would not be more than 20% including reference section. In the case of exclusion of references, it should be less than 5% (Fig. 1).

But Indian companies of various sectors started using this currency technology to speed up their operations, to reduce the fraudulent practices and to minimize their operational costs. The insurance sector also started using this technology in operations. We can rate Blockchain Technology (BCT) as a trusted technology of the decade of the 21st century where we can use its services greatly in both the insurance and banking sectors. BCT can define as the fastest growing technology

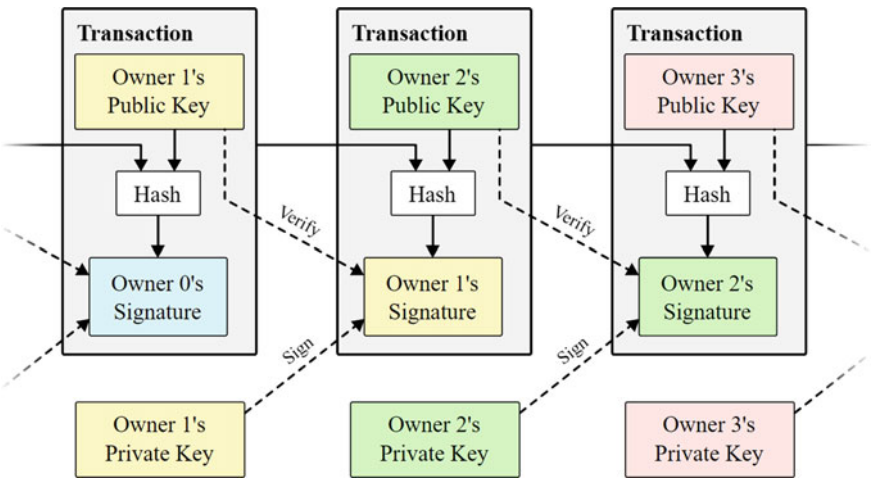

Fig. 1 A peer-to-peer electronic cash system *Source* Kassandra Jucutan*; April 2018 [2]*

which is having a distributed and decentralized digital ledger which records transactions across a global network of computers where the information is highly secure with two different kinds of passwords. The companies which are using BCTs are in the gaining process

2.3 What Is Financial Engineering

Financial Engineering is a process of using statistics, financial mathematics, econometrics, computer sciences, software technologies like ICTs, Fintech and InsurTech, etc., to create a new and innovative financial model or product. All over the world all most all companies serving in the insurance sector using FE in the process of creating new policies and in the management of insurance operations.

2.4 What Is Insurance, Brief Overview of Global and Indian Insurance Sectors

The business turnover worth of the global insurance industry is over 5$ trillion. In India, the gross premium written in the year of 2019 is Rs. 5.78 trillion. Indian insurance industry expected to grow by 2020 is 280$ billion [6].

3 Brief Overview on the Role of Technologies in Insurance Sector

In the digital world, particularly since two decades' customers' insurance needs, preferences are changing frequently in the direction of personalized and customized models, products. Use of computer and mobile apps increased and customers started referring to the policies, applying insurance policy and renewal payments and query or claims submission, etc., activities are mostly doing in online. Since a decade the following five InsurTech technologies are having a great impact on Insurance sector i.e., Artificial Intelligence (AI), Big Data (BD), Blockchain Technology (BCT), Internet of Things (IoT) and Augmented Reality (AR), etc. [5].

Table 1 Various steps in the working of Blockchain Technology

Sl. No.	Phases/Steps in BCT transaction	What exactly happens at each phase/step
1	Someone requests a transaction	From a node of Peer To Peer (P2P) Network
2	The requested transaction will be broadcasted	The broadcasted transaction will be visible at another P2P Network at all Nodes. Where this P2P consists high-speed of computers well-known as Nodes
3	Validation of the transaction	The P2P network of nodes validates the transaction and the user's status using known as hash algorithms
4	Content of the transaction	The verified transaction can involve any one of the listed cryptocurrency, or its related contracts, records or any other related information
5	Creation of new block	The verified transaction by nodes has to be combined with other transactions to create a new block of data for the ledger
6	Adding of newly created block to the existing blockchain	The newly created block after verification by the nodes will be added to the existing blockchain, in a way it is permanent, unalterable, in editable

4 How Blockchain Technology Works and What Is Its Significance

Block Chain Technology is disrupting the insurance sector worldwide. BCT is not only a currency transfer technology, but this was also used by the worldwide industries even beyond that. Though all the above said 1600+ cryptocurrencies are powered by blockchain technology, now it is transforming as a new ecosystem in the countries and world economy where one can do virtually anything. It is like a database or registry or data. The following diagram and Table 1 clearly explaining how BCT works (Fig. 2).

5 Objectives of the Study

Objective 1: To list the areas where blockchain technologies are playing a greater role in insurance operations.
Objective 2: To study the use of blockchain technology as a tool in the financially engineered insurance products.

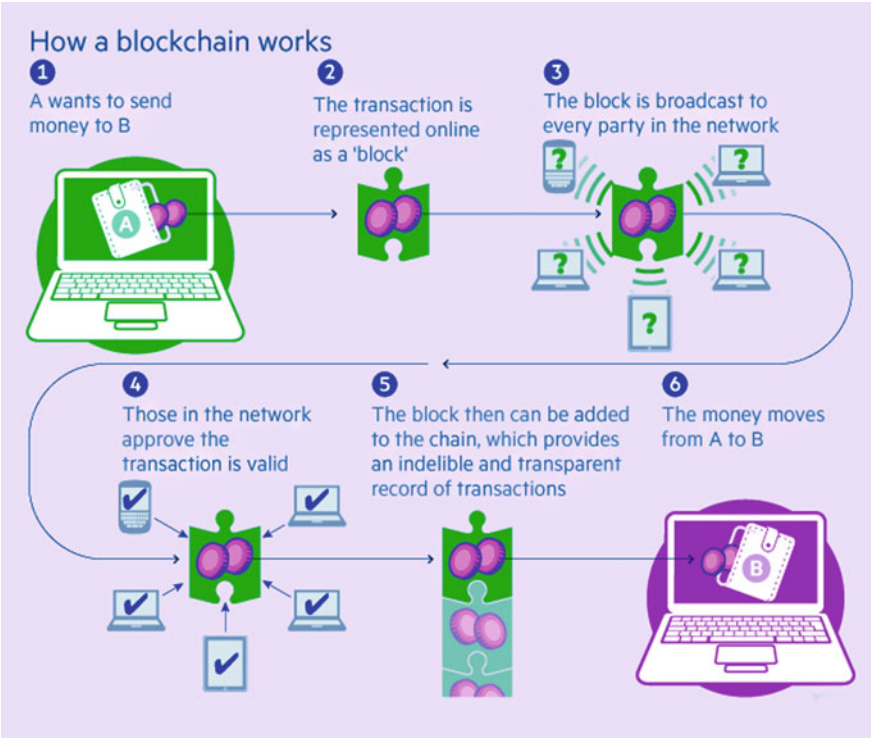

Fig. 2 Working of Blockchain Technology with *example Source* Dataflairteam 2018

5.1 Research Methodology

Both observational and case study types of descriptive research methodologies are used in the proposed research work.

5.2 BCT in Insurance

Blockchain Technology has lots of scope in the insurance sector. Not only for money or currency transfers, but BCT also plays a major role in various core and key areas in the insurance value chain. BCT network by connecting multiple devices and mobile apps, it will speed up the insurance processes, helps to achieve accuracy in the transactions, helps to minimize the cost of insurance operations and helps to remove completely the fraudulent claim application submission practices in the insurance sector. The estimated loss in the USA alone due to fraudulent practices in Insurance claims is up to 80 $ million and in the UK is up to 2.1$ million

[5]. Insurers can maintain cordial relations with their satisfied customers due to use of BCTs in their operations. No need to submit again and again repeatedly to the company once the customer submits his/her KYC, health and policy documents, etc., records. This decentralized BCTs makes is a regular course of business transactions to authenticate transactions, policies and customers. Nephila Capital and Allianz insurance companies are using BCTs to process their claims fast. BCT also playing a major role in underwriting activity in the insurance process. BCTs minimize identity fraud or theft, minimizes fraudulent practices, decentralization of data repository, a great reduction of paper works and improves the efficiency across insurance value chain [7].

There is a special initiative called B3i (The Blockchain Insurance Industry Initiative) was introduced and launched in the year 2018 by 17 insurance market participants across the world. This is a startup company established in the world to use Blockchain Technology for the benefit of the insurance industry. At present 40 companies are playing a major role in this consortium across the world. The promoting insurers of this new venture are Aegon Insurance Company, Allianz, Munich Re, Swiss Re, Zurich, etc. [5]. B3i offers better services in a short time at a cheaper cost to customers and other market participants of the insurance sector using blockchain technology [8]. Similarly, Engineering InsurTech, R, Chain, Wave, ripple and symbiont are also working as other consortium using blockchain technologies in the insurance industry [10–12].

5.3 *Blockchain Technology as a Tool in Financial Engineering*

Blockchain Technology used by the insurance companies in the financial engineering process of the insurance business. BCT is one of the effective tool in financial engineering process in the insurance business in the complete value chain of the insurance business.

Particularly in the following insurance areas BCT is playing an effective and major role and generating effective results.

- Financially Engineered Product design and development process.
- Financially Engineered effective policy features, policy risk riders, etc.
- Financially Engineered customized insurance policies.
- Financially Engineered Sales and distribution channels.
- Financially Engineered underwriting procedures in the insurance business.
- Financially Engineered insurance claim application process.
- Financially Engineered Insurance Management process.

5.4 *Potential Usage of BCT in Financial Engineering of the Insurance Business Is Happening in the Following Areas*

Claims Management: It is one of the important managerial operations in the insurance business where most companies are facing fraudulent practices. Incurring losses every year in crores. BCT effectively used as a tool in the financial engineering process of insurance claims management to stop frauds, to administer claims payouts and also to encourage and convert the existing systems to auto initiation of the claim (Fig. 3).

Product Management: To design the financially engineered insurance products and its features BCT using as a tool. Particularly to design various risk riders, attractive insurance features with fund switching options, renewal payment procedures and claim application submission process, etc.

Marketing Management: BCT used in this process to bring back the track in the target market at target customers. With huge data transactions, it is possible to track the customers easily when the BCT is using as a technological tool in the systems.

Sales and Distribution: By sharing the customer data based recorded at various online enquiry nodes to the agents or advisers also by sharing newly designed financially engineered policies and its features in the network we can easily achieve the transfer or distribution of information effectively at a cheaper cost by using BCT as a tool.

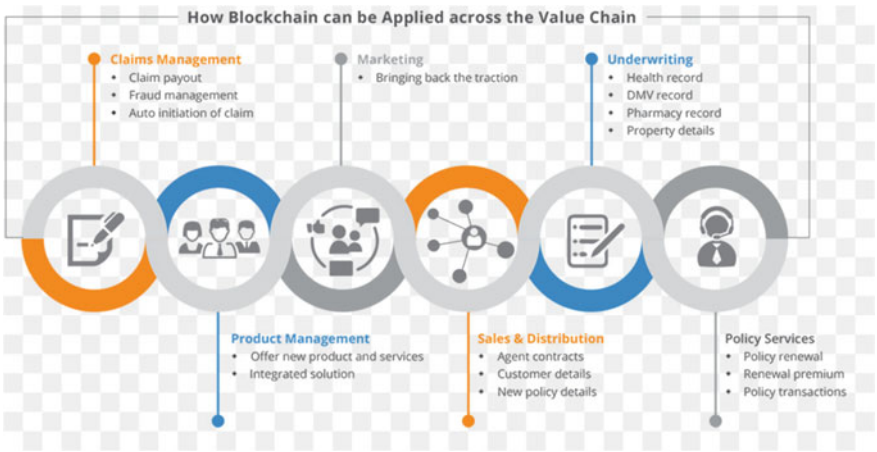

Fig. 3 How Blockchain can be applied across the value chain *Source* kisspng dated 5th Aug 2019 [9]

Underwriting: It is a process of evaluating an insurance application to determine the risk associated with the applicant by reviewing his/her submitted medical records, financial soundness and his lifestyle also taking other demographic factors of the applicant like age, gender, etc., BCT plays an effective role by authenticating the provided data or information by the customers matching with the data recorded in its Distributed Ledger when he/she was transacted on the similar purchases with other companies (Fig. 4).

Policy Services: BCT plays an effective role in after-sales services. Particularly in reminding renewals payment transfers at a cheaper cost, or sharing the related information at a cheaper cost, etc. Claims processing is a long and confusion stage for the clients. Instead of wasting time in the sourcing process of required documents, if the information is available in the blocks earlier with various insurance companies and financial companies, that can share easily to the insurer to authenticate the claim application to process the claims quickly (Fig. 5).

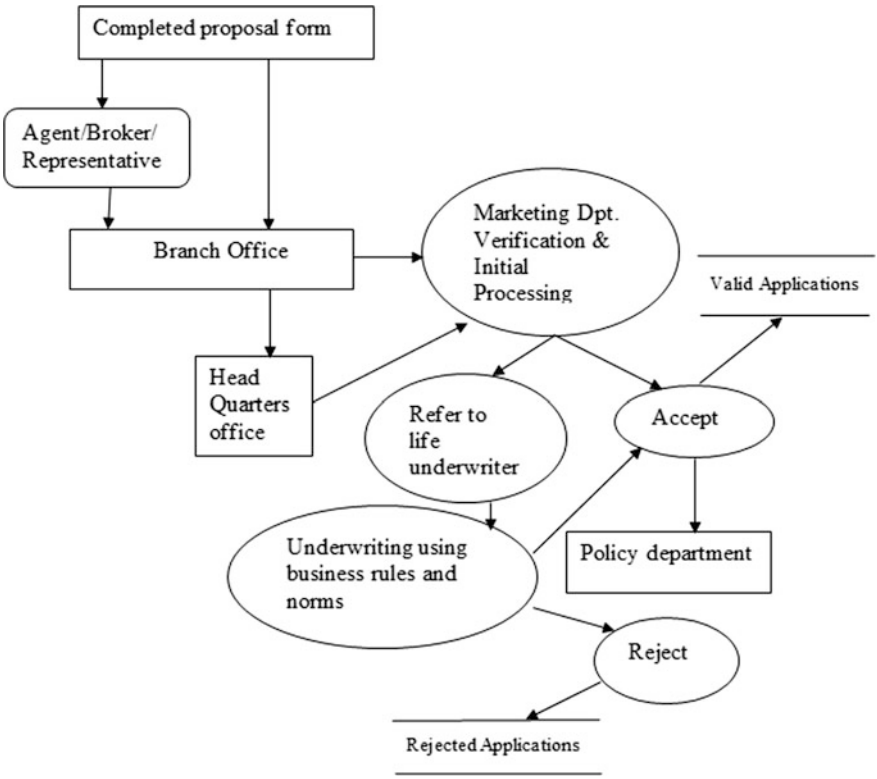

Fig. 4 The existing process of insurance underwriting [11] *Source Mutai Joram (2017)*

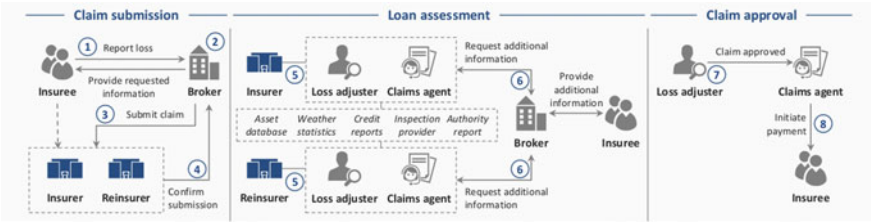

Fig. 5 Insurance claim process *Source* World Economic Forum. https://www.skcript.com/svr/insurance-industry-use-case-blockchain-hyperledger-fabric/ [10]

5.5 Scope for Further Research

Based on the above discussions and observations, there is a lot of scope and research opportunities are there in this domain. If we can get the designing part data from the companies, we will have a lot of scopes to see the usage of BCT in Financial Engineering of Insurance Business.

6 Result and Discussion

Blockchain Technology has started playing a major role in across the world crossing its main origin i.e. Cryptocurrency. By 2030, All most all insurers will migrate gradually to the BCT to adopt in their business management to minimize their operational costs and fraudulent claiming processes

References

1. https://en.wikipedia.org/wiki/list_of_cryptocurrencies
2. Kassandra jucutan (2018) Coding boot camp news, career guidance and more. https://www.codingdojo.com/blog/what-is-cryptocurrency-engineering-jobs
3. Residual (2017) How Blockchain Technology works in layman's English – infographic. https://steemit.com/blockchain/@residual/how-blockchain-technology-works
4. Dataflairteam (2018) Working of Blockchain technology with example; https://data-flair.training/blogs/working-of-blockchain/
5. Hacker Earth Blog (2018) 5 Technologies that made a major impact on the insurance industry. https://www.hackerearth.com/Blog/Talent-Assessment/5-Technologies-Insurance-Industry/
6. IBEF (2019) https://www.Ibef.org/Industry/Insurance-Presentation
7. Kumar M (2018) Dlesblockchain; the blockchain revolution in the insurance industry. https://Blockchain.oodles.Io/Blog/Blockchain-Technology-In-Insurance/
8. B3i. https://B3i.Tech/Who-We-Are.Html
9. Kiss Png (2019). https://www.Kisspng.com/Png-Life-Insurance-Blockchain-Value-Chain-Block-Chain-5001274/

10. Jain P (2018) Redefining the insurance industry with blockchain using hyper ledger fabric. https://www.Skcript.com/Svr/Insurance-Industry-Use-Case-Blockchain-Hyperledger-Fabric/
11. Joram M (2017) A knowledge-based system for life insurance underwriting. https://www.Researchgate.net/Publication/314838086_A_Knowledge-Based_System_For_Life_Insurance_Underwriting
12. Chakravaram V, Srinivas J, Ratnakaram S (2019) Use of ICTS in financial engineering applications in insurance business, November 2019, ICT Analysis And Applications, Lecture Notes In Networks And Systems 93. Springer Nature Singapore Pte Ltd. 2020. https://doi.org/10.1007/978-981-15-0630-7_27

Identification of Malignant Region Through Thermal Images: Study of Different Imaging Techniques

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Abstract Human body has a unique defined structure which can be differentiated from any unwanted growth of different body tissues or muscles or sometimes diseased cells. In medical science, unwanted growth of mass in the body is termed as malignant region. Abnormal growth of any cell is called as cancer. This abnormal growth of the cancer cell can affect any part/location of the body. This different location is called as malignant region. In this paper we did study on different imaging techniques focus on the different types of malignant region discovery methods such as thermal imaging, X-Ray imaging, Magnetic Resonance Imaging (MRI), optical imaging. Also, how the thermal image detects the abnormal cell in the human body. It is analyzed that malignant regions of the body help to prove the cancer cells those are present within the body. The early detection of malignant region helps in saving the life of an individual. To obtain thermal images, a thermal camera is used. Capacity of thermal camera is able to detect wide range of temperature of our body from lowest 0.1 °C to highest temperature. The temperature can vary due to physiological and emotional state in the human body.

Keywords Medical imaging · Malignant · Thermal imaging · Cancer bio- medical

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_73

1 Introduction

A disease caused by abnormal growth of cells which is difficult to control in our body it is known as cancer. Cancer is a multistage process in which the normal cells will transform into the pre-cancerous lesion to a malignant tumor. There are a number of factors which cause the cancer is classified by the cancer agencies like WHO, IARC. Ageing is the most influencing factor of the cancer for its development. The chances of cancer increase with age, some cancers grow with the age. It is because of our cellular self repairing system getting decrease with the increase of age.

The causes of the cancer's mostly apart from genetic factors, it may also includes 3 external agents like physical, chemical, and biological carcinogens. Type of cancer which is occurring due to ultraviolet and ionizing radiation from various sources is called physical carcinogens. Smoke, tobacco, asbestos, food and water contamination due to certain chemical components is called as chemical carcinogens and infections from viruses, parasites or bacteria are biological carcinogens. Almost 70% of deaths occurred due to cancer it is found in low-middle economy nations. All over the world it is 2nd rank death cause by cancer. It is calculated 9.6 million deaths only because of cancer in the year 2018.

Worldwide out of 6 deaths, 1 death is because of cancer. Cancer deaths are due to low fruit & vegetable eating, low physical activity, drinking alcohol, tobacco, high BMI, etc. are the most influencing factors of cancer and near about 25% deaths of cancers are from this. Near about 22% deaths of cancer are because of tobacco therefore, eating of it, is highly risky. In the developing countries 25% cancer patients dies due to infections from cancer like hepatitis, human papilloma virus (HPV), etc. Late diagnosis is common in developing counties, therefore, treatment given by the doctors are not effective. 26% pathology facilities were available in public sector in 2017. As compare to developed countries 90% of pathology and treatment facilities are available. Hence, economy is important factor of cancer growth in developing countries. The annual budget of cancer was $1.16 trillion in 2010. Therefore, developing countries does not have such kind of budget to fight against the cancer with proper treatment.

World Health Organization (WHO) clearly mentioned in their report i.e. all over the world deaths caused by cancer is at top as compare to remaining deaths from other diseases or factors. Cancer patients are increased day by day on the globe. Scientist has given the high alert deaths will be caused by various types of cancer it will reach up to 13 million in 2030. In the developing countries 80% chances to increase the cancer up to 2030.

It is also observed that skin cancer patient increased but proper diagnostics of skin cancer either it is benign or malignant [6]. A tumour is an abnormal increase in cells that shows no purpose [7].

Various techniques are used to create a variety of imaging human body parts it includes MRI, X-Ray, Fluoroscopy, etc. which are termed as medical imaging [11]. It is used to study or diagnose the body and give the proper treatment to patient and

monitor the conditions. Radiology is one of the option for diagnose the treatments given by the physicians [13].

There are two types of cancer cells benign and malignant tumor. Benign cells does not spread like malignant. It is observed that benign looks good. Malignant cells spread in the body and grow rapidly it is indication of cancerous cell. They consume more melanoma, hence, very high metabolism rate. Because of this factor blood supply and temperature is high to malignant region as compared to normal cells. Such kind of suspected region can be captured by using thermal, infrared camera [8].

Thorsten M. Buzug, et al. [1] research on early diagnosis of malignant skin cancer reports near about 133000 patients are detected world wide throughout the year because of malign nature of melanoma. To identify the mistrust skin cancer is either malign or benign there is no sufficient and sound non-invasive techniques are not available. To keep safe the life and avoid the miss i.e. false surgeries they have worked on early stages screening based diagnostic approach to make necessary surgeries. After the screening anomalies on the affected skin area through microscope they suggested to the patient go for the pragmatic ABCD- approach (Asymmetry, Border, Color, and Diameter) after 15–20 weeks on the basis of visual diagnostic decision [1, 7].

Most of the papers are explained ABCD method to get accurate results polarized light surface microscopes. This ABCD method convert into ABCDE which can measure the temperature of malignant cell or tumor. Through the systematic study it is found that temperature of malignant cells are higher than healthy cells. As per previous discussion malignant tumor required more blood therefore, here flow of blood supply is high and temperature is also increased. We need to give the proper treatment before malignant region affects or need to identify premalignant region through Thermal Imaging or Infrared Imaging techniques are capable enough to capture their temperature [2].

To discriminate the difference between normal image and temperature image are shown in the Fig. 1 [1]. Thermography has been extensively used as a cancer detection tool, but has not been accepted for routine application [3, 9].

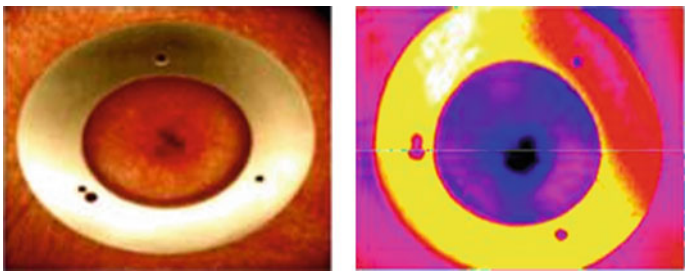

Fig. 1 Original and temperature image of a Absalom

Fig. 2 Vehicle thermal camera with highlighted hot region

Fig. 3 Thermal image of iron pole showing hot region

Nonneurological vasodilation adaption of nitric oxide, increase in blood flow and angiogenesis inside the tumor is a regional hyperthermia of a malignant tumor studied by Qi Zhao, et al. [2] (Figs. 2 and 3).

2 Types of Imaging

There are plenty of imaging techniques are available in the market. But here discussed only the common types of imaging techniques which are useful in medical imaging. Thermal Camera, Sonography (Ultrasound), CT (Computed Tomography) Scan, Nuclear Medicine, MRI (Magnetic Resonance Imaging), X-Ray, etc [16].

2.1 X- Ray Imaging

The mammograms for any specific abnormality hunts by radiologist expert, Biopsy and anxiety for the patient involved due to human factor error (Fig. 4).

Such type of human error can be resolved by automatic computer aided based detection system which will help to overcome it and plus point is, it involves radiologist for automation to gain the mammogram images.

2.2 Magnetic Resonance Imaging

The data of MRI is important but, it may affect on normal human body. MRI is an advanced technology which gives the rich information about human self tissue anatomy. Different technique to detect the cancer cell using the MRI:

- Dynamic contrast enhances MRI
- Proton magnet resonance spectroscopy

For detecting and clinical management of breast cancer used the dynamic contrast enhances method. Nowadays major health disorder is breast cancer. It can cause death when it is not treated. In the US 2013 cancer patient 1,660,290 were affected and 580,350 deaths are occurred due to cancer only.

About 234,580 cancers are detected as in Cancer Journal for Clinicians. The sensitivity of Breast cancer detection using mammography is moderate (75%) and even reduced in women with dense breasts is 62%. X- mammography has a 22% fake constructive rate in women below 50. The mammography cannot identify whether the cancer is malignant tumors. Drawbacks of MRI and Ultrasonic are:

(a) It is high cost,
(b) Low throughput
(c) Low sensitivity.

Because of this drawback of MRI system, rarely used this system for the detection of the breast cancer. After this many techniques/methods comes out to detect breast cancer such as elastography, tom synthesis, dedicated computer

Fig. 4 X-Ray image

tomography (CT), positron emission tomography (PET), photo acoustic imaging and optical imaging.

2.3 Ultrasound

Ultrasound uses sound waves in high frequency to detect and produce the images of internal body parts like muscles, organs, various joints and some kind of gentile or soft tissue.

Ultrasound mechanism works like light within the body which can penetrate from skin and it is visible by electronic sensors.

Through the Nuclear medicine we cannot identify most of the tissues. In thermal imaging radioactive tracers material is used which is reproduce the radiation for the identification of tissues. They are inserted or swallowed therefore it is possible to travel through digestive circulatory system. This radiations are captured and generates the images (Fig. 5).

The use of medical imaging techniques is depends on the type of disease and its condition. For illustration bone skeleton, structures and any damage or cracks are identified by using radiography. Brain and its internal tissues identification is possible using MRI images. Nuclear medicine is used to identify inside the digestive systems, such as to see blockages. Some times ultrasound images are used to find the condition of fetuses in the womb and status of internal organ in this case high resolution images are not required. In short it's depends on application of medical requirement which type of high resolution imaging technique is used.

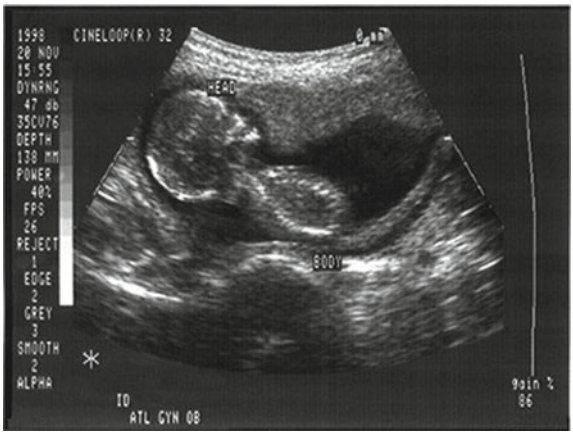

Fig. 5 Ultrasound

2.4 Cancer Diagnosis Computational Steps

Cancer detection is very important steps to save the life of patient. It can be possible to diagnose cancer patient with the help of computational processing. Broadly it is divided into two parts i.e. pre-processing and feature extraction [14].

Pre-processing
In this image preprocessing tools enhachased the some important feature to required the further processing. Ex. crop the image, remove unwanted image.

Feature Extraction
Feature extraction is one of important tools to extract image parameter that, want the processing and compare with real image. There are different techniques for features extraction according to study, Local binary patterns (LBP), Histogram of oriented gradients (HOG), Color histograms, Speeded-up robust features (SURF), etc. are mostly used [10].

3 Thermography Camera

Different types of thermal camera are used for the capturing the images and those cameras are shown in the Fig. 6. These captured images are analysed utilized for identification of malignancy in human body one of the example of with thermal camera is shown below (Fig. 7).

The use of thermal cameras on a tripod in controlled room temperature and calibrated after thermal equilibrium had been achieved (Fig. 8).

Fig. 6 Thermograph camera

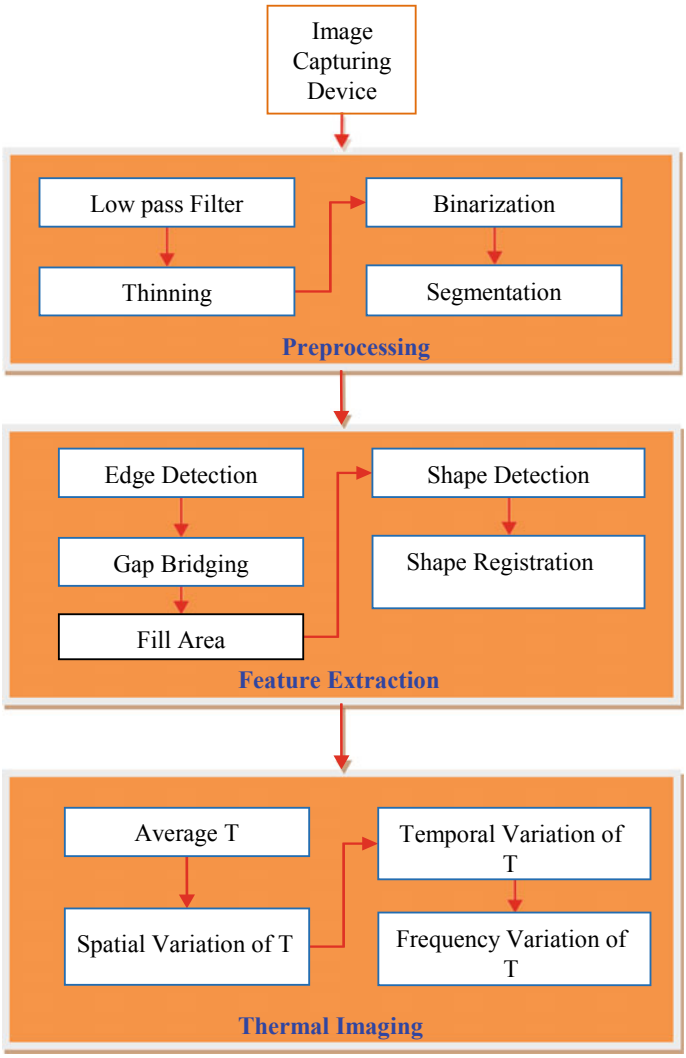

Fig. 7 Flowchart of image acquisition

3.1 Breast Thermograph

Thermograms is a representation of radiance (x) and spatial coordinator (y). It is represented by T(x, y), here, T is thermal image in the form of graphs. Thermo means temperature is represented in the form of graph i.e. thermogram. It is a pixel intensity of various colors like red, white, green, etc. High blood pressure tissue or organs show high temperature, it is a indication of abnormal cells are present i.e. it may be malignant region. When thermal image is captured of breast then it is may

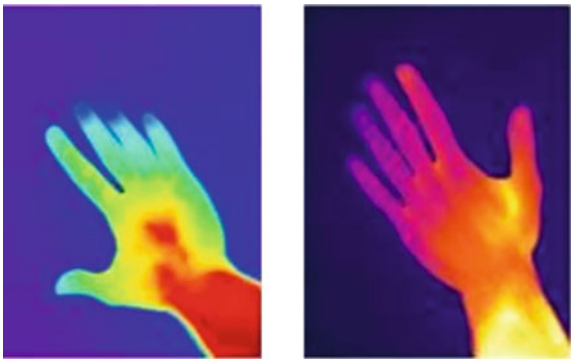

Fig. 8 Image captured by thermal camera

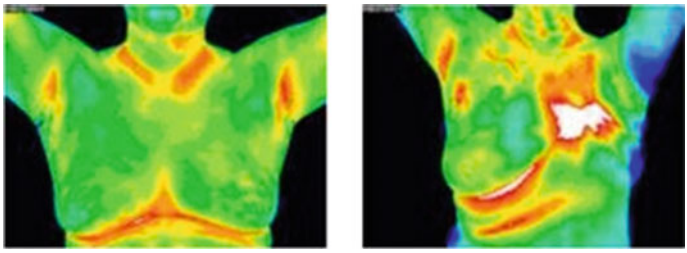

Fig. 9 Breast thermograph

symmetric or asymmetric in nature. If sudden changes in temperature of healthy person it is called as symmetric and if temperature difference is found in breast then it is called asymmetry. To find out the difference between right and left breast temperature mean, variance, skewness, kurtosis, etc. statistical term should measure. Figure 9 shows the difference between health and abnormal breast [15]. It will be found that there will be difference in the theromograms comparing with normal thermograms skewness and absolute difference in variance is high. Through he statistical moment asymmetry will be measured. Similarly Computer aided analysis also used for abnormal detection [12].

3.2 Principle of Thermal Imaging in Medicine

Thermal imaging scanner or camera is purely on the basis of electromagnetic radiation reflected by the any objects above the absolute zero, this mechanism is termed as thermal radiarion. Every substance or object or any surface has the power of emit the energy from the inside to outside. After detection of high temperature region we need to classify it whether it is cancer or normal or abnormal cells. Through the study it is observed the analysis of cancer cell is depends upon the

asymmetric nature of breast it may be left or right part of it. For asymmetric measurement there are various statistical methods should apply on the image such as mean, variance, standard deviation, etc. Sometimes by plotting the histogram of left and right halves it is useful to find the nature of cells by its curve plotting [4]. Before process thermal image, need to identify the boundries of body part and exact region of breast for this purpose Hough Transform with gradient is used. Canny edge detector, snake transform also be useful to find the boundries of it. At the last for classification and grading of severity of cancer Neural Network techniques are useful like Back Propagation Neural Network, Radial Function, etc. [5].

4 Conclusion

We studied all the imaging technique to find the malignant cells/abnormal growth, cell in the human body. Like X-Rays, MRI, Ultrasound and Thermal Images. With respective to this the thermal image processing is emerging technique to find out the cancer cell in the human body with good accuracy. It would be benefitted in non-invasive physiological imaging modality.

References

1. Buzug TM, Schumann S, Pfaffmann L, Reinhold U, Ruhlmann J (2006) Functional infrared imaging for skin-cancer screening. In: Annual international conference IEEE engineering in medicine and biology proceedings, pp 2766–2769
2. Zhao Q, Zhang J, Wang R, Cong W (2008) Use of a thermocouple for malignant tumor detection. IEEE Eng Med Biol Mag 27(1):64–66
3. Skala K, Lipić T, Sović I, Gjenero L, Grubišić I (2011) 4D thermal imaging system for medical applications. Period Biol 113(4):407–416
4. Otsuka K, Okada S, Hassan M, Togawa T (2002) Imaging of skin thermal properties with estimation of ambient radiation temperature. IEEE Eng Med Biol Mag 21(6):49–55
5. Suzan AM, Prathibha G (2017) Classification of benign and malignant tumors of lung using bag of features. J Sci Eng Res 8(3):1–4
6. Arthur TJ, Khan MM (2011) Thermal infrared imaging: toward diagnostic medical capability. In: Proceedings of annual international conference IEEE engineering in medicine and biology society EMBS, pp 6146–6149
7. Rumiński J, Kaczmarek M, Renkielska A, Nowakowski A (2007) Thermal parametric imaging in the evaluation of skin burn depth. IEEE Trans Biomed Eng 54(2):303–312
8. Jones F (1998) A reappraisal of the use of infrared thermal image analysis in medicine. IEEE Trans Med Imaging 17(6):1019–1027
9. Szentkuti A, Skala Kavanagh HA, Grazio S (2011) Infrared thermography and image analysis for bio- medical use. Period Biol 113(4):385–392
10. Voronin V, Tokareva S, Semenishchev E, Agaian S (2018) Thermal image enhancement algorithm using local and global logarithmic transform histogram matching with spatial equalization. In: Proceedings of IEEE southwest symposium image analytical interpretation, vol 2018–April, pp 5–8

11. Cho Y (2018) Automated mental stress recognition through mobile thermal imaging. In: 2017 7th international conference affective computing and intelligent interaction ACII 2017, vol 2018–January, pp 596–600
12. Snekhalatha U, Anburajan M, Teena T, Venkatraman B, Menaka M, Raj B (2012) Thermal image analysis and segmentation of hand in evaluation of rheumatoid arthritis. In: 2012 international conference computation communication informatics, ICCCI 2012
13. Nhan R, Chau T (2010) Classifying affective states using thermal infrared imaging of the human face. IEEE Trans Biomed Eng 57(4):979–987
14. Mukhopadhyay S et al (2016) A new paradigm of oral cancer detection using digital infrared thermal imaging. In: Medical imaging 2016 computer diagnosis, vol 9785, p 97853I
15. Yang H, Xie S, Lin Q, Ye Z, Chen S, Li H (2007) A new infrared thermal imaging and its preliminary investigation of breast disease assessment. In: 2007 IEEE/ICME international conference on complex medical engineering, Beijing, pp 1071–1074. https://doi.org/10.1109/ICCME.2007.4381905
16. Sruthi S, Sasikala M (2015) A low cost thermal imaging system for medical diagnostic applications. In: 2015 international conference smart technology management computing, communication controls energy materials ICSTM 2015 - Proceedings, vol 0, no May, pp 621–623

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Multi Criteria Decision Making Under Fuzzy, Intuitionistic and Interval-Valued Intuitionistic Fuzzy Environment: A Review

Suman, Namita Saini, Neeraj Gandotra, and Ravinder Kumar

Abstract Multi Criteria decision making (MCDM) problems can be handled with the help of fuzzy set theory and moreover, this theory has been extended to a new concept called IFS named as Intuitionistic fuzzy set. There has been an increasing demand in the growing research under the fuzzy environment because of numerous applications such as artificial intelligence, medical science, logic programming, medical diagnosis, neural networks and machine learning. We have systematically conducted a review on this topic after a deep analysis of 50 research papers to provide a new framework from all the existing theoretical results, logic and applications.

Keywords FS · IFS · MCDM · Applications

1 Introduction

Fuzzy sets are called those sets in which the elements are represented by some kind of membership function (μ_A). This idea was first proposed by Zadeh and Klaua in the year 1965 [1] which is really the expansion of established thought of set. The fuzzy set theory has been found in the research area of evolutionary computational programming tangled to various aspects such as artificial intelligence, control engineering, Decision Making theory, operational research and medical science. From the recent decades, various authors as well as the scientists uses various MCDM approaches for handling the fuzzy issues. Therefore, for solving these issues, decision making was helpful in the research area for detruncates cost of the material, time reducing and improving the production quality. There are two different types of decision-making methods taken into consideration for solving the

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_74

problems related to alternatives - group and individual. It has been reported that there are interpretation criteria and different errands for describing the finite number of different sets contained in decision making when all the criteria are supposed the same. The main role of these errands is to determine the principal alternative for doing the ranking of these alternatives in order to get the resulting final opinion when each one of the criteria is supposed at the similar time. Taking care of such issues is the focal point of different criteria choice investigation called MCDM investigation. The numerous applications of MCDM investigation are helping the decision makers to understand these methods easily because it is directly related to complex mathematics, especially operational research. The researchers and scientists are also developing new techniques or methods in order to handle the MCDM issues which lead to the phenomenon of decision making paradox [2]. Fuzzy set only tells us about membership degree but this concept was further extended by Atanassov in 1986 to a new concept named as Intuitionistic fuzzy set (IFS) which includes both membership as well as membership degrees. The scientists as well as from across the world showing a great attention in studying IFS because of broader approach in comparison with the fuzzy sets. L I Junhong et al. (2012) introduced MADM approach with the help of extended approach under the FS as well as IFS system [3]. Wu and Zhang (2011) presented some entropy measures to find out the average entropy of IFS values and with the help of this algorithm; they introduced the idea of weighted entropy under intuitionistic fuzzy set. Then, this idea was taken into consideration for developing a new technique for MCDM problems under the intuitionistic fuzzy approach [4]. Zeshui along with Hui investigated the MADM related issues under the IFS environment by proposing entropy based systems. Here, the information in regards with the criteria weights was totally unexplored. For the establishment of the normalized score matrix, a new proposal related to the entropy-based procedures were taken into consideration for finding the criteria weights [5]. In addition to this, Atanssov and Gargov formulated the concept of IFS to a new category named as IVIFS (Interval-valued intuitionistic fuzzy set) and therefore, it can be characterized by two types of functions such as non-membership degree and membership degree having values at intervals instead of real numbers. After the proposal of IVIFS, a great interest in studying IVIFS instead of IFS [6] - [7]. Zeshui Xu (2010) proposed a MCDM technique under the IVIFS which was based on the conceptual phenomenon of distance measures along with the reviewing of some relations, operations, fuzzy matrix [8]. Zeshui Xu and Jian Chen (2007) have given the proposal regarding the IVIFSGDM judgment matrices with the help of arithmetic and hybrid aggregation operators. In addition to this, they have also explored the approach of score matrix, accuracy matrix and judgment matrix under IVIFS [9]. The objective of present review paper is to focus on the various problems in regarding to the MCDM application under the FS, IFS and IVIFS environment and moreover, studied their specified methods with unknown weight information.

2 Preliminaries

2.1 Fuzzy Set

A fuzzy set is that kind of set which have a different degree of membership and it can be represented either for discrete or continuous variables. Let us consider Z is a universe set then, the fuzzy set $D \subseteq Z$ is characterized with the help of membership function (D) defined by the following condition:

$$D = \{(z, \mu_D(z))); z \in Z\} \tag{1}$$

where $\mu_D(z)$ is described as the degree of membership of z element in fuzzy set D for all $z \in Z$. Then, there exists two conditions as given below:

When the universal set Z is discrete then, fuzzy set is represented as,

$$D = \sum\nolimits_Z \mu_D(z) / z \tag{2}$$

When the universal set Z is continuous then, fuzzy set is represented as,

$$D = \int_Z \mu_D(z) / z \tag{3}$$

where $\sum$ represents the function theoretic union for discrete variables and $\int$ represents the continuous theoretic union for continuous variables. In addition to this, when the interval of real numbers as described in the fuzzy set is interchanged by the set of discrete values {0, 1} then, the fuzzy set X becomes crisp set. We shall concentrate on the various basic properties, and different operations attached with the fuzzy sets are discussed as:

Definition 1: Core of a Fuzzy Set

The core of a Fuzzy Set is the collection of all the points with a membership degree equal to one as defined by the following condition:

$$\text{Core}(D) = \{z \in Z; \mu_D(z) = 1\} \tag{4}$$

where $\mu_D(z)$ represents the degree of membership of z element in fuzzy set D for all $z \in Z$.

Definition 2: Normal Fuzzy set

Let us consider Z be a universe set and $D \subseteq Z$ be a fuzzy set then, D is normal to Z if $\exists$ an element $z \in Z$. such that D(z) = 1 otherwise D is sub-normal.

In addition to this, a fuzzy set can be normalized if the core of the fuzzy set is non-empty.

Definition 3: Support set of a Fuzzy Set

The support of a Fuzzy set D is defined as the collection of elements which have membership degree not equal to zero represented by the following condition as:

$$\text{Support}\,(\mathrm{D}) = \{\mathrm{z} \in \mathrm{Z};\ \mu_{\mathrm{D}}(\mathrm{z}) > 0\} \tag{5}$$

where Z is the universal set and μ_{D} (z) represents the degree of membership of z element in fuzzy set D for all $\mathrm{z} \in \mathrm{Z}$.

Definition 4: Crossover points in a Fuzzy Set

The crossover points are really those elements in the universal set for which a specific fuzzy set have values equivalent to 0.5.

Definition 5: α-level set or α-cut set

Let Z is universal set and $\mathrm{D} \subseteq \mathrm{Z}$ is a fuzzy set, then an α-level set of a fuzzy set D is called as non-fuzzy set or crisp set as represented and defined by the following condition:

$$[\mathrm{D}]^{\alpha} = \{\mathrm{z} \in \mathrm{Z} \,/\, \mu_{\mathrm{D}}(\mathrm{z}) \geq \alpha\} \tag{6}$$

where $\alpha \in [0, 1]$. For a strong α-cut, the above condition becomes,

$$[\mathrm{D}]^{\alpha} = \{\mathrm{z} \in \mathrm{Z} \,/ \mu_{\mathrm{D}}(\mathrm{z}) \geq \alpha\} \tag{7}$$

The α-level set or α-cut set is one of the interesting and important concepts in fuzzy sets because of two specified reasons- The first reason is that it portrays a power or quality that is utilized by fuzzy sets models to choose whether or not a true value is to be viewed as equal to zero and moreover, it controls the fuzzy rules as well as intersection of fuzzy sets to execute. The second reason is that in case of a fuzzy set, the support set at zero is defined with the usage of strong alpha cut.

Definition 6: Convex and Concave Fuzzy set

Let Z is a universal set and $\mathrm{D} \subseteq \mathrm{Z}$ is a fuzzy set which is called convex set if and only if $\mathrm{z}_1, \mathrm{z}_2 \in \mathrm{Z}$. and for all $\lambda \in [0, 1]$ satisfying the following relation as,

$$\mu_{\mathrm{D}}(\lambda.\mathrm{z}_1 + (1 - \lambda).\mathrm{z}_2) \ > \ = \ \min(\mu_{\mathrm{D}}(\mathrm{z}_1),\ \mu_{\mathrm{D}}(\mathrm{z}_2)) \tag{8}$$

On the other hand, fuzzy set D is called concave set if it satisfies the following relation as,

$$\mu_{\mathrm{D}}(\lambda.\mathrm{z}_1 + (1 - \lambda).\mathrm{z}_2) < = \ \min(\mu_{\mathrm{D}}(\mathrm{z}_1),\ \mu_{\mathrm{D}}(\mathrm{z}_2)) \tag{9}$$

with the same condition as mentioned in case of convex fuzzy set.

Definition 7: Cardinality of a fuzzy set

Let Z is a universal set and $\mathrm{D} \subseteq \mathrm{Z}$ is a fuzzy set. Then, the cardinality of fuzzy set D is represented by $|\mathrm{D}|$ and defined by the following relations in two ways as for the discrete and continuous fuzzy set. Therefore,

For discrete fuzzy set,

$$|D| = \sum \mu_D(z) \text{ as } z \in Z \tag{10}$$

For continuous fuzzy set,

$$|D| = \int_z \mu_D(z)dz \text{ as } z \in Z \tag{11}$$

Definition 8: Operations on Fuzzy sets (FS)
For any two Fuzzy sets R and S, the following operations satisfied as [10],

- $\mu_{R \cup S} = \max \{\mu_R(z), \mu_S(z)\}$ for all $z \in Z$
- $\mu_{R \cap S} = \min \{\mu_R(z), \mu_S(z)\}$ for all $z \in Z$
- R is complement of S if it satisfies the following condition i.e. $R = \bar{S}$,
- $\mu_R(z) = \mu_S(z) = 1 - \mu_S(z)$ for all $z \in Z$

2.2 Intuitionistic Fuzzy Set

Let Z be a fixed set and D be an intuitionistic fuzzy set in Z which can be defined as,

$$D = \{ < z, \mu_D(z), \nu_D(z) > , z \in Z\} \tag{12}$$

where μ_D: $Z \rightarrow [0, 1]$ define the membership function of element $z \in Z$ to set D and ν_D: $Z \rightarrow [0, 1]$ define the non-membership function of same element $z \in Z$ to same set D with the specified condition,

$$0 \leq \mu_D(z) + \nu_D(z) \leq 1, \text{ for all } z \in Z \tag{13}$$

It should be noted that either $\mu_D(z) = 0$, $\nu_D(z) = 1$ or $\mu_D(z) = 1$, $\nu_D(z) = 0$, $\forall z \in Z$ if and only if D is crisp set.

Therefore, the Eq. 12 can be rewritten as,

$$\{ < z, \mu_D(z), 1 - \mu_D(z) > , \quad z \in Z\} \text{ and } \pi_D(x) = 1 - \mu_D(z) - \nu_D(z) \tag{14}$$

where $\pi_D(x)$ indicates the degree of hesitancy of element z to D called intuitionistic index of z in D.

2.3 Operations on Intuitionistic Fuzzy Set

For every two intuitionistic sets R and S, the following operations satisfied [11]:

- $R \subset S$ iff (for all $z \in Z$ $(\mu_R(z) \leq (\mu_S(z)$ and $(\nu_R(z) \leq (\nu_S(z))$
- $R = S$ iff $R \subset S$ and $S \subset R$
- $\bar{R} = \{(z, \mu_R(z)$ and $\nu_R(z)), z \in Z\}$
- $R \cup S$ $\{<x, \min(\mu_R(z), \mu_S(z)), \max(\nu_R(z), \nu_S(z)) >, z \in Z\}$
- $R \cap S = \{<x, \max(\mu_R(z), \mu_S(z)), \min(\nu_R(z), \nu_S(z)) >, z \in Z\}$
- $R + S = \{<x, \mu_R(z) + \mu_S(z) - \mu_R(z).\mu_S(z)), \nu_R(z).\nu_S(z) >, z \in Z\}$
- $R.S = \{<x, \mu_R(z).\mu_S(z), \nu_R(z) + \nu_S(z) - \nu_R(z).\nu_S(z) >, z \in Z\}$

2.4 Interval-Valued Intuitionistic Fuzzy Set

Let Z be a fixed set and D be an interval-valued intuitionistic fuzzy set in Z which can be defined as,

$$D = \{< z, \mu_D(z), \nu_D(z) >, z \in Z\} \tag{15}$$

where μ_D:$Z \subset [0, 1]$ define the membership function of element $z \in Z$ to set D and ν_D: $Z \subset [0,1]$ define the non-membership function of same element $z \in Z$ to same set D with the specified condition,

$$0 \leq \sup(\mu_D(z)) + \sup(\nu_D(z)) \leq 1, \text{ for all } z \in Z \tag{16}$$

If Inf $((\mu_D(z))$ = sup $((\mu_D(z))$ and Inf $((\nu_D(z))$ = sup $((\nu_D(z))$ for a given set D as

$$D = \{(z,[\text{Inf}(\mu_D(z), \sup(\mu_D(z)], [\text{Inf}(\nu_D(z), \sup(\nu_D(z)]) z \in Z\} \tag{17}$$

then, the interval-valued intuitionistic fuzzy set 'D' reduces to intuitionistic fuzzy sets. For each interval-valued intuitionistic fuzzy set D, there exists a condition as,

$$\pi_D(z) = [1 - \sup(\mu_D(z)) - \sup(\nu_D(z)), 1 - \text{Inf}(\mu_D(z)) - \text{Inf}((\nu_D(z))] \tag{18}$$

where $\pi_D(x)$ indicates the degree of hesitancy of element z to D called interval-valued intuitionistic index of z in D.

2.5 *Operations on Interval-Valued Intuitionistic Fuzzy Set*

For any two interval-valued intuitionistic fuzzy sets R and S, following operations satisfied [12],

- $R \subset S$ iff for all $z \in Z$ then, $\sup((\mu_R(z)) \leq \sup(\mu_S(z))$ and $\text{Inf}(\mu_R(z)) \leq \text{Inf}((\mu_S(z))$ and $\sup((\nu_R(z)) \geq \sup(\nu_S(z))$ and $\text{Inf}(\nu_R(z)) \geq \text{Inf}((\nu_S(z))$
- $R = S$ iff $R \subset S$ and $S \subset R$
- $\bar{R} = \{< Z, (\nu_R(z), (\mu_R(z) >$, for all $z \in Z\}$.
- $R \cup S = \{< z, [\max(\text{Inf}\ \mu_R(z), \text{Inf}\ \mu_S(z)), \max(\sup \mu_R(z), \sup \mu_S(z))], [\min(\text{Inf}\ \nu_R(z), \text{Inf}\ \nu_S(z)), \min(\sup \nu_R(z), \sup \nu_S(z))] > , \forall z \in Z\}$
- $R \cap S = \{< z, [\min(\text{Inf}\ \mu_R(z), \text{Inf}\ \mu_S(z)), \min(\sup \mu_R(z), \sup \mu_S(z))], [\max(\text{Inf}\ \nu_R(z), \text{Inf}\ \nu_S(z)), \max(\sup \nu_R(z), \sup \nu_S(z))] > , \forall z \in Z\}$
- $\Diamond$. $R = \{< z, \mu_R(z), [\text{Inf}\ \nu_R(z), 1\text{- sup}\ \mu_R(z)] > , \forall z \in Z$
- $\Box R = \{< z, [\text{Inf}\ \mu_R(z), 1 - \sup\ \nu_R(z)] > , \forall z \in Z$

3 Review of Literature

For handling the real life issues, numerous MCDM techniques such as AHP, ANP, TOPSIS, ELECTRE, PROMETHE, ORESTE, COPRAS, MAUA, MOORA, MULTIMOORA, ARAS, WASPAS were constructed through various technologies such as computer technology and mathematical optimization [13, 14, 38–41].

3.1 *Recent Developments Under the Fuzzy and Intuitionistic Fuzzy Environment*

As per the literature survey, Fan et al. (2002) use the desirable data on alternatives for investigating the MADM technique by considering a new approach. The decision makers were indoctrinated to give his or her choice in case of fuzzy relation on alternatives and the decision maker's preference information was reflected on the basis of an optimization model [15]. Ling (2006) initiated FMADM approach in order to get its solution [16]. Ze Shui Xu and Jian Chen build up an interactive technique for MADM related issues which are helpful in those conditions in which the data about attribute weights are not fully well known under fuzzy environment [17].

Cheng and Mon use Analytical Hierarchy Approach for evaluating the weapon systems under fuzzy environment [18]. Chang and Chen (1994) suggested MCDM (Multicriteria Decision-Making) fuzzy technique in the field of biotechnology for the transfer strategy selection along with some algorithm, linguistic numbers and triangular fuzzy numbers [19]. Ribeiro (1996) presented a brief description on the

theories and techniques found under the fuzzy set theory related to the MADM (Multiple Attribute Decision-Making) problem which contains two processes such as ranking and rating of alternatives [20]. Alfonso Mateos and Antonio Jiménez (2009) constructed a new technique on the ground of fuzzy trapezoidal numbers in MCDM issues for accumulating the group preferences and to rank the decision alternatives [21]. Dhanasekaran et al. (2017) established a new approach for handling the FMCDM issue [22]. Uluçay et al. (2016) examined the trapezoidal fuzzy multi-number with the usage of multiple criteria decision-making method by giving a proposed approach of operational laws for the TFMN. After the proposal of operational laws, TFMN arithmetic and geometric operators are constructed for proposing MCDM technique. Shaw et al. (2013) introduced a new a mathematical formulation on the IFN and their applicability on reliability evaluation [23]. Jun Ye (2013) interpreted the MAGDM issues without knowing the criteria weights under Intuitionistic fuzzy setting [24]. Hung and Chen investigated MCDM issues under the Intuitionistic fuzzy environment by inducing a new model called TOPSIS. This new type of decision-making TOPSIS fuzzy model uses entropy weights of each alternative [25]. Boran et al. (2009) investigated the MCGDM issues for determine the suitable supplier [26]. Li and Yang (2003) reported the different MADM issues under the IFS system [27]. H. Bustince (1995) introduced a new method on the basis of an IFS and this has been carried out for solving the MCDM issues. In addition to this, he finds out the degree of suitability for the selection of specific alternatives with the introducement of new score function [28]. Mahapatra along with Roy (2013) proposed an approach related to the IFN named as Intuitionistic fuzzy set [29]. Jayagowri and Ramani (2014) introduced a new algorithm on the basis of TIFN for calculating the optimal track given to every arc length under the fuzzy set [30].

3.2 *Recent Developments Under the Interval-Valued Intuitionistic Fuzzy Environment*

Kavita et al. (2009) considered a TOPSIS approach under the IVIFS for handling the MCGDM issues in order to get the solution of multi-criteria decision making related problem where the execution of rating values and weights of this type of multi-criteria was seized as IVIFS [31]. Zhang et al. (2011) propose another aphoristic meaning of entropy on IVIFS and a technique to build diverse entropies on IVIFS. Moreover, in decision-making conditions where the data about the attribute weights are totally unknown and alternatives on attributes are depicted by IVIFS, a new MADM technique depending upon the similarity distance is taken into consideration. This new technique uses the approach of entropy-based attribute weights under the IVIFS [32]. Jun Ye (2010) developed a MCDM technique under the IVIFS environment. The weighted correlation coefficients use the concept of entropy weights and applicable in those conditions where the data about the criteria

weights in relation to the alternatives is totally untold. The ranking of these alternatives and to find the most beneficial alternative can be suggested on the findings of weighted correlation coefficients values [33]. Rashid et al. (2018) have given the approach of entropy measure under IVIFS in regards with the unclear information. For calculating the fuzzy entropy of each alternative, aggregation of IVIFS data has been carried analogous to each alternative [34]. Izadikhah (2012) introduced the TOPSIS technique for handling the supplier selection issue in regards with the GDM for the IVIFNs [35].

4 Techniques for Finding the Weight of Experts in Regrading with the Multiple Attribute Group Decision Making

In this section, we are discussing the methods in relation with the information about the weights of the experts or decision makers and moreover, weights of the attributes are totally unknown under multiple attribute decision making related problems. So, with the help of Intuitionistic and interval-valued fuzzy matrices, firstly, we formulated and derived the criteria weights with unknown information of the opinioners by the following two specified methods as mentioned below:

4.1 Technique for Finding the Weight of Experts with the Usage of Intuitionistic Fuzzy Set

This technique consists of following steps as discussed below:

Step 1: Ground work of the presented method under intuitionistic fuzzy set environment

Suppose R = {R_1, R_2 … R_p) and S = {S_1, S_2…Sq) are the set of alternatives and attributes in relation with the group decision-making problem (GDMP) which concludes that there are m decision makers. Then, the gth intuitionistic fuzzy matrix represented by E^g where g = 1, 2, 3, 4, 5, 6, 7, 8….m which is given by g^{th} opinioner.

$$E^g = \begin{array}{c} \\ R_1 \\ R_2 \\ R_p \end{array} \begin{bmatrix} S_1 & S_2 & \ldots..\ldots S_q \\ <\mu_{11}^g, \nu_{11}^g> & <\mu_{12}^g, \nu_{12}^g> & \ldots..\ldots <\mu_{1q}^g, \nu_{1q}^g> \\ <\mu_{21}^g, \nu_{21}^g> & <\mu_{22}^g, \nu_{22}^g> & \ldots..\ldots <\mu_{2q}^g, \nu_{2q}^g> \\ <\mu_{p1}^g, \nu_{p1}^g> & <\mu_{p2}^g, \nu_{p2}^g> & \ldots..\ldots <\mu_{pq}^g, \nu_{pq}^g> \end{bmatrix} \tag{19}$$

Here μ_{ij}^g and ν_{ij}^g (g = 1, 2, 3, 4 …. m; i = 1, 2, 3, 4, …. p; j = 1, 2, 3, 4 …. q) represents that an alternative R_i satisfies and not satisfied the attribute S_j provided by the g^{th} opinioner.

Step 2: Finding the weights of decision makers or experts

The solution of multi-attribute group decision-making problems are not possible without knowing the weights of decision makers or experts and therefore, in this step, we are going to interpret that how to find out the weights of decision makers. We can create intuitionistic score matrix s^g (g = 1, 2 …m) with the help of matrix provided by the decision makers as mentioned in step 1 (Eq. 21) as,

$$s^g = \begin{array}{c} \\ R_1 \\ R_2 \\ R_p \end{array} \begin{array}{c} \begin{array}{cccc} S_1 & S_2 & \ldots..\ldots & S_q \end{array} \\ \begin{bmatrix} s^g_{11} & s^g_{12} & \ldots..\ldots & s^g_{1q} \\ s^g_{21} & s^g_{22} & \ldots..\ldots & s^g_{2q} \\ s^g_{p1} & s^g_{p2} & \ldots..\ldots & s^g_{pq} \end{bmatrix} \end{array} \tag{20}$$

where $s^g_{ij} = \mu^g_{ij} - \nu^g_{ij}$ (g = 1, 2 …m; i = 1, 2 ….. p; j = 1, 2 ……q). Now, we can take the average score matrix s^a by using the intuitionistic fuzzy score matrix s^g as,

$$s^a = \begin{array}{c} \\ R_1 \\ R_2 \\ R_p \end{array} \begin{array}{c} \begin{array}{cccc} S_1 & S_2 & \ldots..\ldots & S_q \end{array} \\ \begin{bmatrix} s^a_{11} & s^a_{12} & \ldots..\ldots & s^a_{1q} \\ s^a_{21} & s^a_{22} & \ldots..\ldots & s^a_{2q} \\ s^a_{p1} & s^a_{p2} & \ldots..\ldots & s^a_{pq} \end{bmatrix} \end{array} \tag{21}$$

Here $s^a_{ij} = \frac{1}{m}\sum_{g=1}^{m} s^g_{ij}$ (i = 1, 2 ……p; j = 1, 2 ……q). It has been found that a score matrix 's^g' is much closer to the average score matrix 's^a'. Therefore, the collective correlation coefficient between s^g and s^a satisfied the following condition,

$$d_g = \sum_{i=1}^{p} \frac{\sum_{j=1}^{q} s^a_{ij} s^g_{ij}}{\sqrt{\sum_{j=1}^{q} \left(s^g_{ij}\right)^2} \sqrt{\sum_{j=1}^{q} \left(s^a_{ij}\right)^2}} \tag{22}$$

So, we get weight model of decision makers as,

$$\rho_g = \frac{d_g}{\sum_{g=1}^{m} d_g} \tag{23}$$

Therefore, we combine all the separate score matrices of s^g into a single score matrix 's' with the usage of determined weight vector 'ρ_g' obtained in Eq. 7 satisfying the following condition as follows,

$$\sum_{g=1}^{m} \rho_g = 1 \text{ and } 0 \le \rho_g \le 1 \tag{24}$$

$$s = \begin{array}{c} \\ R_1 \\ R_2 \\ R_p \end{array} \begin{array}{c} \begin{array}{cccc} S_1 & S_2 & \ldots..\ldots & S_q \end{array} \\ \begin{bmatrix} s_{11} & s_{12} & \ldots..\ldots & s_{1q} \\ s_{21} & s_{22} & \ldots..\ldots & s_{2q} \\ s_{p1} & s_{p2} & \ldots..\ldots & s_{pq} \end{bmatrix} \end{array} \tag{25}$$

Here $s_{ij} = \sum_{g=1}^{m} \rho_g s^g_{ij}$(i = 1, 2, 3, 4 ….. p; j = 1, 2, 3, 4 ……q).

Step 3: Finding the criteria weights for MCDM method

The criteria weights can be described limited by a subset comparable to weight data which is represented by G in accordance with a MAGDM issue. The suitable values of criteria will have larger whole score value of all alternatives for doing their ranking. Hence, the phenomenon of attributes helps us in proposing optimization model which is actually a linear programming problem for finding out the weight vector of attributes in multi- attribute decision-making method as,

$$\begin{aligned} &\text{Max } P(w^*) = \sum_{i=1}^{p} \sum_{j=1}^{q} w_j^* s_{ij} \text{ so that } \sum_{j=1}^{q} w_j^* = 1, \\ &w^* \text{ belongs to } G \text{ and } w^*_i \geq 0 \end{aligned} \tag{26}$$

This linear programming problem can be constructed by number of algorithms for finding the weights attributes for multiple attribute decision-making method.

Step 4: Finding the ranking of alternatives for multiple attribute decision-making method

The total weighted score determination of each alternative R_i (i = 1, 2, 3, 4 …. p) can be obtained by summing all the score values of the collective score matrix 's^g' keeping in knowing the values of attribute weights in order to rank the order of alternatives for the multiple attribute decision-making problem. Thus, the overall weighted score determination of each alternative R_i is given by,

$$H(R_i) = \sum_{j=1}^{q} w_j^* s_{ij} \tag{27}$$

Now, we can rank the alternatives according to the overall weighted score determination of each alternative R_i in descending order for finding the superior one.

4.2 Technique for Finding the Weight of Experts with the Usage of Interval-Valued Intuitionistic Fuzzy Set

The Multiple attribute group decision-making method under interval-valued intuitionistic fuzzy environment with unknown weights consists of following steps as discussed below:

Step 1: Ground work of the presented method

In this section, we consider the same MADM problem as discussed in case of Intuitionistic fuzzy set but the assessment value of criteria S_j on an alternative R_i is denoted by the IVIFS, $R_i = \{ < S_j, [\mu_{R_i L}(S_j), \mu_{R_i U}(S_j)], [\nu_{R_i L}(S_j), \nu_{R_i U}(S_j)] > , S_j$ belongs to S$\}$ where $0 \leq \mu_{R_i U}(S_j) + \nu_{R_i U}(S_j) \leq 1, \mu_{R_i L}(S_j) \geq 0, \nu_{R_i L}(S_j) \geq 0$, i = 1, 2 ……p; j = 1, 2, …….q. The interval-valued intuitionistic fuzzy set that is the pair of intervals $\mu_{R_i}(S_j) = [\mu_{ij}, \nu_{ij}]$, $\nu_{R_i}(S_j) = [y_{ij}, x_{ij}]$ for S_j belongs to S which is represented by $t_{ij} = < [u_{ij}, v_{ij}], [y_{ij}, x_{ij}] >$. Let us consider the assessment values of criteria, S_j (j = 1, 2, 3, 4 ….q) for an alternative R_i (i = 1, 2, 3, 4, ….p) are, $t_{ij}^1 = < \left[u_{ij}^1, v_{ij}^1\right], \left[y_{ij}^1, x_{ij}^1\right] >$, $t_{ij}^2 = < \left[u_{ij}^2, v_{ij}^2\right], \left[y_{ij}^2, x_{ij}^2\right] >$,……,$t_{ij}^m = < \left[u_{ij}^m, v_{ij}^m\right], \left[y_{ij}^m, x_{ij}^m\right] >$, given by the m-opinioners, where each element is represented by the opinioners for an alternative R_i with respect to an criteria S_j in regards with the Fuzzy phenomenon. Here $\left[u_{ij}^g, v_{ij}^g\right], g = 1, 2 \ldots m$; i = 1, 2, 3, 4 ….p; j = 1, 2, 3, 4 …..q represents that the attribute R_i fulfilled the criteria S_j given by the g^{th} opinioner, $\left[y_{ij}^g, x_{ij}^g\right]$, g = 1, 2, 3, 4, …m; i = 1, 2, 3, 4 p; j = 1, 2, 3, 4 …q represents that the alternative R_i does not fulfilled the criteria S_j given by the g^{th} opinioner and $0 \leq \mu^g{}_{R_i U}(S_j) + \nu^g{}_{R_i U}(S_j) \leq 1, \mu^g{}_{R_i L}(S_j) \geq 0, \nu^g{}_{R_i L}(S_j) \geq 0$, g = 1, 2, 3, 4… m; i = 1, 2, 3, 4….p; j = 1, 2, 3, 4…..q. Therefore, the structure of g^{th} IVIFS decision matrix R^g (g = 1, 2, 3, 4….m) is shown as,

$$R^g = \begin{array}{c} \\ A_1 \\ A_2 \\ A_p \end{array} \begin{array}{c} \begin{array}{cccc} S_1 & S_2 & \ldots\ldots\ldots & S_q \end{array} \\ \begin{bmatrix} < \left[u_{11}^g, v_{11}^g\right], \left[y_{11}^g, x_{11}^g\right] > & < \left[u_{12}^g, v_{12}^g\right], \left[y_{12}^g, x_{12}^g\right] > \cdots & < \left[u_{1q}^g, v_{1q}^g\right], \left[y_{1q}^g, x_{1q}^g\right] > \\ < \left[u_{21}^g, v_{21}^g\right], \left[y_{21}^g, x_{21}^g\right] > & < \left[u_{22}^g, v_{22}^g\right], \left[y_{22}^g, x_{22}^g\right] > \cdots & < \left[u_{2q}^g, v_{2q}^g\right], \left[y_{2q}^g, x_{2q}^g\right] > \\ < \left[u_{p1}^g, v_{p1}^g\right], \left[y_{p1}^g, x_{p1}^g\right] > & < \left[u_{p2}^g, v_{p2}^g\right], \left[y_{p2}^g, x_{p2}^g\right] > \cdots & < \left[u_{pq}^g, v_{pq}^g\right], \left[y_{pq}^g, x_{pq}^g\right] > \end{bmatrix} \end{array} \tag{28}$$

Step 2: Obtain the weights of opinioners

We can create interval-valued intuitionistic score matrix s^g (g = 1, 2 …m) with the help of matrix provided by the decision makers as mentioned in step 1 (Eq. 21) as,

$$s^g = \begin{array}{c} \\ R_1 \\ R_2 \\ R_p \end{array} \begin{array}{c} \begin{array}{cccc} S_1 & S_2 & \ldots..\ldots & S_q \end{array} \\ \begin{bmatrix} s^g_{11} & s^g_{12} & \ldots..\ldots & s^g_{1q} \\ s^g_{21} & s^g_{22} & \ldots..\ldots & s^g_{2q} \\ s^g_{p1} & s^g_{p2} & \ldots..\ldots & s^g_{pq} \end{bmatrix} \end{array} \tag{29}$$

where $s^g_{ij} = u^g_{ij} + v^g_{ij} - y^g_{ij} - x^g_{ij}/2$ (g = 1, 2, 3 …m; i = 1, 2, 3 …..p; j = 1, 2 ……q). Now, we can take the average score matrix s^a by using the intuitionistic fuzzy score matrix s^g as,

$$s^a = \begin{array}{c} \\ R_1 \\ R_2 \\ R_p \end{array} \begin{array}{c} \begin{array}{cccc} S_1 & S_2 & \ldots..\ldots & S_q \end{array} \\ \begin{bmatrix} s^a_{11} & s^a_{12} & \ldots..\ldots & s^a_{1q} \\ s^a_{21} & s^a_{22} & \ldots..\ldots & s^a_{2q} \\ s^a_{p1} & s^a_{p2} & \ldots..\ldots & s^a_{pq} \end{bmatrix} \end{array} \tag{30}$$

Here $s^a_{ij} = \frac{1}{m}\sum_{g=1}^{m} s^g_{ij}$ (i = 1, 2 ……p; j = 1, 2 ……q). It has been found that a score matrix 's^g' is much closer to the average score matrix 's^a'. Therefore, the collective correlation coefficient between s^g and s^a satisfied the following condition,

$$D_g = \sum_{i=1}^{p} \frac{\sum_{j=1}^{q} s^a_{ij} s^g_{ij}}{\sqrt{\sum_{j=1}^{q} \left(s^g_{ij}\right)^2} \sqrt{\sum_{j=1}^{q} \left(s^a_{ij}\right)^2}} \tag{31}$$

So, we get weight model of decision makers as,

$$\sigma_g = \frac{D_g}{\sum_{g=1}^{m} D_g} \tag{32}$$

Thus, we combine all the separate score matrices of s^g into a single score matrix 's' with the usage of determined weight vector 'σ_g' obtained in Eq. 7 satisfying the following condition as follows,

$$\sum_{g=1}^{m} \sigma_g = 1 \text{ and } 0 \leq \sigma_g \leq 1 \tag{33}$$

$$s = \begin{array}{c} \\ R_1 \\ R_2 \\ R_p \end{array} \begin{array}{c} \begin{array}{cccc} S_1 & S_2 & \ldots..\ldots & S_q \end{array} \\ \begin{bmatrix} s_{11} & s_{12} & \ldots..\ldots & s_{1q} \\ s_{21} & s_{22} & \ldots..\ldots & s_{2q} \\ s_{p1} & s_{p2} & \ldots..\ldots & s_{pq} \end{bmatrix} \end{array} \tag{34}$$

Here $s_{ij} = \sum_{g=1}^{m} \sigma_g s_{ij}{}^g$ (i = 1, 2, 3, 4 …. p; j = 1, 2, 3, 4 ……q).

Step 3: Finding the criteria weights for MADM method

The criteria weights can be explained limited by a subset comparable to weight data which is represented by J in accordance with a MAGDM problem. The suitable values of criteria should make the larger whole score value of all alternatives for doing their ranking. This phenomenon of attributes helps us in proposing optimization model which is actually a linear programming problem for finding out the criteria weight vector in MADM method as,

$$\begin{aligned} &\text{Max } B(w^{**}) = \sum_{i=1}^{P} \sum_{j=1}^{q} w_j^{**} s_{ij} \text{ so that } \sum_{j=1}^{q} w_j^{**} = 1 \\ &w^{**} \text{ belongs to J and } w_i^{**} \geq 0 \end{aligned} \tag{35}$$

This linear programming problem can be constructed by number of algorithms for finding the weights attributes for MADM method.

Step 4: Finding the ranking of alternatives for multiple attribute decision-making method

The total weighted score determination of each alternative R_i (i = 1, 2 …. p) can be obtained by summing all the score values of the collective score matrix 's^g' keeping in knowing the values of attribute weights in order to rank the order of alternatives for the multiple attribute decision-making problem. Thus, the overall weighted score determination of each alternative R_i is given by,

$$M(R_i) = \sum_{j=1}^{q} w_j^{**} s_{ij} \tag{37}$$

Now, we can rank the alternatives according to the overall weighted score determination of each alternative R_i in descending order for finding the superior one [24].

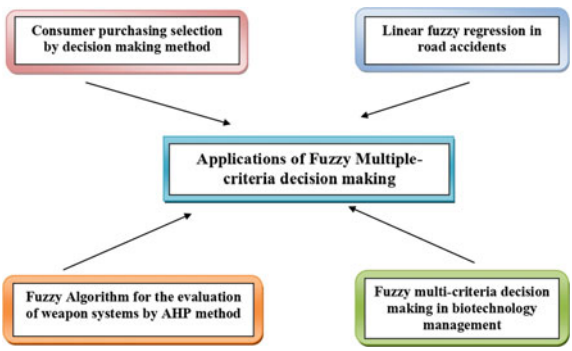

Fig. 1 Applications of fuzzy multiple criteria decision making related problems

5 Applications of Fuzzy Multicriteria Decision Making Related Problems

After the introducement of fuzzy multi-criteria decision-making (FMCDM), the researchers have shown a lot of interest and attention in studying various applications of FMCDM issues. Few of them are as follows as shown in Fig. 1.

5.1 Introducement of Fuzzy Algorithm for the Assessment of Weapon Systems with the Usage of AHP (Analytical Hierarchy Process) Technique

Cheng and Mon developed am new approach on the basis of fuzzy sets combined with Analytical Hierarchy Process for evaluating the weapon systems. This category of weapon systems can be handled with the help of conventional as well as fuzzy MCDM techniques. They introduced the concept of triangular fuzzy numbers and alpha cuts for deriving the algorithm in Analytical Hierarchy Process [18]. Then, this concept of triangular fuzzy numbers was used to construct a judgment matrix for estimating the fuzzy Eigen vectors to indicate the degree of satisfaction of decision maker.

5.2 Fuzzy Multi Criteria Decision Making in Biotechnology Management

Chang and Chen solved the problem of transfer of technology strategy with the use of fuzzy multiple criteria decision-making methods in the field of biotechnology management. They aggregate the weighting of criteria by the use of Linguistic variables and fuzzy numbers for the decision makers. In addition to this, the index of optimism was determined with the help of data provided by the decision makers for the multi-criteria decision-making related problem in order to rank the alternatives to find the most desirable one [19].

5.3 Role of Multiple Criteria Decision-Making in the Field of Consumer Purchasing Selection

The third application of fuzzy multiple criteria decision making is the consumer purchasing selection. Yager et al. have given a method in relation to the data obtained by the surveys of the market in order to deal with the findings of linguistic

variables values and their relative anticipating powers. They have used the approach of linguistic statements by providing multi-objective decision functions [36].

5.4 *Importance of Linear Fuzzy Regression in Road Accidents*

Zamri and Abdullah formulated the fuzzy regression analysis in road accident problems. The parameters used in the fuzzy regression analysis were population, road lengths and registered vehicles and their suitability have done on the basis of estimation of road accidents form the year 1974 to 2007 to obtain a final regression model along the formation of three independent variables [37].

6 Conclusions

In this review paper, we have examined the various Multiple Criteria Decision Making related problems and their specified methods with unknown weights under the fuzzy, intuitionistic and interval-intuitionistic fuzzy setting. Firstly, we introduce the entropy-based model for finding the weights of the decision-maker with respect to the decision matrix given by Intuitionistic and interval-valued intuitionistic fuzzy sets. Then, we pressed a weighted formula for the evaluation of correlation coefficients for each alternative in order to rank the alternatives for finding the most beneficial alternative. This review provides a detailed investigation of multi criteria decision making techniques which helps in providing a larger amount of research in this fuzzy category. In addition to this, various applications of fuzzy multi criteria decision making related problems were also taken into consideration and solved with the help of fuzzy and intuitionistic fuzzy logic.

Acknowledgements All the authors are thankful to the reviewers for their valuable suggestions and comments.

References

1. Zadeh LA (1965) Fuzzy sets. Inf Control 8(3):338–353
2. Guzman LM (2001) Multi-criteria decision making methods: a comparative study. In: Applied optimization. Evangelos Triantaphyllou. Kluwer Academic Publishers, p 288. Wiley Periodicals Inc.
3. Li J, Li J, You C, Dong M (2012) Multi-attribute decision making method with intuitionistic fuzzy sets. In: 2012 9th International Conference on Fuzzy Systems and Knowledge Discovery, 2012, pp 97–101

4. Wu J-Z, Zhang Q (2011) Multicriteria decision making method based on intuitionistic fuzzy weighted entropy. Exp Syst Appl 38(1):916–922
5. Zeshu X, Hu H (2009) Entropy-based procedures for intuitionistic fuzzy multiple attribute decision making. J Syst Eng Electron 20(5):1001–1011
6. Atanassov KT (1994) Operators over interval valued intuitionistic fuzzy sets. Fuzzy Sets Syst 64(2):159–174
7. Hong DH (1998) A note on correlation of interval-valued intuitionistic fuzzy sets. Fuzzy Sets Syst 95(1):113–117
8. Huang H-L, Shi F-G (2008) L-fuzzy numbers and their properties. Inf Sci 178(4):1141–1151
9. Hung W-L, Wu J-W (2002) Correlation of intuitionistic fuzzy sets by centroid method. Inf Sci 144(1–4):219–225
10. Mondal TK, Samanta SK (2001) Topology of interval-valued intuitionistic fuzzy sets. Fuzzy Sets Syst 119(3):483–494
11. Xu ZS, Chen J (2008) An overview of distance and similarity measures of intuitionistic fuzzy sets. Int J Uncertainty Fuzziness Knowl-Based Syst 16(04):529–555
12. Xu Z (2010) A method based on distance measure for interval-valued intuitionistic fuzzy group decision making. Inf Sci 180(1):181–190
13. Xu Z-S, Jian C (2007) Approach to group decision making based on interval-valued intuitionistic judgment matrices. Syst Eng Theory Pract 27(4):126–133
14. Zimmermann H-J (2011) Fuzzy set theory—and its applications. Springer, Heidelberg
15. Atanassov KT (1999) Intuitionistic fuzzy sets. In: Intuitionistic fuzzy sets, pp 1–137. Springer, Heidelberg
16. Atanassov KT (1999) Interval valued intuitionistic fuzzy sets. In: Intuitionistic Fuzzy Sets, pp 139–177. Springer, Heidelberg
17. Wiecek MM, Ehrgott M, Fadel G, Figueira JR (2008) Multiple criteria decision making for engineering. Omega Int J Manag Sci 36(3):337–339
18. Zavadskas EK, Turskis Z, Antucheviciene J, Zakarevicius A (2012) Optimization of weighted aggregated sum product assessment. Elektronika ir elektrotechnika 122(6):3–6
19. Hwang C-L, Masud ASM (2012) Multiple objective decision making—methods and applications: a state-of-the-art survey, vol. 164. Springer, Heidelberg
20. Zavadskas EK, Kaklauskas A, Sarka V (1994) The new method of multicriteria complex proportional assessment of projects. Technol Econ Dev Econ 1(3):131–139
21. Brauers WK, Zavadskas EK (2006) The MOORA method and its application to privatization in a transition economy. Control Cybern 35:445–469
22. Brauers WKM, Zavadskas EK (2010) Project management by MULTIMOORA as an instrument for transition economies. Technol Econ Dev Econ 16(1):5–24
23. J. B. Kadane, *Principles of uncertainty*. Chapman and Hall/CRC, 2011
24. Liou JJ, Tzeng G-H (2012) Comments on 'Multiple criteria decision making (MCDM) methods in economics: an overview'. Technol Econ Dev Econ 18(4):672–695
25. Tzeng G-H, Huang J-J (2011) Multiple attribute decision making: methods and applications. Chapman and Hall/CRC, Boca Raton
26. Jiang Y-P, Fan Z-P (2008) An approach to group decision making based on incomplete fuzzy preference relations. Int J Uncertainty Fuzziness Knowl-Based Syst 16(01):83–94
27. Zeng L (2006) Expected value method for fuzzy multiple attribute decision making. Tsinghua Sci Technol 11(1):102–106
28. Xu Z-S, Chen J (2007) An interactive method for fuzzy multiple attribute group decision making. Inf Sci 177(1):248–263
29. Cheng C-H, Mon D-L (1994) Evaluating weapon system by analytical hierarchy process based on fuzzy scales. Fuzzy Sets Syst 63(1):1–10
30. Chang P-L, Chen Y-C (1994) A fuzzy multi criteria decision making method for technology transfer strategy selection in biotechnology. Fuzzy Sets Syst 63(2):131–139
31. Ribeiro RA (1996) Fuzzy multiple attribute decision making: a review and new preference elicitation techniques. Fuzzy Sets Syst 78(2):155–181

32. Ehrgott M, Fonseca CM, Gandibleux X, Hao JK, Sevaux M (2009) Evolutionary multi-criterion optimization. In: 5th International Conference, EMO 2009, Nantes, France, April 7–10 2009, Proceedings, vol 5467. Springer, Heidelberg
33. Ponnialagan D, Selvaraj J, Velu LGN (2018) A complete ranking of trapezoidal fuzzy numbers and its applications to multi-criteria decision making. Neural Comput Appl 30 (11):3303–3315
34. Uluçay V, Deli I, Şahin M (2018) Trapezoidal fuzzy multi-number and its application to multi-criteria decision-making problems. Neural Comput Appl 30(5):1469–1478
35. Ye J (2013) Multiple attribute group decision-making methods with unknown weights in intuitionistic fuzzy setting and interval-valued intuitionistic fuzzy setting. Int J Gen Syst 42 (5):489–502
36. Hung C-C, Chen L-H (2009) A multiple criteria group decision making model with entropy weight in an intuitionistic fuzzy environment. In: Intelligent Automation and Computer Engineering, 2009, pp 17–26. Springer, Heidelberg
37. Boran FE, Genç S, Kurt M, Akay D (2009) A multi-criteria intuitionistic fuzzy group decision making for supplier selection with TOPSIS method. Exp Syst Appl 36(8):11363–11368
38. Khan M, Ansari MD (2020) Multi-criteria software quality model selection based on divergence measure and score function, 3179–3188
39. Rani P, Mishra AR, Ansari MD (2019) Analysis of smartphone selection problem under interval-valued intuitionistic fuzzy ARAS and TOPSIS methods. In: 2019 Fifth International Conference on Image Information Processing (ICIIP), pp 509–514. IEEE
40. Ansari MD, Mishra AR, Ansari FT (2018) New divergence and entropy measures for intuitionistic fuzzy sets on edge detection. Int J Fuzzy Syst 20(2):474–487
41. Ansari, MD, Mishra AR, Ansari FT, Chawla M (2016) On edge detection based on new intuitionistic fuzzy divergence and entropy measures. In: 2016 Fourth International Conference on Parallel, Distributed and Grid Computing (PDGC), pp 689–693. IEEE

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Speech and Facial Based Emotion Recognition Using Deep Learning Approaches

M. M. Venkata Chalapathi

Abstract Deep learning models dependent on static highlights vector just as standardized fleeting highlights vector, were utilized to perceive feeling state from discourse. Also, relative highlights got by registering the progressions of acoustic highlights of passionate discourse comparative with those of nonpartisan discourse were embraced to debilitate the impact from the singular contrast. The strategies to relativize static highlights and fleeting highlights were presented separately and tests on the basis of database Germany also, database of Mandarin were executed. The outcomes show that the exhibition of relative highlights exceeds expectations that of supreme highlights for feeling acknowledgment as an entirety. At the point when speaker is free, the half and half of static relative highlights vector and relative fleeting highlights standardized vector accomplishes best outcomes. The principle motivation behind this discussion is to give a few presentations about the necessities and employments of facial articulation acknowledgment. Non-verbal type of correspondence is outward appearance. It communicates the human frame of mind and furthermore perceives their psychological condition. Quantities of research have been completed in the course of recent decades for improving the human PC connection. This paper contains the a few data about outward appearance acknowledgment, application, related investigation of face demeanor acknowledgment systems and steps.

Keywords Deep learning · Fleeting · Facial articulation · Psychological condition

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_75

1 Introduction

Vocal feeling is a significant factor in human correspondence. In this way, making a machine to perceive feelings from discourse is a fundamental piece of the street guide to make correspondence among people and PCs increasingly human-like. However, a lot of look into has been done to perceive feelings consequently from human speech, low acknowledgment rate is as yet a major issue. The general issue of programmed discourse feeling acknowledgment is that the acoustic signs of discourse signals are impacted by an assortment of components besides the feeling. The physiological contrasts among all the speakers are the key difficulty that prompts a low acknowledgment rate.

Discourses produced by the state of the vocal tract and its variety with the time. State of vocal tract in which relies upon shape or size of vocal organs, unavoidably show singular contrasts. The distinction in the state of the vocal tracts causes diverse recurrence spectra. For instance, the territories of formant are assorted for different speakers. In contrast talking custom of various speakers, counting talking speed, voice size, are moreover extraordinary. This prompts clear contrasts among musicality highlights of various speakers. For instance, vitality parameter of discourse will change in particular scope of a speaker is feeling changes. For the speaker who consistently talks noisily, the vitality least of his discourse is likely greater than the vitality limit of another speaker who consistently talks humble. That is, interclass fluctuation is large and between-bunch fluctuation is little, which prompts trouble in discourse feeling acknowledgment [1, 2].

In perspective on the individual contrasts of acoustic character, culture foundation are principle issues impacting the acknowledgment pace of vocal feeling, relative highlights which speak to changes of acoustic highlights of passionate discourse comparative with those of unbiased discourse are utilized to diminish the impact from person contrast [8, 9].

In light of deep learning models, tests are done utilizing Germany database and Mandarin database individually. In this found that better acknowledgment result can be accomplished utilizing relative highlights, particularly in speaker free case. Feeling highlights have large impact on social capacities to learn, comprehend and think in a consistent route about things, for example, correspondence, understanding human conduct and settling on differing choices. Feeling assumes an essential job during the time spent correspondence. Voice is considered as the Verbal type of correspondence [10]. Non-verbal types of interchanges are outward appearance activity, body stance and signal. Outward appearance acknowledgment has number of uses, for example, human PC communication, social robots, ready framework and liveliness. Characterization of outward appearance and it's viewpoints: To portray human feeling outward appearance assumes a significant job.

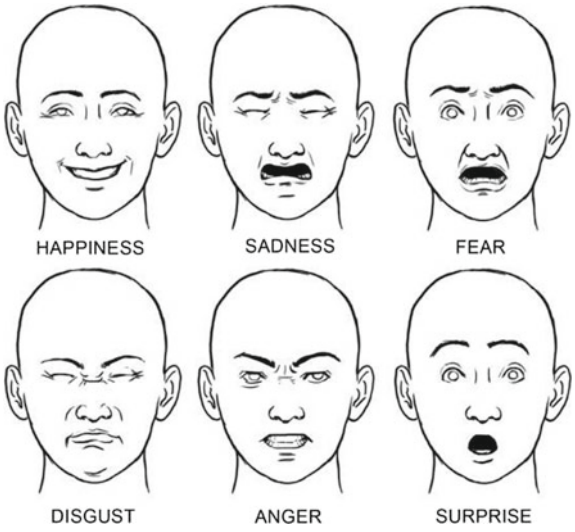
As people are loaded up with number of feelings they tend to alteration their feelings from beginning of the day to the end of the day. Fundamentally six feelings are characterized by the cutting edge brain research they are joy, misery, outrage,

dread, and amaze and nauseate. Human feelings are perceived by the facial muscles developments. Eyebrows, mouth, nose, eyes are the essential facial highlights.

2 Facial Expression Emotion Recognition

There are many facial expressions for humans. Some of the expressions are like happiness, sadness, fear, disgust, anger, fear etc. These expressions where shown in the following diagram. An emotions of the human are recognized by the facial muscles movements, eyes, eyebrows, mouth, nose, and are the basic facial features.

The emotions of the human where shown in the following figure.



3 Related Work

To choose fit highlights conveying data about feeling is fundamental for feeling acknowledgment. For the errand of discourse feeling arrangement, both fleeting highlights and measurement highlights are accessible. Concentrate on feeling of discourse demonstrates that pitch, vitality, term, and formant are compelling highlights to recognize certain feelings. In the paper, for each edge, six fundamental highlights, including pitch, sufficiency vitality, box-measurement, zero cross proportion, vitality recurrence esteem, first formant recurrence just as their first and second subsidiaries, are removed [5–7].

Bharati A. Dixit, in this creators clarified Zernike development that is one of the outward appearance acknowledgment frameworks utilizing clamor and pivot invariant dependent on a factual development. Gullible Bayesian classifier accepts contribution as the Extricated highlight from Zernike developments for feeling acknowledgment [3].

Mateuszzarkowskietal, creators have introduced a customized feeling acknowledgment system. This work stretches the primary need to order of feelings. For facial arrangement, they involved 2-models, for example, dynamic space model and dynamic appearance models [4].

4 Proposed Work

4.1 Speech Expression Recognition

The Six estimation features are used to institutionalize looking at static and transient features for each feeling talk, including planning tests and test tests. Let Sfi, j, i = 1, 2,…..,15, j = 1, 2, 3, 4 speak to the j th insights include (comparing to greatest worth, least worth, mean and fluctuation) from the ith fleeting component of passionate discourse. Let Nf i, j, i = 1,2,…15 j = 1, 2, 3, 4 compare to reference highlights from impartial discourse. The equation for ascertaining relative measurement highlights is:

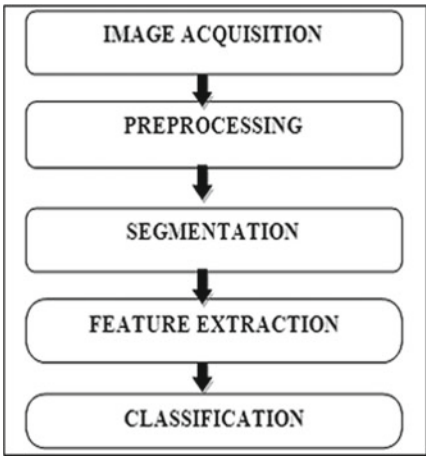
$$\mathrm{RSfi,j} = (\mathrm{Sfi,j} - \mathrm{Nfi,j})/(\mathrm{Nfi,j} + 0.0000001)$$

Two sorts of strategies to relativize transient highlights are utilized. First strategy is like that of static highlights. Assuming f_i i = 1, 2, …,15 stand for temporal feature vectors, relative temporal feature vectors Rf_i can be contracted using succeeding formulation:

$$Rf_i = (f_i - NF_{\mathrm{i,3}})/(NF_{\mathrm{i,3}} + 0.0000001)$$

4.2 Facial Expression Recognition

Image acquisition: Picture securing stands initial stage, where the picture can be acquired. Static picture or picture grouping strategies are utilized for the face feeling acknowledgment. The utmost mainstream picture is two-D dim facial picture scale and simultaneously shading pictures can give progressively helpful data about feelings. Preprocessing: Preprocessing is, where undesirable commotion bends will be dispensed with. This stage upgrades the info picture and it likewise incorporates the procedures of separating and standardization.



Segmentation: Segmentation is the procedure where the info picture is fragmented into number of sub pictures based on their surface, edges and force. Highlight extraction: It is the fascinating piece of the picture preparing. The procedure extricates the first picture and later conveys significant picture. It lessens the picture size which extraordinarily helps in picture stockpiling process.

Classification: This stage arranges the pictures as indicated by their comparable attributes. This progression is otherwise called the element determination arrange.

5 Experimental Results

As per the test results over, the Profound learning classifier utilizing relative component vector can accomplish preferred acknowledgment results over those utilizing total element vector on the grounds that the aggravation from singular acoustics contrast is decreased when relative highlights are utilized.

Furthermore, the second sort of relative highlights, which are gotten by computing relative highlights of standardized highlights, is fit to speaker autonomous acknowledgment (Tables 1, 2, 3, 4 and 5).

Table 1 Experimental results without using relative temporal features when speaker is dependent (%)

Feature vector	Mandarin database						Berlin database				
	Sadness	Anger	Surprise	Joy	Disgust	Average	Sadness	Anger	Joy	Disgust	Average
AS	100	16.7	83.3	100	66.7	72.0	83.8	88.0	26.7	74.4	68.8
RS	100	100	66.7	100	66.7	88.0	89.3	91.9	35.6	80.5	74.9
AT	100	50.0	50.0	66.7	33.3	64.0	84.0	87.8	32.2	79.9	71.0
AS+AT	85.7	50.0	83.3	100	66.7	76.0	89.3	72.3	35.9	80.5	68.9
RS+AT	100	66.7	100	66.7	66.7	84.0	89.3	95.8	22.2	92.6	74.9

Table 2 Experimental results when using the 2nd kind of relative temporal features vector and when speaker is dependent (%)

Feature vector	Mandarin database						Berlin database				
	Sadness	Anger	Surprise	Joy	Disgust	Average	Sadness	Anger	Joy	Disgust	Average
RTl	100	66.7	66.7	0.0	66.7	68.0	89.3	95.8	27.3	74.4	72.2
AS+RTl	100	66.7	66.7	100	66.7	80.0	89.3	67.9	40.6	80.5	68.7
RS+RTl	100	83.3	83.3	100	66.7	88.0	89.5	88.0	27.3	90.0	73.3

Table 3 Experimental results when using the 2nd kind of relative temporal features vector and when speaker is dependent (%)

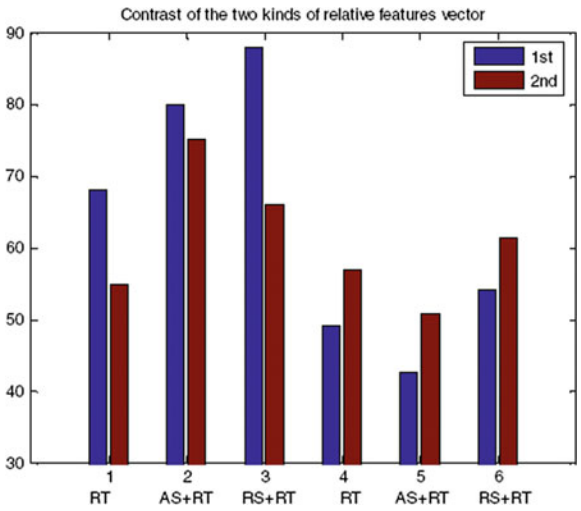
Feature vector	Mandarin database						Berlin database				
	Sadness	Anger	Surprise	Joy	Disgust	Average	Sadness	Anger	Joy	Disgust	Average
RT2	81.8	36.1	53.0	37.5	33.3	54.8	76.7	92.1	39.8	80.6	73.8
AS+RT2	95.5	66.7	70.5	87.5	33.3	75.2	83.7	94.7	23.4	75.3	69.6
RS+RT2	90.9	47.2	61.4	70.8	33.3	65.9	85.4	86.1	28.0	80.6	69.8

Table 4 Experimental results without using relative temporal features when speaker is independent (%)

Feature vector	Mandarin database						Berlin database				
	Sadness	Anger	Surprise	Joy	Disgust	Average	Sadness	Anger	Joy	Disgust	Average
AS	75.0	29.5	80.1	27.0	35.0	45.3	32.2	91.9	17.2	80.0	60.8
RS	75.8	35.0	50.2	50.0	35.0	46.4	32.2	73.1	17.2	80.0	53.0
AT	83.4	44.7	58.1	29.6	35.0	46.2	32.2	77.6	17.2	90.0	56.2
AS+AT	51.7	54.7	48.7	40.7	22.3	41.0	39.3	62.3	60.0	80.0	59.9
RS+AT	65.0	29.5	49.8	57.7	35.0	46.4	32.2	84.7	17.2	90.0	59.3

Table 5 Experimental results when using the 1st kind of relative temporal features vector and when speaker is independent (%)

Feature vector	Mandarin database						Berlin database				
	Sadness	Anger	Surprise	Joy	Disgust	Average	Sadness	Anger	Joy	Disgust	Average
RT1	64.2	52.5	74.8	40.7	42.5	49.1	32.2	69.5	17.2	90.0	53.2
AS+RT1	65.0	26.7	58.5	40.7	35.0	42.5	32.2	91.9	17.2	75.3	50.8
RS+RT1	75.8	51.7	71.0	54.7	40.7	54.1	33.3	86.1	30.3	90	59.9



6 Conclusion

In this course of recent decades, speedy investigates endeavors have been completed in the field of facial feeling acknowledgment. Relative highlights, which can reduce the aggravation from singular acoustic contrast, were embraced to improve the acknowledgment ability of the entire framework. Exhibitions of the total highlights and the two sorts of the relative highlights stayed gathered from tests utilizing Berlin database of enthusiastic discourse and Beihang University mandarin feeling discourse store. The experiment results show that relative highlights are more powerful than outright highlights for acknowledgment. Investigate an increasingly sound technique to separate relative highlights is our next work Feelings are reflected as the significant and important of action of mind. Feelings are basically recognized by the face in which normally comprises more intellect slicks. The principle objective of the broadside is to allow a short presentation around facial feeling acknowledgment framework, their presentations and continuing exploration all of it in the territory feeling acknowledgment.

References

1. Tsapatsoulis E, Cowie R, Cowie D, Votsis N, Kollias S, Fellenz W, Taylor JG (2001) Recognizing emotions in human and computer communication. IEEE Signal Process J 18 (1):32–80

2. Foo, SW, Nwe TL, De Silva LC (2003) Perceptual perceptions with hidden markov models. Voice Commun 41:603–623
3. Dixit BA, Gaikwad AN (2015) Statistical moment based on facial expression analysis. In: IEEE International Pretreatment Conference (IACC)
4. Zarkowski M (2013) Introduction to emotional recognition system for social robots. IEEE
5. Dubey M, Singh L (2016) Automatic recognition of emotions with facial expressions: a review. Int J Res Eng Technology (IRJET) 3(2):488–492
6. Banerjee A, Miss DN (2017) The analysis of emotional eye movements with electromagnetic alerts. Int J Biomed Eng Technol20(8):2384. https://doi.org/10.3390/s20082384
7. Kim MH, Joo YH, Bae's J (2015) Electronica with portrait (2015)
8. Sarkar M, Leong TY (2003) Characteristics of medical journals using similar bone fractures. Artif Intell Med 27:201–222
9. Chen GH, Liu JH, Ye J (2006) Improvement methods for analyzing endpoints based on energy frequency values. In: Proceedings of the IEEE HDP 2006, pp 9–11
10. Gosavi VR, Deshmane AK (2015) J Rev Emotional Recogn Int J Recent Adv Eng Technol (IJLTET), 5th edn, 1 January 2015

Graph: An Efficient Data Structure to Represent and Interpret Semantic Information

Ashwini V. Zadgaonkar and Avinash J. Agrawal

Abstract A popular Data structure Graph is a quite a useful structure to model variety of real-life problems. In language understanding domain, Semantic analysis makes an attempt to map syntactic structures of a language such as sentences and paragraphs as a whole, to their language-independent meanings. Main focus of Semantic analysis mainly focuses the context window frame surrounding individual words. To represent the context between words in the form of relationships between two words, Graph data structure is quite suitable. A Knowledge Base (KB) is a special type of graph which stores data in the form of entities as nodes and relation between entities as edges. Knowledge Bases majorly follow Resource Description Framework (RDF) standard to store relational data. Semantic Knowledge Graphs automatically identify relationships between entities to form a compact graphical representation from a data corpus to represent a knowledge in the given domain.

Keywords Knowledge base · Knowledge graph · Information retrieval · Open information extraction · Distant supervision

1 Introduction

Large volume of information is available on web nowadays which exists in different forms such as news articles, blogs, social media text, images, videos and many more. Information available on web exists in unstructured format and manually analyzing and using it for semantic analysis is quite a tedious and labor intensive task. Obliviously such semantic analysis will rely upon sophisticated and customized techniques of Information retrieval and Information Extraction for required

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_76

outcome. Natural Language Processing (NLP) applications use statistical techniques to analyze and process the running text, the default human communication mode. Information Extraction takes as a input natural language text and produces structured representation out of it required for a particular application as an output. Such extracted information needs a specific format for computer based storage, processing, manipulation and retrieval. Different NLP tasks like Named Entity Recognition, Entity Linking, Ambiguity Resolution, Relation Extraction task, Knowledge Base inference mechanism can be applied on raw text to work for different applications like Machine Translation.

Question-Answering Systems, Natural Language Understanding, Text Summarization and Digital Assistants etc. This paper aims at understanding the need of efficient data structure for representing this natural language information and claiming that knowledge graph is one of the suitable options available to represent such information.

1.1 Knowledge Graph

A knowledge graph is a systematic graphical representation of semantic information where nodes are Entities and edges represent semantic relations between the entities. Considering a sample running text sentence "***Leonardo DiCaprio***, ***41***, *was an actor who starred in* ***James Cameron****'s romantic disaster movie* ***Titanic*** *(1997) as* ***Jack Dawson***. *Its knowledge* graph representation can be visualized as follows (Fig. 1).

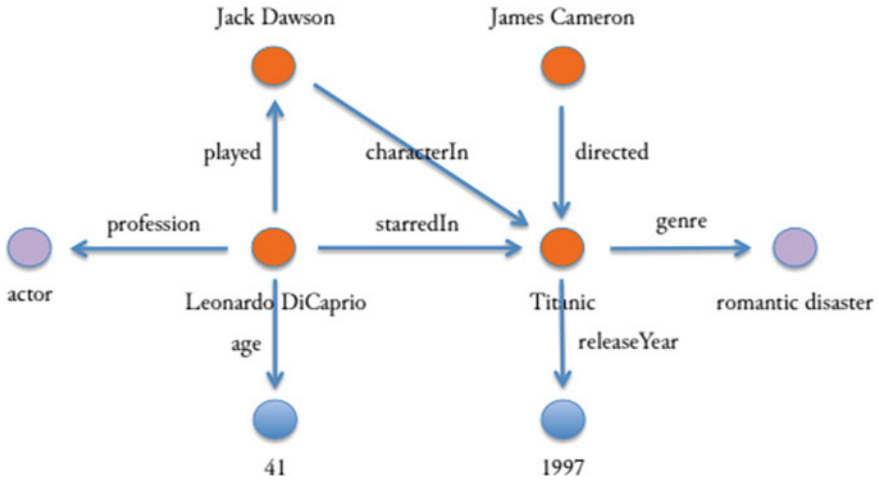

Fig. 1 A sample knowledge graph

A knowledge graph

- Captures and shows real world entities and relationships between them, organized as a graph.
- Identifies potential classes and relationships of entities in a given domain.
- Allows for identification of hidden relationships between arbitrary entities.
- Covers variety of domains.
- Try to identify and represent semantic connections in natural text

Based on representation techniques used Knowledge Graph can adapt.

- **Schema-based approach**:- Where each entity and relation is given unique identifier for the system and all relations are pre-defined in a fixed vocabulary. For example, the fact that *Shivaji Maharaj was born in Maharashtra* using the triple ***(/m/06abcd,/people/person/born-in,/m/04efg),*** where/*m/06abcd* is the ID for Shivaji Maharaj *and m/04efg* is the ID for Maharashtra.
- **Schema-free approach**:- Where Entities and relations are not having unique identifiers assigned and mostly rely on Open information extraction techniques [1] and represented by strings. For example, an OpenIE system may extract triples such as ("Shivaji Maharaj", "born in", "Maharashtra"), ("Shivaji Maharaj", "place of birth", "Shivneri fort"). But this representation is subjected to entity disambiguation problems, the main drawback of Open IE systems.

2 Literature Review

Compared with traditionally used knowledge representation systems mentioned in literature such as Expert systems, Semantic net, the significance of knowledge graph is that it is a combination of knowledge representation structures, information management processes and efficient searching algorithms to process knowledge. It's relational representation is adapted from logic and artificial intelligence area of frames [1] and Semantic networks [2]. Information stored in KG's is interpretable by computers which is a very useful feature to build intelligent machines. Knowledge graph is already a preferred choice for many commercial and scientific applications.

DBpedia [3] is a knowledge graph which is generated from structured data in Wikipedia. The latest version of the DBpedia shows 4.8 million entities and 176 million text statements about those entities. The ontology defined for this is containing 735 classes and 2,800 relations. YAGO [4] builds its knowledge base from the category system available in Wikipedia with infoboxes and the lexical resource WordNet. The difference between DBpedia and YAGO is that where first generates interlinked knowledge graphs for different language edition Whereas the second focuses on an automatic fusion of knowledge extracted from various Wikipedia language editions. The latest release of YAGO3, is composed of 4.6 million entities

and 26 million facts about those entities. The YAGO3 schema contains approximately 488,000 classes and 77 relation types.

The Cyc [5] knowledge graph is built by using curated approach, developed and maintained by Cy Corp In. OpenCyc is composed of nearly 120,000 entities and 2.5 million entity facts. OpenCyc schema is composed of a type hierarchy of 45,000 types, and 19,000 relations. Wikidata is following a collaborative approach which is operated by the Wikimedia foundation. They are also hosting the different language editions of Wikipedia. Later on Freebase data is clubbed with Wikidata to generate approximately 16 million instances and 66 million text sentences. Their Knowledge base consists of about 23,000 entity classes and 1,600 relations types.

Extracting knowledge from unstructured data have been proposed by Never Ending Language Learning (NELL) [6] project. The project takes a large corpus of web sites and uses a set of methods to learn text patterns of different types and relation assertions. They applied the extracted patterns to recognize new entities and relations from the corpus. Logical reasoning is applied in the system for consistency checking and withdrawal of inconsistent axioms. The system is continuously expanding its knowledge base till date and claimed that the contained data can be transformed to RDF and can be provided as Linked Open Data. Latest version of NELL stores approximately 2 million entities and 433,000 relation types with ontology of 285 classes and 425 relation types.

Google's Knowledge Graph was introduced with the invention of the term knowledge graph. Though Google is maintaining secrecy about its construction still few external sources discussed information flow mechanism based on experience. These sources assume that major semi-structured web sources like Wikipedia, structured markup (like schema.org Microdata) on web pages and contents from Google's online social network Google+ mainly contributes for this knowledge graph. The Knowledge Vault [7] is Knowledge base construction project by Google which uses different sources available on web in the form of text documents, HTML tables, and Microdata or Micro Formats. Extracted facts are the processed using the confidence score, and prior probabilities for the statements to compute using the Freebase knowledge graph. A confidence score for each extracted fact is compared with threshold and only those facts which are having score more than threshold are taken for knowledgebase construction for Knowledge Vault. The Knowledge Vault stores nearly 45 million entities and 271 million fact statements using 1,100 entity classes and 4,500 relation types.

Yahoo search engine is also maintaining their knowledge graph to improve search results. This knowledge graph was constructed from public data resources like Wikipedia and Freebase as well as closed commercial resources of different domains. Using wrappers for different sources, the system monitors evolving sources for frequent updates. From the online sources it is claimed that Yahoo's knowledge graph contains around 3.5 million entities and 1.4 billion relations. It is adapting a schema based approach of 250 types of entity classes and 800 relation types. **Microsoft's Satori** is also a knowledge base developed and maintained by Microsoft with high secrecy. According to online information available. It has been

claimed that Satori is composed of 300 million entities and 800 million relations in 2012, using RDF format.

Data available on online social network Facebook is visualized as connections between people which contain a large variety of entities. The personal information provided by people regarding their home town, school attended, their likes for movies, bands, books, etc. often represent entities linked with people as well as connections amongst people. By parsing this textual information a knowledge base is designed containing links among entities. In is believed that Facebook entity graph is maintaining more than 100 billion connections between entities in the form of relations.

3 Issues and Challenges

3.1 Construction of Semantic Knowledge Graph

Knowledge base are evaluated on various parameters like *Completeness*, *accuracy*, and *data quality*. Manually created knowledge bases gives highly accurate results, but not capable of handling large corpora. Collaborative efforts for constructing knowledge bases like Wikipedia and Freebase, works better with large corpora but has associated constraints. To overcome the problems of manual KG construction, automatic knowledge base construction methods are focused by the research community.

Automated KB construction techniques are classified into two categories.

- Construction of KB from semi-structured data, which results into large, highly accurate knowledge graphs such as YAGO [4] and DBpedia [3]. The accuracy of facts in such automatically created KGs were very high.
- Construction of KB by extracting facts from running text available in different forms on Web. Example projects in this category include NELL [6] and the Knowledge Vault [7]. These method is subjected to the inconsistencies in the generated knowledge bases which can be reduce by using the knowledge from existing, high-quality repositories.

Constructing knowledge graphs involves two steps. Extracting knowledge from external resources (*knowledge population*) followed by inferring missing knowledge using statistical techniques on the extracted information (*knowledge completion*). In practical scenarios often weak knowledge population affect the performance of knowledge completion task. To reduce the performance gap between these two processes an incremental population approach can be adapted which follows following steps.

1. ***Filter:*** The external resource is scanned/filtered to find relevant entities.
2. ***Schema Mapping:*** some form of mapping is designed to identify which property in the source semantically corresponds to property in the knowledge graph.
3. ***Candidate Generation***: This step finds potential candidate entities in the data source. The objective of candidate generation is to find maximum number of matching using some similarity function.
4. ***Linking:*** Linking function clustered all entities satisfying matching rule while non matching entities will be discarded. Linking can be extended to multiple levels for more accuracy.
5. ***Consolidation:*** After all matched candidates are processed the unmatched entities need to be consolidated as a new entity in the knowledge graph by iterating over the data source.

Identifying relations between the entities from the resource is a primary task for constructing knowledge graph. Identifying semantic relations between entity facts in running text is a primary objective of natural language understanding systems. A Mathematical model to represent relation between two entities can be represented as a tuple T = (entity1, entity2, relation) where the entity1 and entity2 are entities in a predefined relation within document D of a corpus.

3.2 Methods for Identifying Relations Between Entities for Constructing Knowledge Graphs

1. **Knowledge Based Methods**

The Knowledge based Relation extraction methods are suitable for domain-specific tasks. Here it is handling similar texts and relations are predefined. These Systems used different pattern matching methods designed for individual domain. But some relations are domain-independent. To summarize, it can be said that knowledge-based methods are not applicable across different domains and require manual labor for construction. At the same time they can be effectively utilize for well-defined domains and document collections for faster construction.

2. **Supervised Methods**

Supervised methods for Relation Extraction uses machine learning algorithms trained on a tagged set of domain specific examples which learns relation extractors automatically. The major drawback is developing tagged corpus for each domain takes lot of time and efforts. At the same time these systems are portable to different domains provided tagged corpus for that domain is ready. Some supervised systems rely upon bootstrapping for relation extraction. Mistakes in relation extraction at bootstrapping will propagate at later stages also and decrease the accuracy. Another problem of this approach is of semantic drift occurring due to multiple senses of the same word. Hence each iteration creates a diversion from the original meaning.

Drawbacks of supervised relation extraction methods are listed below.

1. These methods will not work for new entity classes in absence of labeled data.
2. higher order relations are difficult to extract and maintain.
3. Involves lot of computational overheads and not scalable.
4. Most of the methods demands preprocessed data in different forms of parse tree, dependency parse trees and many more. Pre-processing the data is always error prone thus affecting system performance.

3. **Self Supervised Systems**

Self-supervised systems will try to make relation extraction completely automatic. Self-Supervised approach can be categorized into following categories.

4. **Open Information Extraction**

Etzioni [8] introduced the term Open Information Extraction defined as "a novel extraction paradigm that tackles an unbounded number of relations". This method will not define relations in advance and try to extract all possible relations present in corpus. These system takes corpus as an input and apply some heuristics for classification. It extracts only explicitly mentioned phrase-based relations 2. It is having the limitation of extracting facts and relations within sentence boundary.

5. **Distant Learning**

Mintz [9] introduced the term "*distant supervision*" which uses a large semantic database. For each pair of entities appearing in a relation, it will try to locate all sentences containing those entities in a large unlabeled corpus. Such systems uses feature extraction method to train relation classifier. Many researchers are working on this approach to further investigate and improve system performance.

4 Conclusion

There are various challenges involved in constructing efficient knowledge bases using relational machine learning [10] which can be summarized as follows.

(a) **Managing higher order relations in KGs**

The KGs discussed so far are focusing on binary relations i.e. in triplet format for representing entities but entities can have multidimensional relations. One way of representing higher cardinality functions is express it as multiple binary relations. Auxiliary nodes can be used to model such relationships. But a distinct model is needed to represent higher order relations without converting them to binary relations for handling higher degree relations efficiently.

(b) **Authentication of temporal data**

Truth value of a fact can change over a time period. Consider an example, India's Prime Minister is Mr. Narendra Modi but this fact was not true before 2014 as that time Mr. Manmohan Singh was the Prime Minister. Actually Both facts are

correct within a specified time interval, but each fact has to be verified with associated time stamp. For this reason, it is expected to tag the facts with time stamps. Future KGs systems are needed to handle such temporal data frequently.

(c) **Constraints based KG schema design**

Applying constraints over extracted triplets will increase the accuracy of knowledge graph. One way to implement this is that system should extract only those relation triplets which are satisfying the constraints and then construct knowledge base. But Modeling the constraints for a given domain is not an easy task and demands large and complex amount of manual work. To overcome this problem there is an alternative available where type constraints need to be learned by observing the extracted triplets.

(d) **Training of extraction models**

Many entities which exist in a corpus are missing in the knowledge graphs as they go undetected by extraction methods used. When new type of entities gets added then it demands for training the entire system again which not a feasible solution for runtime considerations. Considering existing KG model and set of newly discovered relationships, an extraction model is required to mapped existing model with newly discovered relations.

(e) **Validity estimation of facts in KGs**

Reliability of Automated knowledge graphs is directly proportional to the sources used for facts extraction. In this process the correctness of information supplied by multiple sources plays a major role. If a given source contains stale/ incorrect information, the result will be incorrect knowledge base construction. Using such incorrect knowledge base will affect the performance of the knowledge graphs so techniques need to be developed to estimate validity of facts.

References

1. Friedman A (1979) Framing pictures: the role of knowledge in atomized encoding and memory for gist. J Exp Psychol 108:316–355
2. Sowa JF (2006) Semantic networks. In: Encyclopedia of cognitive science, pp 123–135
3. Auer S, Bizer C, Kobilarov G, Lehmann J, Cyganiak R, Ives ZG (2007) DBpedia: a nucleus for a web of open data. In: The Semantic Web, 6th International semantic web conference, ISWC/ASWC 2007:722–735, 2nd Asian semantic web conference, ISWC 2007 + ASWC 2007, Busan, Korea, 11–15 November 2007
4. Suchanek F, Kasneci G, Weikum G (2007) Yago: a core of semantic knowledge. In: Proceedings of the 16th international conference on world wide web. ACM, New York, pp 697–706
5. Lenat DB (1995) CYC: a large-scale investment in knowledge infrastructure. Commun ACM 38:32–38

6. Carlson A, Betteridge J, Kisiel B, Settles B, Hruschka Jr ER, Mitchell TM (2010) Toward an architecture for never-ending language learning. In: Proceedings of the 24th AAAI conference on artificial intelligence, AAAI 2010, Atlanta, Georgia, US, pp 1306–1313
7. Dong X, Gabrilovich E, Heitz G, Horn W, Lao N, Murphy K, Strohmann T, Sun S, Zhang W (2014) Knowledge vault: a web-scale approach to probabilistic knowledge fusion. In: Proceeding SOF the 20th ACM SIGKDD international conference on knowledge discovery and data mining, New York, NY, USA. ACM, pp 601–610
8. Etzioni O, Fader A, Christensen J, Soderland S, Mausam M (2011) Open information extraction: the second generation. In: Proceedings of the twenty-second international joint conference on artificial intelligence, Barcelona, Catalonia, Spain, vol 18. AAAI Press, pp 3–10
9. Mintz M, Bills S, Snow R, Jurafsky D (2009) Distant supervision for relation extraction without labeled data. In: Proceedings of the Joint Conference of the 47th annual meeting of the ACL and the 4th international joint conference on natural language processing of the AFNLP, ACL 2009, vol 2. Association for Computational Linguistics, Stroudsburg, pp 1003–1011
10. Nickel M, Murphy K, Tresp V, Gabrilovich E (2015) A review of relational machine learning for knowledge graphs. In: Proceedings of IEEE transactions on, vol 104, no 1

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Application and Impact of Power System Optimization on Non Linear Problem

Sadaf Qasim and Geetika Pandey

Abstract There are several methods have been presented to eliminate and obtain the optimized value of a given function in power system optimization. The main goal of all these issues is to minimize the required effort or maximized the benefit desired in any practical situation. The literature on Engineering Optimization is vast and diverse [2]. Energy power systems can easily be seen at its peak level in all the sectors which involve the generation of power system to transmission of energy and finally its distribution is the major issue [1]. With the increase in the usage of electric system, there can be seen a huge rise in complexity in the system. And likewise the utility of planning in generation came into focus and cannot be ignore. Thus there is an interconnection between the system which involve transmission and utility system [7].

Keywords Optimization · Nonlinear · Elimination technique · Decision variable · Optimality

1 Introduction (Optimization)

Optimization may be defined as the act of getting the best optimizing result within the given limit of constraint. Figure 1, we can observe that the minimum and maximum value of any function in both positive and negative value is same for the optimizing point. Thus we can find the maximum of any function simply by evaluating the minimum of that function [2, 6].

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_77

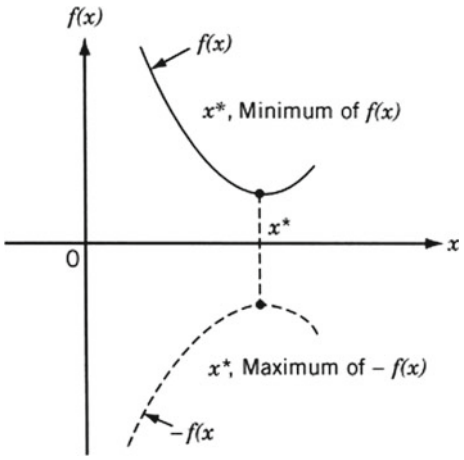

Fig. 1 Optimised point of two function in positive and negative circumstances

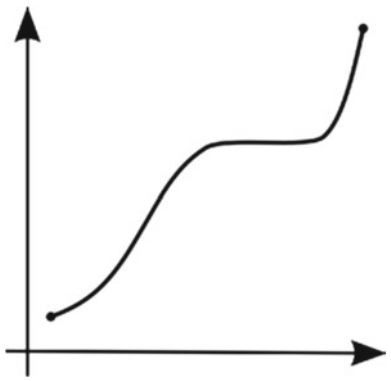

Fig. 2 Monotonically increasing function

1.1 Unimodality

A unimodal function is one in which the function is said to be unimodal if and only if for some value n, the function is increasing for $x \leq n$ i.e. contains the maximum peak and monotonically decreasing for $x \geq n$ i.e. contains minimum valley. In that case, the maximum of f(x) is same as that of f (n) and there are no local maxima in that region.

A function is said to be increasing or decreasing if for any values of x and y, $x \leq y$ such that $f(x) \leq f(y)$ (see Fig. 2), then is it monotonically increasing. And similarly if $x \leq y$ such that $f(x) \geq f(y)$ (see Fig. 3), then is it monotonically decreasing.

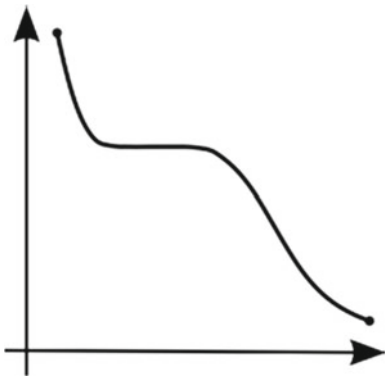

Fig. 3 Monotonically decreasing function

1.2 Non Linear programming: One Dimensional Minimization Methods

Optimization of any problem involves the main objective function and different problem of constraints are too difficult to calculate, than they are hard to find it with the classical analytical methods. The optimality of any the objective function can be determined by the optimal values of that function. This can be done with the help of numerical methods [8].

They are classified as follows:

1. *Methods of Elimination*
   (a) Unrestricted Method Search
   (b) Exhaustive Method Search
   (c) Dichotomous Method Search
   (d) Interval Halving Method Search
   (e) Fibonacci Method Search
   (f) Golden Method Search
2. Interpolation Methods

2 Implementation of Methods in the Field of Optimization

2.1 Unrestricted Search

The optimum value of any objective function is known to lie in the ranges of the design variables. But in some cases it is known to have no restriction [4].

- Fixed Step Size
- Accelerated Step Size

2.2 Exhaustive Method Search

The exhaustive method of search is basically meant to calculate those value which lie in the interval limits which act as constraint of the function. Consider X_s and X_f, respectively, be the start and destination points of uncertainty in the interval given [1].

The exhaustive method of search may have determination of objective main function at a point that are previously define by the number of several points which are at equal interval of time within the interval (X_s, X_f), and resultant interval of uncertainty may consist to have the approximation of unimodality.

The final interval is given by for finding uncertainty (Fig. 4):

$$L_n = \frac{2}{n+1} L_0$$

Where $L_0 = X_f - X_s$

2.3 Dichotomous Search Method

In the dichotomous search method, we deal with experiments of two that are close enough at the center of the uncertainty interval [1]. And by seeing that the values of the objective at those two points, the uncertainty interval are eliminated. Consider experiments with two numbers as follow (Fig. 5):

$$x_1 = \frac{L_o}{2} - \frac{\delta}{2}$$

$$x_2 = \frac{L_o}{2} + \frac{\delta}{2}$$

where δ is a small value. Then the new interval of uncertainty is given by (Table 1),

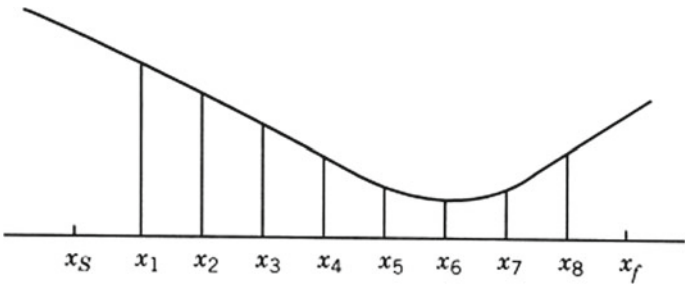

Fig. 4 Exhaustive search

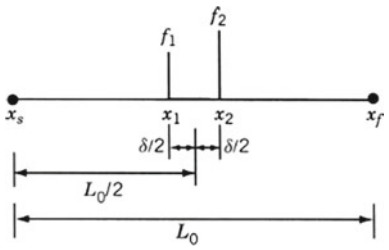

Fig. 5 Dichotomous search method

Table 1 New interval of uncertainity

Experiments set	Uncertainty at final interval
2	$\frac{1}{2}(L_0+\delta)$
4	$\frac{1}{2}\left(\frac{L_0+\delta}{2}\right)+\frac{\delta}{2}$
6	$\frac{1}{2}\left(\frac{L_0+\delta}{4}+\frac{\delta}{2}\right)+\frac{\delta}{2}$
…	……..
n	$L_n=\frac{L_o}{2^{n/2}}+\delta\left(1-\frac{1}{2^{n/2}}\right)$

$$\frac{L_o}{2}+\frac{\delta}{2}$$

2.4 Method of Interval Halving for Search

In this method of interval halving, we have to make exactly half of the uncertainty interval given and then the limit is eliminated at every new level. It requires three points of approximation in the initial stage and two points of approximation in subsequent of each stage.

At the end of n experiments is given by,

$$L_n=\left(\frac{1}{2}\right)^{n-1/2}L_o$$

2.5 Fibonacci Method

The Fibonacci method is used to find the minimum value of function which is not even continuous. This method has certain limitations to follow (Fig. 6):

- Optimum of initial interval should be defined.
- The function has to be unimodal
- Specified number of specification.

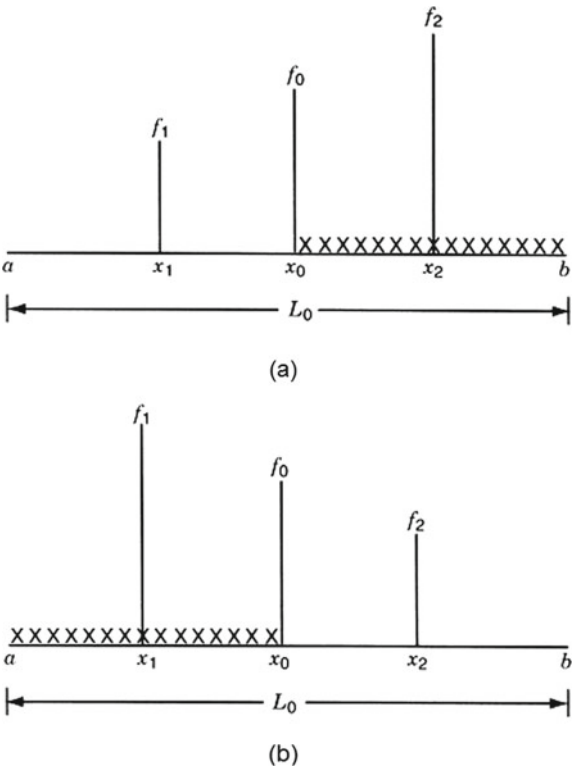

Fig. 6 (a) $f_2 > f_0 > f_1$, (b) $f_1 > f_0 > f_2$

This method can be used by taking the sequence pattern of Fibonacci series numbers, [F_n], for taking the value in the experiments.

Here

$$F_0 = F_1 = 1$$

$$F_n = F_{n-1} + F_{n-2} \qquad n = 2, 3, 4, 5, 6\ldots$$

Therefore,

$$F_n = 1, 1, 2, 3, 5, 8, 13, 21, 34, 55\ldots.$$

Let L_0 = initial interval of uncertainty within $a \leq x \leq b$
n = total number of experiments.

$$L_{2^*} = \frac{F_{n-2}}{F_n} L_0$$

where L_{2^*} is a distance located from two point of approximation, X_1 and X_2.

$$X_1 = a + L_{2^*} = a + \frac{F_{n-2}}{F_n} L_0$$

$$X_2 = b - L_{2^*} = b - \frac{F_{n-2}}{F_n} L_0 = a + \frac{F_{n-1}}{F_n} L_0$$

With the help of unimodality assumption, we will discard some part of interval.

Hence we get new interval for every step and which gives close value for optimality. For j^{th} experiment:

$$L_{j^*} = \frac{F_{n-j}}{F_{n-(j-2)}} L_{j-1}$$

The following relation gives the value of n:

$$\frac{L_n}{L_o} = \frac{F_1}{F_n} = \frac{1}{F_n}$$

2.6 Golden Section Method

This Golden Section Method is very similar to Fibonacci method. Here the experiment which is to be conducted has to perform at the beginning. This is not done in the golden section method. In the golden section method assumption is made before hand and then we can obtain numbers of experiments [3].

This can be calculated as follow:

$$L_2 = \lim_{n\to\infty} \frac{F_{n-1}}{F_n} L_0$$

$$L_3 = \lim_{n\to\infty} \frac{F_{n-2}}{F_n} L_0 = \lim_{n\to\infty} \frac{F_{n-2}}{F_{n-1}} \frac{F_{n-1}}{F_n} L_0$$

$$\simeq \lim_{n\to\infty} \left(\frac{F_{n-1}}{F_n}\right)^2 L_0$$

Table 2 Uncertainty of function at final intervals

Experiment	Logic	N for value 5	N for value 10
Exhaustive	$L_n = \frac{2}{n+1} L_0$	0.33454 Lo	$0.182822 L_o$
Dichotomous search (δ = 0.01 and n = even	$L_n = \frac{L_o}{2^{n/2}} + \delta\left(1 - \frac{1}{2^{n/2}}\right)$	$\frac{1}{4} L_o + 0.0075$ with n = 4 $\frac{1}{8} L_o + 0.00875$ with n = 6	0.03125 Lo + 0.0096875
Interval halving method (n $\geq$ 3 and odd)	$L_n = \left(\frac{1}{2}\right)^{(n-1)/2} L_o$	$0.25 L_o$	$0.0625 L_o$ with n = 9 $0.3125 L_o$ with n = 11
Fibonacci search	$L_n = \frac{1}{F_n} L_o$	$0.125 L_o$	$0.01124 L_o$
Golden section	$L_n = 0.618^{n-1} L_o$	$0.1459 L_o$	$0.01315 L_o$

The generalized form can be expressed as

$$L_k = \lim_{n \to \infty} \left(\frac{F_{n-1}}{F_n} \right)^{k-1} L_0$$

$$\gamma = \lim_{n \to \infty} \frac{F_n}{F_{n-1}}$$

Or this can be written as (Table 2),

$$\gamma \simeq \frac{1}{\gamma} + 1$$

Or, $\gamma^2 - \gamma - 1 = 0$

$$L_k = \left(\frac{1}{\gamma} \right)^{k-1} L_0$$

3 Interpolation Method

The interpolation methods aim to develop with the orientation as method of one-dimensional in searches with the constraint of multivariable techniques of optimization. It is more useful and efficient than Fibonacci Search method [6].

The basic principle of all the minimization technique using one-dimensional method is to find X*, for which the function (Table 3).

Table 3 For specified accuracy

Method	Error: $\frac{1}{2}\cdot\frac{L_n}{L_o} \leq 0.1$	Error: $\frac{1}{2}\cdot\frac{L_n}{L_o} \leq 0.01$
Exhaustive Method Search	n ≥ 9	n ≥ 99
Dichotomous Method Search (δ = 0.01 and Lo = 1)	n ≥ 6	n ≥ 14
Interval Halving Method (n ≥ 3)	n ≥ 7	n ≥ 13
Fibonacci Search	n ≥ 4	n ≥ 9
Golden Section	n ≥ 5	n ≥ 10

3.1 Quadratic Method

In this quadratic method, only the function values is used therefore this is very useful for finding the various step involved in pointing out the optimized point or we can say minimizing the functions f (X) at (x*) in which partial derivatives w.r.t. the variables Xi are not available. Three step are involved in finding the minimized step length x*. In the step two, the approximated value of function p(x) and the minimum of p(x), ˜x*, is found. If ˜x* is not found to be sufficient close enough than step three will be taken [5].

Hence at this point a new approximation of quadratic function is $p'(x) = a' + b' x + c'x^2$ is used to accomplish the function f (x), and a new value of ˜x* is taken out. Hence the process is further continued unless the value ˜x∗ is sufficiently close to x* framed.

Let us suppose a quadratic equation as given below be approximating function of f(x).

$$p(x) = a + bx + cx^2$$

Than necessary condition for minimum of p(x) is

$$\frac{\mathrm{dp}}{\mathrm{dx}} = \mathrm{b} + 2\mathrm{cx} = 0$$

i.e.

$$\tilde{\mathrm{x}}^* = \frac{-\mathrm{b}}{2\mathrm{c}}$$

For sufficient condition,

$$\frac{d^2p}{dx^2} \geq 0$$

To find the value of a, b, c, calculate f(x) at three points. Let us suppose A, B, C be points at which function need to be calculated. Then,

$$f_{x_1} = a + bx_1 + cx_1^2$$

$$f_{x_2} = a + bx_2 + cx_2^2$$

$$f_{x_3} = a + bx_3 + cx_3^2$$

Therefore, our task is to find the values of a, b, c because these are the coefficient of p(x),

$$a = \frac{f_{x_1} x_2 . x_3 (x_3 - x_2) + f_{x_2} x_1 . x_3 (x_1 - x_3) + f_{x_3} x_2 . x_1 (x_2 - x_1)}{(x_1 - x_2)(x_2 - x_3)(x_3 - x_1)}$$

$$b = \frac{f_{x_1} \left(x_2^2 - x_3^2\right) + f_{x_2} \left(x_3^2 - x_1^2\right) + f_{x_3} \left(x_1^2 - x_2^2\right)}{(x_1 - x_2)(x_2 - x_3)(x_3 - x_1)}$$

$$c = \frac{f_{x_1} ((x_2 - x_3) + f_{x_2} (x_3 - x_1) + f_{x_3} (x_1 - x_2)}{(x_1 - x_2)(x_2 - x_3)(x_3 - x_1)}$$

Then, minimum value of p(x) is calculate as (Fig. 7, Table 4),

$$\tilde{\mathrm{x}}^* = \frac{-b}{2c}$$

$$\tilde{\mathrm{x}}^* = \frac{\mathrm{f}_{\mathrm{x}_1} \left(\mathrm{x}_2^2 - \mathrm{x}_3^2\right) + \mathrm{f}_{\mathrm{x}_2} \left(\mathrm{x}_3^2 - \mathrm{x}_1^2\right) + \mathrm{f}_{\mathrm{x}_3} \left(\mathrm{x}_1^2 - \mathrm{x}_2^2\right)}{2[\mathrm{f}_{\mathrm{x}_1} (\mathrm{x}_2 - \mathrm{x}_3) + \mathrm{f}_{\mathrm{x}_2} (\mathrm{x}_3 - \mathrm{x}_1) + \mathrm{f}_{\mathrm{x}_3} (\mathrm{x}_1 - \mathrm{x}_2)]}$$

3.2 Cubic Interpolation Method

This cubic interpolation method is different from quadratic interpolation method. It finds the minimization of step length x* in four different steps. It uses the derivative of the function f as follows:

$$f(\lambda) = \frac{df}{d\lambda} = \frac{df(X + \lambda S)}{d\lambda}$$

Here we suppose a cubic equation as given below be approximating function of f (x).

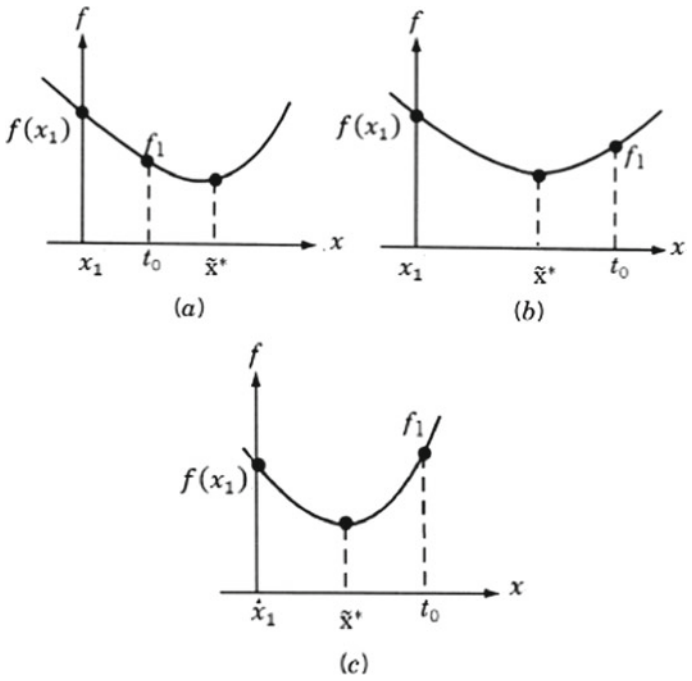

Fig. 7 Possibilities when function is evaluated at x* = t_o, $(a) f_1 < f_{x_1}$ *and* $t_o < \tilde{x}^* (b) f_1 \langle f_{x_1}$ *and* $t_o \rangle \tilde{x}^*, (c) f_1 > f_{x_1}$ *and* $t_o > \tilde{x}^*$

Table 4 Refitting scheme

S. No	Characteristic	New points of refit	
		New	Old
1	$\tilde{\mathbf{x}}^* > \mathbf{x}_2$ $\tilde{f} < f_{\mathbf{x}_2}$	$\boldsymbol{x}_1$ $\boldsymbol{x}_2$ $\boldsymbol{x}_3$ Neglect old $\boldsymbol{x}_1$	$\boldsymbol{x}_2$ $\tilde{\mathbf{x}}^*$ $\boldsymbol{x}_3$
2	$\tilde{\mathbf{x}}^* > \mathbf{x}_2$ $\tilde{f} > f_{\mathbf{x}_2}$	$\boldsymbol{x}_1$ $\boldsymbol{x}_2$ $\boldsymbol{x}_3$ Neglect old $\boldsymbol{x}_3$	$\boldsymbol{x}_1$ $\boldsymbol{x}_2$ $\tilde{\mathbf{x}}^*$
3	$\tilde{\mathbf{x}}^* < \mathbf{x}_2$ $\tilde{f} < f_{\mathbf{x}_2}$	$\boldsymbol{x}_1$ $\boldsymbol{x}_2$ $\boldsymbol{x}_3$ Neglect old $\boldsymbol{x}_3$	$\boldsymbol{x}_1$ $\tilde{\mathbf{x}}^*$ $\boldsymbol{x}_2$
4	$\tilde{\mathbf{x}}^* < \mathbf{x}_2$ $\tilde{f} > f_{\mathbf{x}_2}$	$\boldsymbol{x}_1$ $\boldsymbol{x}_2$ $\boldsymbol{x}_3$ Neglect old $\boldsymbol{x}_1$	$\tilde{\mathbf{x}}^*$ $\boldsymbol{x}_2$ $\boldsymbol{x}_3$

$$p(x) = a + bx + cx^2 + x^3$$

Or we can say if f(x) is any minimum function within the limit [a, b], then the approximated polynomial function is given by,

$$p(x) = a_o + a_1(x - x_1) + a_2(x - x_1)^2 + a_3(x - x_1)^3$$

And the value of a, b, c are calculated by the relations:

$$p(x_1) = f(x_1)$$

$$p(x_2) = f(x_2)$$

$$p'(x_1) = f'(x_1)$$

$$p'(x_2) = f'(x_2)$$

The condition which is applied to this method is given by the expression,

$$p''(x^*) > 0$$

Such that, $x^* = x_1 + \frac{(-a_1)}{\left(a_2 + \sqrt{a_2^2 - 3a_{1a_3}}\right)}$

4 Conclusion

Power system consist of planning and scheduling of operation that provide many important and crucial problems which require decision making, are normally stated in industrial scale, continuous, non-convex, non-linear, and also sometimes may conclude in chaotic optimization type problems.

We have seen in this that the problem been faced in nonlinear system focus on formulation and decision of multistage problem of which are in the category of optimization problems with the use of power, and aims to develop more effectively the useful involvement of research scholar in applied science and electrical which indulge the importance and enhances the generation of defining and sorting the effective way for upgrading these problems [2].

And simultaneously, we end up having the clear view for investments in somehow more focused way with the use of advanced information technologies. The different methods discussed and studied here help you to solve the function and optimized in more advance way [5].

References

1. Zimmerman R (2011) MATPOWER Steady-state operations C. Murillo-S´anchez, and R. Thomas., planning, and analysis tools for power systems research and education. IEEE Trans Power Syst 99:1–8
2. Ghaddar B, Marecek J, Mevissen M (2014) Optimal power flow as a polynomial optimization problem. IBM Research Ireland, Tech. Rep. http://arxiv.org/abs/1404.3626
3. Leyffer S, Linderoth J (2005) Mixed integer nonlinear programming (MINLP). In Informs Annual Meeting, San Francisco
4. Oren SS, Svobada AJ, Johnson RB (1997) Volatility of unit commitment in competitive electricity markets. In: Proceedings of the thirtieth annual hawaii international conference on system sciences; Hawaii
5. Rockafellar RT, Wets RJ-B (1991) Scenarios and policy aggregation in optimization under uncertainty. Math Oper Res 16(1):119–147
6. Low SH (2014) I: Convex **Relaxation** of Optimal Power Flow — Part I: Formulations. IEEE Trans Control Network Syst 1(1):15–27
7. Optimization, India: Prentice-hall of India Pvt Ltd
8. Gungor VC, Sahin D, Kocak T, Ergut S, Buccella C, Cecati C, Hancke GP A Survey on Smart Grid Potential Applications and Communication Requirements
9. Zeng B, Zhao L (2013) Solving two-stage robust optimization problems using a column-and-constraint generation method. Oper Res Lett 41(5):457–461

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Compressive Sensing and Contourlet Transform Applications in Speech Signal

Korla Ramya, Vijayasri Bolisetti, Durgesh Nandan, and Sanjeev Kumar

Abstract This paper explains a new method for performing two different processes compact and encode in a single algorithm. Speech compression is the way toward changing over discourse signals into a structure that is neatly packed so it has good quality in performance for correspondence and capacity by minimizing the dimensions of the data without losing the information standard (quality) of the original speech. On the other hand Speech encryption is the process of converting usual formal into an unrecognized format to give security to the data across an insecure channel in the transmitter. These two processes can be achieved by a compressive sensing algorithm. In addition to compressive sensing, the transformation of the outline is advantage to demonstrate the compressive sensing concept. It is a two-dimensional transform method for image representations. Contourlet transform plays an important for representing the sparse signals in the signal.

Keywords Basic pursuit · Compressive sensing · Contourlet transform · Compression · Encryption · Matching pursuit · Orthogonal matching pursuit

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_78

1 Introduction

Speech is by its nature a communication signal and is a significant means for face to face and telephone apps. It is generally the procedure that decreases the size of the information in a particular way without losing the value of the initial information. The compression concept being is used to convey the sound signal to the recipient. Compression algorithms are mainly aimed at removing undesirable information. This takes less time and space to save the data in your memory. The information is transferred via secure communication channels using the compression method so that the user must safeguard the information.

Therefore encryption process is used to provide security to the data by converting the normal alignment of data format into random alignment of data. Hence, the encryption process plays a vital role in communication. To perform compression and encryption process two separate algorithms (methods) are used. This article is going to describe the extent to which the both procedures are performed in the same principle. It can also be called sparse sampling or compressive sampling [1]. Compressive sensing is a theory that goes beyond the traditional method. This method is mainly used to acquire and is below the Nyquist speed for compressed signals and then the reconstruction process is performed [2, 3]. Compressive sensing involves both sampling and compression processes along with the encryption process. These three processes are very important for nowadays communication [4]. The main applications of the compressive sensing principle are, it requires less time, less sampling rates and less use of analog to digital converters [4]. Compressive sensing develops the signal by considering only a few random measurements so there is no need to take too many samples [5, 6]. In addition to compression sensing, Contourlet transform (2-dimensional transform methods) is also used to get the smooth representation of shapes and boundaries of the images. By using the Contourlet transform, the construction of images results in local and directional image expansion using segments [7].

2 Literature Review

For image coding, there is a technique called the Laplacian Pyramid. By using this technique, the filtered copies have been deleted by subtracting low pass. The Laplacian pyramid has many attractive features in image processing [8–10]. The Shannon/Nyquist sampling theorem was introduced to transmit the data without losing the original information. But this theorem results in a high Nyquist rate to an excessive number of samples that have occurred in the transmission process. So to avoid this problem, a new technique is proposed to represent a frequency less than the Nyquist average for compressible signals. It is known as compressive sensing [1, 11, 12]. The actual process of Compressive sensing makes use of inappropriate linear projections containing the signal structure. The signal is rebuilt utilizing these

predictions. Therefore, by making use of this procedure converting sampling signals into digital numeric values is more efficient. For the reconstruction of signal in compressive sensing, squares optimization is not sufficient, so that effective use of convex optimization must be involved [2, 4, 6].

In compressive sensing, the matching pursuit (MP) technique is used for signal recovery of sparsely or scattered signals. Matching pursuit is an iterative algorithm. The efficient and effective use of coding and the quality of an image can be achieved through the corresponding pursuit. MP signal is an important method for recovering the compressed (encoded) signal along with the representation of the linear model. So that compressive sensing is possible for sparsely excited signals such as speech. The signal recovery produced by the matching pursuit is also used for speech recognition [5]. The extension of the MP technique is the Orthogonal Matching Pursuit algorithm.

Orthogonal Matching Pursuit (OMP) is another method used in compressive sensing for recovering the signal from random measurements. It is a greedy algorithm that makes the use of the best ideal option at each tiny level to ultimately achieve an ideal solution worldwide. The algorithm thus provides the best way to solve the issue. Compared to previous results, this method has immense improvement. Orthogonal matching pursuit results are comparable with the approach of basic pursuit (BP). OMP process is easy to effectuate and an appealing alternative to fundamental signal retrieval efforts. The theoretical work on this method proves that OMP is an efficient algorithm for signal recovery from random measurements [7, 13, 14]. OMP is used only when the scattered or sparse signals are on the orthogonal basis, if the sparse signals are in redundant dictionaries then the method basic pursuit must be invoked. Basic pursuit is a method to decompose a signal into an optimum dictionary element superposition. In addition to BP, another algorithm called thresholding is used for signal recovery in compressed sensing. BP method can reconstruct the signal with high probability. Hence, compressed sensing is also suitable for the sparse signals in redundant dictionaries. The threshold algorithm is the fastest reconstruction method than basic pursuit. Because BP relies on the proportion between the highest and lowest coefficients, unlike the threshold algorithm. So future work has to be performed for BP [15–17]. Sparse solutions to the equations require various issues in signal processing. So to avoid those problems, Gradient projection algorithms are introduced. By using this method, quadratic programming in compressed sensing and various inverse problems are solved [18]. Another principle is implemented for signal reconstruction from incomplete frequency sections [19].

By predicting the brightness of speech, the achievement of multiple objective measures is estimated by noise suppression methods. There are seven objective measures and they are segmental SNR (segSNR), weighted-slope spectral distance (WSS), perceptual evaluation of speech quality (PESQ), LPC, Itakura-Saito distance measure, cepstrum distance measure (CEP) and frequency-weighted segmental SNR (fwsegSNR). A technique is used to assess the excellence of the improved communication in three aspects: signal contortion, noise contortion and general quality. A combination of individual objectives measures proposes various

fresh composite measures. The correlation coefficient of PESQ is increased. The segSNR measure results in a less correlation coefficient. Out of the seven objective measures only PESQ, LLR and fwsegSNR are resulting in better speech enhancement [20].

For sparse representation, there is a new two-dimensional approach called Contourlet transform, which results in the exact representation of sparse images in two-dimensional geometry [21, 22]. Sparsity representation of signals play a major role in compression, sampling and in the analysis of the signal [23]. Sparsity can be compared based on six criteria. They are

1. Robin Hood- It defines that only a few of the coefficients contain the most energy. So it decreases sparseness.
2. Scaling- This method specifies that sparsity is a scale-invariant. It means when it is multiplied by a common factor, the objects or laws do not change.
3. Rising Tide- It establishes that the sparsity can be reduced by adding a constant to each coefficient. This implies that multiplicative or additive constants do not alter to sparsity.
4. Cloning- Cloning describes several different processes that can be used to produce an identical result. Sparsity does not change under cloning.
5. Bill Gates- Increases the sparsity.
6. Babies- Increases the sparsity.

So we can measure sparsity from any of these six criteria [23, 24].

The purpose and usage of digital information have increased rapidly from the past decades. Audio Compression is used for encoding the audio data which requires only lower storage and lower transmission bandwidth. The algorithm successfully compressed the audio which consists of speech signal [25].

3 Methodology

Compressive sensing is an emerging technique to synchronize and compress the dispersed signal. The signals are sampled under the Nyquist rate by using compressive sensing. The compressive sensing block diagram is shown below (Fig. 1).

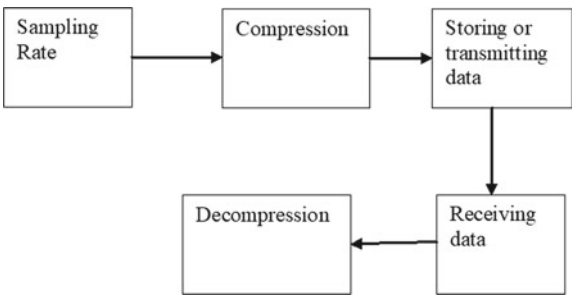

Fig. 1 Block diagram of compressive sensing

There are many solutions for the estimation of sparsity such as Matching Pursuit (MP), the Basic Pursuit (BP) and Gradient Pursuit (GP). The speech signal is time-variant. A constant signal with frame duration should, therefore, be generated. Then to obtain sparse vectors for the individual frame, some techniques are used they are Fast Fourier Transform (FFT), Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT) and Contourlet Transform (CT). Out of all techniques, Contourlet transform shows many spares. Hence Contourlet Transform is selected for the sparse representation. The transformation Contourlet is one of the latest statistical transformations of data in 2D and can quickly constitute contours and textures of 2D elements. There is a phase of sub band degradation and directional transformation in this transformation based on curve lets. Contourlet transform is built using a Laplacian pyramid and directional filter banks. In a decomposition phase, directional filter banks are used to decompose 2D information and generate directional forms.

Laplacian pyramid decomposes the data into the band of low passes and high passes. The frequency spectrum is obtained by applying directive filter banks to the high pass parts. So that Countourlet transform contains many levels and at each level, there are several different directions. It can capture edges that exist in the speech signals. In a high compression ratio, the transformation Contourlet shows elevated efficiency. Now the proposed algorithm is a step by step procedure. The Steps involved in the algorithm is

1. The frames which are obtained from the speech file is arranged in a specific way to convert the speech into 2D data. So this 2D is used by Contourlet transform.
2. The sparse structure of the 2D data is acquired by using contourlet transform as the transfer domain and the information are generated by the compressive sensing principle.
3. Now the encryption and compression processes should be performed by the algorithm compressive sensing in a single step.
4. The compression process is done by eliminating the unwanted part in the signal and size reduction of the data by considering only important samples.
5. The encryption process is Gaussian independent and has the isometric property probability limited. RIP condition leads to the performance of sparse vector reconstruction.
6. A minimization algorithm is used at the receiver for the sparse vector depiction.
7. All the steps above are performed on the opposite side of the transmitter.

The suggested method of the algorithm takes the above measures (Fig. 2).

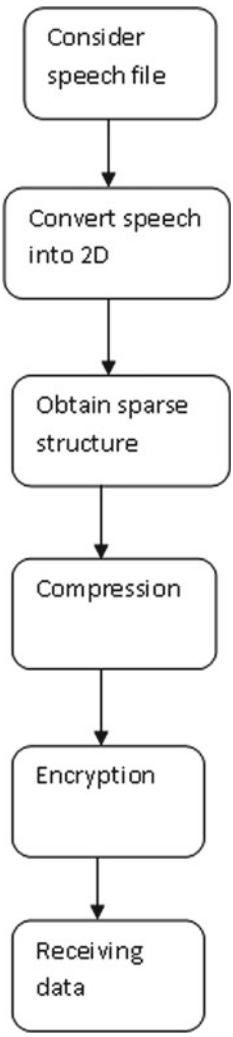

Fig. 2 Diagram of contourlet transform

4 Applications

The compressive sensing field covers several subjects in the field of signal processing and computes mathematical processing, including undefined linear systems, group testing, heavy hitters, thin coding. Some of the main compressive sensing applications are

Table 1 Continuous speech results

Compression ratio	Signal to noise ratio (dB)	Segmental spectral signal to noise ratio	Mean square error
80%	13.43	−26.76	0.00019
60%	9.14	−20.03	0.0004
50%	6.89	−22.38	0.0006
40%	4.23	−24.90	0.0011
30%	3.45	−24.45	0.0013
20%	1.37	−24.77	0.0021

1. Mobile phone camera sensor uses compressed sensing for photography
2. Compressed sensing can be used to enhance picture holography by increasing the number of voxels that a single hologram can infer.
3. Facial recognition
4. In image processing
5. Network applications
6. Infrared cameras
7. Radio astronomical opening synthesis
8. Microscopy of the electron

5 Result

The measure SSSNR in the table provides residual intelligibility as encryption strength while the remainder gives the quality of the reconstructed CR speech as a parameter (Table 1).

6 Conclusion

Before introducing a compressive sampling method, signals are produced greater than or equal to the Nyquist rate. So we can conclude that by using a compressive sensing algorithm a signal is produced under the Nyquist rate. And for the sparse representations, the techniques like matching pursuit, orthogonal matching pursuit, and basic pursuit possess some disadvantages so we go for Contourlet transform. Contourlet transform is the best method for the representation of images. Therefore Contourlet transform and compressive sensing are used for encryption and compression in single-phase algorithms.

References

1. Al-Azawie MKM, Gaze AM (2016) Combined speech compression, and encryption using contourlet transform and compressive sensing. Int J Comput Appl (0975 – 8887) 140(5)
2. Candes EJ, Wakin MB (2008) An introduction to compressive sampling. IEEE Sig Process Mag 21–30
3. Candes EJ, Wakin MB (2008) An introduction to compressive sampling. In: IEEE signal processing techniques, University Purdue, Electrical and computer engineering
4. Baraniuk RG (2007) Compressive sensing. IEEE Sig Process Mag 24:118–121
5. Sreenivas TV, Kleijn WB (2009) Compressive sensing for sparsely excited speech signals. In: IEEE international conference on acoustics, speech, and signal processing, pp 4125–4128
6. Donoho DL (2006) Compressed Sensing. IEEE Trans Inf Theory 52:1289–1306
7. Tropp JA, Gilbert AC (2007) Signal recovery from random measurements via orthogonal matching pursuit. IEEE Trans Inf Theory 53:4655–4666
8. Burt PJ, Adelson EH (1983) The Laplacian pyramid as a compact image coder. IEEE Trans Commun 31(4):532–540
9. Shi C, Bhargara B (1998) Fast MPEG video encryption algorithm. Department of Computer Sciences, Purdue University
10. Do M, Vetterli M (2002) Contourlets. In: Stoeckler J, Welland GV (eds.) Beyond wavelets. Academic Press, pp 1–27
11. Donoho DL, Vetterli M, DeVore RA, Daubechies IC (1998) Data compression and harmonic analysis. IEEE Trans Inf Theory 44(6):2435–2476
12. Fuchs JJ (2002) On sparse representation in arbitrary redundant bases. IEEE Trans Inf Theory 50(6):1341–1344
13. Baron D, Wakin MB, Duarte M, Sarvotham S, Baraniuk RG (2005) Distributed compressed sensing. http://dsp.rice.edu/cs/DCS112005.pdf
14. Aharon M, Elad M, Bruckstein A (2006) K-SVD: an algorithm for designing of overcomplete dictionaries for sparse representation. IEEE Trans Sig Process 54(11):4311–4322
15. Rauhut H, Schnass K, Bandergheynst P (2008) Compressed sensing and redundant dictionaries. IEEE Trans Inf Theory 54:2210–2219
16. Elad M, Bruckstein AM (2002) A generalized uncertainty principle and sparse representations in pairs of bases. IEEE Trans Inf Theory 49(9):2558–2567
17. Akcakaya M, Tarokh V (2008) A frame construction and a universal distortion bound for sparse representations. IEEE Trans Sig Process 56(6):2443–2450
18. Figueiredo MAT, Nowak RD, Wright SJ (2007) Gradient projection for sparse reconstruction. IEEE J Sel Top Sig Process 1:586–597
19. Candes E, Romberg J, Tao T (2006) Robust uncertainty principles: exact signal reconstruction from highly incomplete frequency information. IEEE Trans Inf Theory 52:489–509
20. Hu Y, Loizou P (2008) Evaluation of objective quality measures for speech enhancement. IEEE Trans Speech Audio Process 16(1):229–238
21. Do MN, Vetterli M (2003) Contourlets. In: Beyond wavelets. Academic Press, New York
22. Dick C, Harris F (2000) FPGA signal processing using sigma-delta modulation. IEEE Sig Process Mag 17(1):20–35
23. Candès E, Tao T (2006) Near optimal signal recovery from random projections: universal encoding strategies. IEEE Trans. Inform. Theory 52:5406–5425

24. Hurley N, Rickard S (2009) Comparing measures of sparsity. IEEE Trans Inf Theory 55:4723–4741
25. Zanartu M (2005) Audio compression using wavelet techniques. University Purdue, Electrical and computer engineering

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An Overview of Fog Computing

Jagadeeswari Sambangi, Parvateesam Kunda, Durgesh Nandan, and Sanjeev Kumar

Abstract All know that cloud computing is used for the processing, analyzing and storage of data from the client devices or networks. After the evolution of IoT technology the data generated in large scale ad this can be handled with only cloud computing, moreover more than 45 billion IoT devices by the year of 2021 because of this change the present cloud computing network technique is not sufficient to handle that large amount of data due to its volume, latency and huge bandwidth requirements. The present Fog computing model is used to control all the concerns faced by Cloud computing.

Keywords Cloud computing · Edge computing · IoT devices · Smart things · Fog computing

1 Introduction

Haze registering is a decentralized figuring framework wherein information, process, stockpiling and applications are discovered someplace shut to the information/data source and the cloud. This is critical to take note of that haze frameworks organization supplements - not supplant - distributed computing; a rite of passage licenses for present minute assessment at the edge, and the cloud achieves resource

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_79

elevated longer-period assessment. Meanwhile, edge contraptions and sensors are the place data is made and accumulated, they once in a while don't have the procedure and limit advantages for performing advanced assessment and AI procedures. Despite how that cloud servers can do these; they are as much of the time as conceivable too much far away to development the information and react rapidly. Similarly, having every one of endpoints cooperate with and sending rough information to the spread over the system can have affirmation, security, and legal repercussions, especially when administering delicate information matter to rules in different countries. Realized haze preparing applications consolidate brilliant network, sharp city, savvy structures, vehicle frameworks, and programming portrayed frameworks [1, 19].

Haze processing is a model that holds out Cloud figuring and organizations to the edge of the system. Like Cloud, it offers records, processes, and collecting and usage administration to quit-clients. By this, we can analyze the applications in real situations, similar to keen grids, smart traffic in vehicular and networks in programming. By a case of a confirmation, the model is acquainted with the location of the security situation where the association among cloud and fog. Cisco beginning late passed on the vision of Fog preparing to approve purposes on billions of related gadgets, definitively associated with the Internet of Things (IoT), to run unmistakably at the system frame [3–6] (Fig. 1).

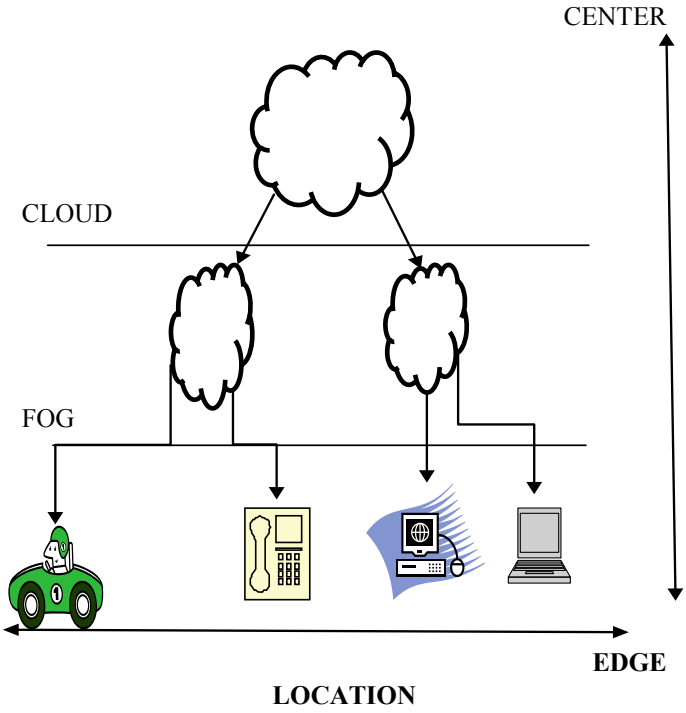

Fig. 1 Fog in the middle of the cloud and edge

From the above Figure, smart things are connected to Fog devices. Devices with fog could be interrelated, and each of them is conjugated to the cloud. Thus, we inspect the condition of state of skill and uncover some broad issues/problems in Fog registering, for example, administration movement among Fog gadgets in the middle of Cloud and Fog. Cloud and fog give facts, registering, amassing, and purpose organizations to end-customers. Despite the way that the fog can be isolated from the cloud by its nearness to the end-customers, the thick land appropriation and its flexibility [2–18].

2 Literature Review

Mist contraptions are masterminded in the cloud and intelligent devices. Exactly when mist devices related to the speed of the web to the cloud and physical proximity to customers, continuous applications and dependent on zone organizations and compactness support. We use mist enrolling instead of distributed computing since when we use cloud organizations to savvy things, and they face preparing and sporadic system issues. Cisco passed on haze figuring thoughts concerning the regions of the astute structure, remote sensors, related vehicles, and robust frameworks. Pleasing data arranging and adaptable traffic light issues in SDN based vehicular frameworks and a small-scale cross-section based shrewd lattice is talked about. In this mist, preparing isn't inspected as of not long ago. Existing strategies should be altered to quarter two layers shadowiness cloud form. Scarcely any issues were considered concerning the astute structure (lattices) [3]. Fog handling perspective as a non-insignificant augmentation of the cloud is found, and the enduring thought of the approach of keen structures is examined. By joining the necessities of lattice and cloud with prerequisites of structures organization of sensor and actuators, it looks for after that orchestrating a mist figuring stage this displayed the resolute quality challenges by current cloud perspective and connects towards mist preparing, all things considered, applications/adventures [4]. We look at web enhancement inside haze registering. We request to existing strategies for web advancement in a different example, and these techniques can work together/joined with one of a kind learning that is accessible at mist hubs [5]. Like the cloud, mist figuring gives information, technique, putting away and application associations to clients. Points of interest of haze processing and they are an examination of its applications in certain situations like keen lattice, brilliant in vehicular systems and programming systems. This reveals the protection and security issues as per mist registering. Mist devices may counsel one another and make alliances [6]. Mist vehicular crowdsensing has seemed a worldview where vehicles use board sensors and gather the information of standard web [7]—the principle utilization of this distributed computing for data stockpiling and data assessment. The contraptions with high versatility may be additional challenges with the scope of data openness and planning at the server farms. By fuses, cloud and haze in the Fifth Generation (5G) condition with the new headways like programming characterized organizing

(SDN) and Network capacities virtualization (NFV) with the model of system document framework (NSC). The essential use of the NSC organization model makes us automate the virtual resources by attaching in the course of action for speedy preparing in both the figuring advancements [8].

For safe transportation, envision/imagine demonstrating open security. Distributed computing decreases cost and high asset utilization, by presenting inertness far away from the incorporated framework—mist structure for insight free security in vehicular environed, which is cost-productive. The principle work is the exhibition of mist associate for structuring shrewd vigilance (surveillance) [9]. Further structure of the web will rely upon distributed computing, with the augmentation of transmission of enormous/high measures of information to the cloud was not just strenuous for the temporary fad of the channel of correspondence yet also delay like administrations and cause a deferral in the transmission. For the advancement of the activity of adaptable traffic, versatility and geometric flow are less critical. The murkiness layer contains geo-administered servers that developed the framework [10]. It is an exemplification to permit provisioning assets and organizations past the cloud, at the border of the frame, and closer to end gadgets. It's not a phony for distributed computing anyway a luring accomplice [17].

3 System Structure for Fog Computing

Edge handling of is another model set up by the cell those sorts out heads to improve the entire system's benefit by offloading its assignments to near to fogs. Besides, the European Telecommunications Standards Institute (ETSI) is one of the rule affiliations stressed over edge handling [11]. ETSI reported an Industry Specification Group (ISG) recognized as edge enrolling to get some information about and sort out the improvement. Basically, MEC can be portrayed as the technique as the strategy for moving scattered enrolling abilities to the boundary of the multipurpose systems. While Moving coursed figuring to the edge of the versatile makes a lot of positive conditions that can be joined in the going with center [12]

- It diminishes the in circles-trip lethargy of conveyed information,
- Which gives a productive path for offloading information conveyed to the core network,
- It gives data transmission,
- High security,
- Power efficiency,
- It acquaints new organizations and applications by getting the system setting information.

The arrangement of fifth Generation cell can be seen as a portable customer, cloud unit, versatile center system, present Internet and distant cloud. Checking for

the simplest spot for the indicated cloud unit, specialists get into numerous ways that. In light-weight of the ETSI details of edge choosing, there are totally different conditions for the operating surroundings of the passed on problem-solving units. Present a unit varied zones for the sting calculation servers, for instance, [10, 11]: The cloud unit may well be set within the third Generation/4th Generation Radio network controller (RNC).

- Cloud servers are linked to the LTE huge scale stations (ENB).
- Cloud element may well be known with totally different areas (diverse ENB).
- Cloud units could also be at the sting of the centre framework.

There is a ton of inquiries about for showing little cloud units that can be used in versatile frameworks. Two or Three shoppers, the period cloud let to imply any aide and small cloud parts. They are, as an example, Nebula [13] and Wang et al.'s. Smaller-scale fogs [14]. The above sketch gives a structure subject to fog handling. Cisco has loosened up to the edge of the remote frameworks and can be used in the cell organize/utilized in the cell arrange [16] (Fig. 2).

During crafted by the framework hub as far as mist processing, we need:

- OFF switch
- Software-characterized organize controllers(B4N)
- Traffic originator (50*Raspberry pi 3)
- Zabbix server system screen
- Keyboard, video, and mouse (KVM)
- Remote cloud [10]

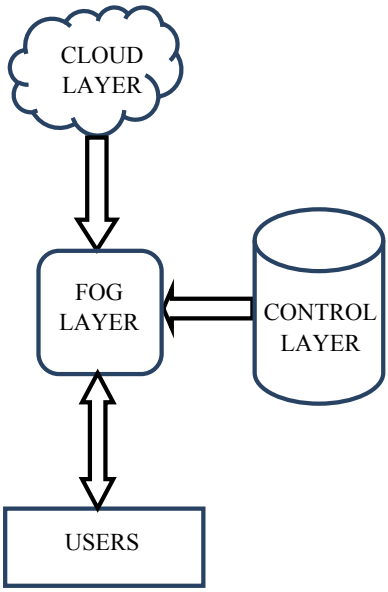

Fig. 2 Cloud computing layers

APPLICATIONS

(a) Automated Grids
(b) Auto Traffic Lights and Connected Vehicles
(c) Smart building control
(d) Wireless Sensor and Actuator Networks
(e) Decentralized Smart Building Control
(f) Connected car
(g) IoT and Cyber-physical systems
(h) Software-Defined Networks

4 Benefits

While loosening up the cloud closer to the things that make/creates and follow up on the upsides of data in business in various ways [15]

(a) Business agility: By using the correct devices/tools, developers can rapidly create applications of fog and use them where they required. Machine manufacturers can offer mass to their clients. Uses of fog program the machine to operate in the client's needs in various ways.
(b) Security purpose: Securing fog nodes utilizing a similar strategy, controls, and strategies we use in various pieces of your IT condition. By utilizing the equivalent physical and cybersecurity solutions.
(c) Deeper bits of knowledge, with security control: By analyzing sensitive information locally as opposed to sending it to the cloud for investigation. Your IT group can screen and control the gadgets that gather, examine, and store information.
(d) low working costs: By conserving system transmission capacity by handling chosen information as opposed to sending it to the cloud for investigation.

5 Result

The present cloud computing network technique is not sufficient to handle because it has more time delay/latency, the security is undefined, transmission bandwidth is low, and services is within the internet when compared to Fog computing (Table 1).

Table 1 Correlation between cloud and fog computing

	Parameters	Cloud computing	Fog computing
Ref. [10]	Latency	High (In minutes)	Low (In milliseconds)
	Location of service	Within network	At the edge of the local internet
	Distance between client and server	Several	Single
	Safety	Undefined	Defined
	Connectivity	Leased line	Wireless
	Server nodes	Few	Large
	Transmission	Low	More

6 Conclusion

Nowadays, all are using this fog computing as cloud computing, EDGE computing, IoT for storage and other technical purposes and they also integrating these technologies with machine learning and other future upcoming technologies. Mist registering is only cloud-based assistance and is likewise an expansion for the distributed computing, it is otherwise called Edge figuring, and the CISCO makes it. Mist figuring is utilized for processing, stockpiling, and systems administration benefits between the end gadgets and server farms. So, it is smarter to utilize haze registering is employed in all angles to incorporating every one of the layers of innovation with the use of fog figuring. It gives better security and it examinations the information before sending it into the cloud. Also, this can be kept up by the IT staff. Likewise, they can oversee and control gadgets.

References

1. Stojmenovic I, Wen S, Huang X, Luan H (2016) An overview of Fog computing and its security issues. Concurr Comput Pract Exp 28:2991–3005
2. Bonomi F, Milito R, Zhu J, Addepalli S (2012) Fog computing and its role in the internet of things. In: MCC'12 - proceedings of the 1st ACM mobile cloud computing workshop, pp. 13–15
3. Stojmenovic I (2015) Fog computing: a cloud to the ground support for smart things and machine-to-machine networks. In: 2014 Australasian telecommunication networks and applications conference, ATNAC 2014, pp. 117–122
4. Madsen H, Albeanu G, Burtschy B, Popentiu-Vladicescu F (2013) Reliability in the utility computing era: towards reliable fog computing. In: International conference on systems, signals and image processing, pp. 43–46

5. Zhu J, Chan DS, Prabhu MS, Natarajan P, Hu H, Bonomi F (2013) Improving web sites performance using edge servers in fog computing architecture. In: Proc. - 2013 IEEE 7th int. symp. serv. syst. eng., SOSE 2013, pp. 320–323
6. Ni J, Zhang A, Lin X, Shen XS (2017) Security, privacy, and fairness in fog-based vehicular crowdsensing. IEEE Commun Mag 55(6):146–152
7. Chaudhary R, Kumar N, Zeadally S (2017) Network service chaining in fog and cloud computing for the 5G environment: data management and security challenges. IEEE Commun Mag 55(11):114–122
8. Neto AJV, Zhao Z, Rodrigues JJPC, Camboim HB, Braun T (2018) Fog-based crime-assistance in smart IoT transportation system. IEEE Access 6:11101–11111
9. Khakimov A, Muthanna A, Muthanna MSA (2018) Study of fog computing structure. In: Proceedings of 2018 IEEE conference of Russian young researchers in electrical and electronic engineering, ElConRus 2018, vol. 2018-January, pp. 51–54
10. Yu Y (2016) Mobile edge computing towards 5G: vision, recent progress, and open challenges. China Commun 3(2):89–99
11. Rimal BP, Van DP, Maier M (2017) Mobile edge computing empowered fiber-wireless access networks in the 5G era. IEEE Commun Mag 55(2):192–200
12. Jonathan A, Ryden M, Oh K, Chandra A, Weissman J (2017) Nebula: distributed edge cloud for data intensive computing. IEEE Trans Parallel Distrib Syst 28(11):3229–3242
13. Wang S et al (2013) Mobile micro-cloud: application classification, mapping, and deployment. In: Proceedings o f annual fall meeting of ITA, no. i, pp. 1–7
14. Waheetha R, Fernandez S (2016) Fog computing and its applications. Int J Adv Res Basic Eng Sci Technol (IJARBEST) 2(19):56–62
15. Klas GI (2015) Fog Computing and Mobile Edge Cloud Gain Momentum Open Fog Consortium, ETSI MEC and Cloudlets. White Pap., pp. 1–14
16. Waqas M, Niu Y, Ahmed M, Li Y, Jin D, Han Z (2019) Mobility-aware fog computing in dynamic environments: understandings and implementation. IEEE Access 7:38867–38879
17. Wadhwa H, Aron R (2019) Fog computing with the integration of internet of things: architecture, applications and future directions. In: Proc. - 16th IEEE Int. Symp. Parallel Distrib. Process. with Appl. 17th IEEE Int. Conf. Ubiquitous Comput. Commun. 8th IEEE Int. Conf. Big Data Cloud Comput. 11th IEEE Int. Conf. Soc. Comput. Netw. 8th IEEE Int. Conf. Sustain. Comput. Commun. ISPA/IUCC/BDCloud/SocialCom/SustainCom 2018, pp. 987–994
18. Bousselham M, Benamar N, Addaim A (2019) A new security mechanism for vehicular cloud computing using fog computing system. In: international conference on wireless technologies, embedded and intelligent systems (WITS) Fez, Morocco
19. Dang TD, Hoang D (2017) A data protection model for fog computing. In: Second international conference on fog and mobile edge computing (FMEC) Valencia, Spain, pp. 32–38

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Multi-point Data Transmission and Control-Data Separation in Ultra-Dense Cellular Networks

Krishna Pavani Karri, R. Anil Kumar, and Sanjeev Kumar

Abstract In this paper, investigation about the Cell-Planning for the upcoming wireless communication such as mobile, radar, etc. is done. Cell arranging (CP) is the most significant stage in the existence cycle of the cell framework. Cell administrators are managing system issues. This paper gives answers to a portion of these issues. Be that as it may, the way that little cells, a significant segment of future systems, are foreseen to be sent in an off the cuff design makes CP for future systems 5G interchanges. Besides, in developing cell frameworks that join a wide range of cell sizes and types, heterogeneous systems (HetNets), vitality proficiency, self-arranging system highlights, control, and information plane split designs (CDSA), gigantic numerous information various away (MIMO), cloud radio access system, and millimeter-wave-based cells in addition to the requirements to help Internet of Things (IoT) and gadget to-gadget (D2D) correspondence necessitate a significant change in perspective in the manner in which cell systems have been arranged before. This paper likewise manages the programmed determination and setup of base stations for versatile cell systems.

Keywords Cell arranging · Cellular network · Base station · Cell planing

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_80

1 Introduction

As the usage of smartphones had become part and parcel of every human life, the usage of data is also high. It is essential to make efficient data transmission with effective speed and accuracy. The fourth-generation (4G) communication, which uses LTE technology, is a bit slower in the data speed and couldn't meet the requirements of the present generation [1, 2]. Here comes the need of the next generation of communication, which is still under a process called fifth-generation communication (5G). 5G is a cellular network technology. 5G is capable of transmitting data 40 times faster than 4G. For the better efficiency of the spectrum and high network capability, cellular network introduces small cells and finally ultra-dense networks (UDN) [3–10]. The initial invention of the cellular structure was planned to provide coverage for some parts of society only. Because of the expensive subscription fees, and lack of competition it seems to be unimportant to invest in the cellular systems. But as the development moved for the development of cellular systems, the main aim of the cellular system is to cover power within the maximum area although maintaining the number of parental stations at least amount [11–17]. This began to the improvement of Cellular Planning (CP) techniques and even for the raise of computer-aided tools. This also led to the research in cellular planning and it is still continuing. the first stage of cellular planning is referred to as Classic CP. Classic CP mainly concentrates on the minimization of location and number of base stations (BS). BS objectives like a number of substations, transmitted power are considered while cellular planning is being done [18–23]. This is done in the last few years of the previous decade. At the start of current decade-high data transmission along with the projects of Internet of things (IoT) gave rise to innovative skill, for example, Massive MIMO and cells [29, 30]. These new technologies were more efficient and effective when used by 5G communications [3–5, 24, 25].

2 Literature Review

In the past years, many researchers have kept their everlasting efforts in making cell design and development. But only some of them succeeded in designing cell and design layout. With the increasing number of cells, it is important to provide frequency planning techniques. The majority up to date occurrence planning methodology is used for the recent digital cellular systems. The frequency up to 10 GHz is provided. The cellular network operators are facing many problems during the planning. In order to solve these problems, very strong research under this process is being done. The cell planning troubles have been deliberated for the past few decades on cellular engineering. Present heterogeneous consists of mainly macro-cells and indoor small cells. But these macro-cells and indoor cells are unable to meet future traffic demands.

The cellular systems are designed for the boundlessness transmission of information. The second-generation cellular system uses classical coverage models, these are not used for planning universal mobile telecommunication systems (UMTS) base stations (BS) systems because of their dependency on signals but not on the traffic distributions. There were discrete processes whose aim is to provide proper decisions which include the placement of new base stations (BSs). Cell planning is an important stage in the life cycle of cellular system. This planning gives us information about the equipped expenditure, assets expenditure and even the lifetime and presentation of the system.

3 Methodology

The cell planning process consists of mainly 3 stages. They are dimensioning, detailed planning and post planning. The first stage output gives us the number of base stations required for an area to be covered by a signal. For more detailed review on this dimension process refer [6]. The second stage i.e., detailed planning allow us to determine actual positions of base stations in and around the given area. In final stage, which occurs after the set of connections has been deployed and is operating performance is analyzed. In the optimization phase the problems are detected and analyzed (Fig. 1).

3.1 Unit Arrangement Aims

The main purposes of cell planning are

1. **Reduce total price of possession:**
   Not only reducing the set of connections cost but the main aim is also helps in reducing the financial expenses associated to deployment cost and constraint optimization.
2. **Increase capability:**
   When we take a single service into consideration capability can be identify as the quantity of customers that are connected at once. In the case of multi-services the capability is decided in conditions of worldwide throughput.

Fig. 1 The three stages of cell planning

3. **Increase exposure:**
   This includes fulfilling coverage strategy constraint for the variety of services. Uplink (UL) and downlink (DL) treatment must be unbiased and together passage channels and reporting of ordinary channel have to be considered.
4. **Reduce power utilization:**
   Due to various physical condition issues caused due to the radiated power increases very much day by day, this objective promotes in greener wireless systems.
5. **Optimizing handover region:**
   In a perfectly designed cellular structure, a portion of region of every cell should overlap with other nearest adjacent cell to satisfy the handover condition.

3.2 Cell Planning Inputs

In this process of planning, various participation is essential to resolve the unit planning difficulties. The inputs needed are

1. **Traffic representation:** The consumer traffic allocation is a very crucial issue which resolve cellular system plan. So it is very important input in cell planning process. When it comes to single-service systems, geographical characteristics of traffic distribution are sufficient when it comes to multi-service structures supporting records, based on the category and stage of service are needed. In this method, a specified area is described in excess of a time interval.
2. **BS Model:** Many parameters for instance antennae type and elevation, receiver sensitivity are used to define BS model.
3. **Propagation prediction structure:** The capacity of this replica is to slip in refection, absorption and propagation of signal in outside area. But producing a complete propagation maps of huge area only by using these methods is a very time taking and even costly. So due to this reason, many new models are proposed. Some of them are [6–8] and these are well known propagation models in cell planning.

3.3 Cell Planning Outputs

The main objective of cell planning method is to supply even a single or extra of subsequent outputs.

1. The accurate quantity of pedestal station.
2. The best places to set up parental stations.
3. Frequency reuse pattern.

4 Control Data Separation

The control data separation architecture (CDSA) gave birth from the known fact that only less amount of signaling is required for more and wide coverage of signals. But the information transmission and signaling rate is required only when there are more number of users i.e. User Equipment (UE). In the CDSA, a prevailing and strong layer is supplied by the Control Base Stations (CBS) [26].

At lower a frequency which provides us a strong connectivity and mobility. The Data plane (DP) is provided with a great flexible and highly capable energy efficient Control Base Stations (CBS). All the UEs are connected to the CBs while the active UEs are attached to CBS and DBSs. The idle UEs are connected to only CBS. So, the DBS can be kept off until the UE is inactive [27]. When the UE comes to the active state i.e., when it starts taking or receiving the calls, the CBS selects a best DBS so that there establishes a new and strong link in between them though backhauls. Many functions are needed to specify UE. In the cell stream, an few approaches are given in order to separate the data plane from the control plane. The CBS provides the multicast data transmission and the DBS provides the uni-cast data transmission [28] (Table 1 and Fig. 2).

Table 1 Functionality mapping in CDSA

Functionality	CBS	DBS	Reason
Cell search	Yes		The link access is provided by the CBS only
Beam forming		Yes	These provide high data transmission and require fast response
Unicast data transmission		Yes	Possible only by DBS
Multicast	Yes		Provided only by CBS
Radio resource control	Yes		UE is connected to large no. of cells. So it provides fast response

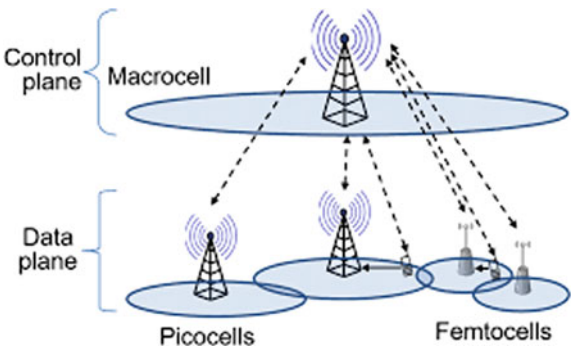

Fig. 2 The figure shows the control data separation architecture

5 Conclusion

There were very less articles till now which concentrated on production volume and production sequence. The development of versatile radio systems focuses on the significance of cell building and recurrence arranging, which can never again be performed following the customary methodology. In this we have displayed the absolute most forward-thinking procedures of asset getting ready for current versatile radio frameworks. An instructive programming apparatus for the recreation of the building steps in the plan of a radio cell arrange has been exhibited. Future media communications engineers have the chance of recreating the total procedure in the structure of a cell organize since the instrument gives the most widely recognized highlights found in proficient arranging apparatuses utilized by organize administrators and experts

References

1. Kumar S, Kumar R, Vishwakarma RK (2019) Microstrip fed highly compact Bluetooth integrated wideband antenna for wireless application. Int J Electron Lett 7(2):166–181
2. Kumar S, Kumar R, Vishwakarma R, Srivastava K (2018) An improved compact MIMO antenna for wireless applications with band notched characteristics. Int. J. Electron. Commun. (AEÜ) 90:20–29
3. Mohamed A, Onireti O, Imran A, Tafazolli R (2015) Control-data separation architecture for cellular radio access networks: a survey and outlook. IEEE Commun Surv Tutor 18(1):446–465
4. Sun W, Liu J (2018) 2-to-M coordinated multipoint-based uplink transmission in ultra-dense cellular networks. IEEE Trans Wirel Commun 17(12):8342–8356
5. Taufique A, Jaber M, Imran A, Dawy Z, Yacoub E (2017) Planning wireless cellular networks of future: outlook, challenges and opportunities. IEEE Access 5:4821–4845
6. Okumura U (1968) Field strength and its variability in VHF and UHF land mobile radio service. Rev Elect Commun Lab 16(9–10):825–873
7. Hatay M (1980) Empirical formula for propagation loss in land mobile radio services. IEEE Trans Veh Technol 29(3):317–325
8. COST 231 Final Report, Digital Mobile Radio Towards Future Generation Systems (1999). http://www.lx.it.pt/cost231
9. Yang H, Wang J, Song X, Yang Y, Wang M (2011) Wireless base stations planning based on GIS and genetic algorithms. In: Proceedings of the 19th international conference on geoinformatics, June 2011, pp 1–5. 8
10. Elkamchouchi HM, Elragal HM, Makar MA (2007) Cellular radio network planning using particles warm optimization. In: Proceedings of the national radio science conference (NRSC), March 2007, pp 1–8
11. Berrocal-Plaza V, Vega-Rodríguez MA, Gómez-Pulido JA, Sánchez-Pérez JM (2011) Artificial bee colony algorithm applied to WiMAX network planning problem. In: Proceedings of the 11th international conference on intelligent systems design and applications (ISDA), November 2011, pp 504–509
12. Lee CY, Kang HG (2000) Cell planning with capacity expansion in mobile communications: a Tabu search approach. IEEE Trans Veh Technol 49(5):1678–1691

13. Toros I, Fazekas P (2011) An energy efficient cellular mobile network planning algorithm. In: Proceedings of the IEEE 73rd vehicular technology conference (VTC Spring), May 2011, pp. 1–5
14. Chamaret B et al (1997) Radio network optimization with maximum independent set search. In: Proceedings of the IEEE 47th vehicular technology conference, May 1997, vol 2, pp 770–774
15. Wu Y, Pierre S (2004) A new hybrid constraint-based approach for 3G network planning. IEEE Commun Lett 8(5):277–279
16. Amaldi E, Capone A, Malucelli F (2001) Optimizing base station siting in UMTS networks. In: Proceedings of the IEEE 53rd vehicular technology conference (VTC Spring), May 2001, vol 4, pp 2828–2832
17. Amaldi E, Capone A, Malucelli F, Signori F (2003) A mathematical programming approach for WCDMA radio planning with uplink and downlink constraints. In: Proceedings of the IEEE 58th vehicular technology conference (VTC), October 2003, vol 2, pp 806–810
18. Amaldi E, Capone A, Malucelli F (2002) Optimizing UMTS radio coverage via base station configuration. In: Proceedings of the 13th IEEE international symposium on personal, indoor and mobile radio communications, September 2002, vol 1, pp 315–319
19. Amaldi E, Capone A, Malucelli F, Signori F (2003) Optimization models and algorithms for downlink UMTS radio planning. In: Proceedings of the IEEE wireless communication networks (WCNC), March 2003, vol 2, pp 827–831
20. Athley F (2006) On base station antenna beamwidth for sectorized WCDMA systems. In: Proceedings of the IEEE 64th vehicular technology conference (VTC), September 2006, pp 1–5
21. Hurley S (2002) Planning effective cellular mobile radio networks. IEEE Trans Veh Technol 51(2):243–253
22. Thiel SU, Giuliani P, Ibbetson LJ, Lister D (2002) An automated UMTS site selection tool. In: Proceedings of the 3rd international conference on 3G mobile communication technologies, May 2002, pp. 69–73
23. Abusch-Magder D (2005) Novel algorithms for reducing cell sites during a technology upgrade and network overlay. In: Proceedings of the IEEE wireless communications and networking conference, March 2005, vol 3, pp 1726–1732
24. Molina A, Athanasiadou GE, Nix AR (1999) The automatic location of base-stations for optimised cellular coverage: a new combinatorial approach. In: Proceedings of the IEEE 49th vehicular technology conference, July 1999, vol 1, pp 606–610
25. Zhang J, Guo L, Wu JY (2004) An integrated approach for UTRAN planning and optimization. In: Proceedings of the IEEE 59th vehicular technology conference (VTC), May 2004, vol 4, pp 2360–2364
26. Xu X, He G, Zhang S, Chen Y, Xu S (2013) On functionality separation for green mobile networks: concept study over LTE. IEEE Commun Mag 51(5):82–90
27. Zhao T, Yang P, Pan H, Deng R, Zhou S, Niu Z (2013) Software defined radio implementation of signaling splitting in hyper-cellular network. In: Proceedings of ACM 2nd workshop on software radio implementation forum, pp 81–84
28. Yan L, Fang X (2013) Decoupled wireless network architecture for high speed railway. In: Proceedings of international workshop on high mobility wireless communications, November 2013, pp 96–100
29. Awada A, Wegmann B, Viering I, Klein A (2011) Optimizing the radio network parameters of the long term evolution system using Taguchi's method. IEEE Trans Veh Technol 60 (8):3825–3839
30. Capone A, Fonseca dos Santos A, Filippini I, Gloss B (2012) Looking beyond green cellular networks. In: Proceedings of 9th annual conference on wireless on-demand network systems and services, January 2012, pp 127–130

Review of 5G Communications Over OFDM and GFDM

Pasupuleti Sai Deepthi, Vura Sai Priyanka, R. Anil Kumar, and Sanjeev Kumar

Abstract The future generations of wireless communication's main aim is to provide increasing and required demands of the users, mainly focusing on the flexibility, bandwidth, low latency, spectral efficiency. Orthogonal frequency division multiplexing (OFDM) is used in 4G communication systems. To reduce the drawbacks of 4G moved in 5G communication systems in which Generalized frequency division multiplexing (GFDM) is worn. In this manuscript, mainly learn the modulation techniques used for 5G communications like GFDM and OFDM. These modulation techniques are operated in additive white Gaussian noise channel (AWGN). Fast Fourier Transform (FFT) and Inverse Fast Fourier transform (IFFT) are used for performance evaluation and analysis in OFDM. In GFDM, zero forcing receiver (ZFR) is used which represents a crucial task in digital broadcasting. When ZFR is considered the GFDM performs better interference.

Keywords 5G · OFDM · GFDM · AWGN · Peak to average power ratio

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_81

1 Introduction

In the initial generation (1G) of cellular communications, the premier requirement for unbounded telephony and wireless communication has controlled the incidence of cordless headset. Later assimilated in second-generation (2G) the main application is to implement the 2-mode paging by SMS text messaging. The implementation of wireless LAN technology increases the usage of internet browsing internet data connectivity became fascinating for the users. The international market adoption of computers is generating a marketplace for the 3G. The layout of the present 4G offering maximum bandwidth, ultra-high-speed internet accesses multiple user video conferencing [1–5, 20, 21]. As technology increases the use of smart phones also increases rapidly. In the next-generation telecommunication networks, 5G have started hitting the market based on the requirements of the users and will continue to spread out worldwide. Beyond just speed improvements, 5G is expected to release a huge IoT ecosphere, which will influence mobile and IoT developers with its new provocations and manifestations [6–9]. 5G networks can meet communication needs for millions of connected devices, with the right speed exchange, recession, cost. Current 4G technology standards use OFDM [10]. OFDM is used for many of the latest wideband width and high data rate wireless communications including Wi-Fi, cellular telecommunications. By allowing the overlap and channel equalization it makes better use of the spectrum and it becomes simple by adjustable equalization techniques with a single carrier system [11–19].

For 5G technology, the multicarrier transmission technique is used for modulation which is progressively appropriate for intellectual radio (IR) as it diminishes the out-of-band spillage and enables control of PAPR. The incredible preference for CR physical layer blueprint would be to multiplex orthogonal frequency division (OFDM) because the multi-carry transmission offers greater mouldability. Rectangular pulse shaping which is utilized in OFDM cause exorbitant spectral leakage to the bordering required frequency bands. So we have to introduce a new PHY design technique called GFDM. It offers mouldability in pulse forming [5].

2 Literature Review

The future generations of versatile communications needs to acquire the expanding requests of the consumers based on tensile, spectral response, spectrum (bandwidth), intensity, dormancy, peculiarity. These communication systems need rapid data with increased constancy. But they have to manage the essential appliance, mainly the internet of things (IoT), tangible online network. We have to interpret and develop the Bit Error rate (BER), and realization of OFDM and GFDM. There are various kinds of modulation techniques for 5G which are working in the White Gaussian Additive Channel (AWGN). In digital transmissions, Zero Forcing Receiver (ZFR) plays the main role. GFDM is a more flexible transmission method

in which filters are used and it allows the overlapping among the subcarriers. It also reduces the spectral broadening of the original signal [1].

By using or without using oversampling we perform the clipping process on the baseband OFDM signals. In this, we evaluate the efficiency of OFDM clipping on the ability to reduce maximum energy when channel capacity is degraded. These impacts also study the instantaneous power of the bands-limited OFDM signal and effects on envelope cut-off of the PAPR. This results in the depletion of peak power. Before clipping, the OFDM should be oversampled. By using envelope limiter we can calculate peak-power and channel capacity. Degradation in SNR will be low if the scheme, such as QPSK, is covered by a comparatively less number of strong stream modulations. In this case, the clipping process is not a difficult task [2].

The data of each subcarrier is indicated by points or by extended points with a new technique called constellation extension. Constellation extension is proposed based on conditional probability. By using the de-randomization algorithm we can acquire the sufficient OFDM signal. The enhanced offers improved PAPR reduction performance when compared to other reduction techniques [3]. A generalized digital multiple-carrier transceiver theory is studied. GFDM follows the traditional channel bank multi-branch multicarrier ideas. The technical problem of Digital Dividend Use Cases is Spectrum Fragmentation, using the White spectrum in UHF TV bands near to the range allotted. By using GFDM we can reduce the PAPR. This low peak-to-average power ratio diminishes the hardware cost, power dispersion. Every single subcarrier is modulated and gives a high degree of mould ability in the design of the system and allows systematic multiuser scheduling [4]. The GFDM modulation technique provides the stretch ability to select the shape of the pulse and the out-band spillage in the incumbent frequency space of cognitive radio signals is decreased. For a GFDM multicarrier system, the performance of fundamental and double-sided sequential interference cancellation is studied. Generalized Frequency Division Multiplexing can be a fetched option for cognitive radio as a physical layer modulation design for an extremely fragmented range such as new TV White spaces [5]. GFDM is the generalization of the OFDM technique; it offers expanded mould ability which will take part in a vital responsibility in upcoming cellular applications [6]. To produce high bandwidth pipes to cellular users have to improve LTE and LTE advanced. By put into effect strict synchronize and orthogonality inside a solo cell and within a single neighboring frequency band to maximizing single cell performance in the transport mechanism [7].

3 Methodology

3.1 Orthogonal Frequency Division Multiplexing

The method involved in OFDM is digital signal modulation. In this process at different frequencies, every data stream splits into several separate narrowband

channels. Input is converted from serial stream to parallel by transmitter. For every subcarrier, each set of information carries one symbol si. Let us consider a set of data [P_0, P_1, P_2]. The given data is aligned on the parallel axis in the frequency domain. To operate this data by using IFFT (Inverse Fourier Fast Transform) the vertical axis should be arranged symmetrically. The conversion of frequency domain data of the correlative time-domain data into samples is called inverse Fourier transform (IFFT). IFFT produces samples with orthogonal frequency components which is very useful for OFDM. The OFDM signal is created by parallel to serial block. The effect of noise, clipping, and multipath are allowed by the channel simulation. The noise is replicated by attaching erratic data to the given transmitted signal and by appending the attenuation and delayed copies to the original signal of transmitted signal the multipath can be simulated. Ultimately the problem of saturation can be simulated by clipping. The receiver accomplishes the reverse of the transmitter. The serial to parallel converter block in the receiver splits the sequential stream into parallel sets. The time-space tests are again changed over once again into the frequency domain by quick Fourier transform. The frequency-domain magnitudes correlate to the original data (Fig. 1).

3.2 Generalised Frequency Division Multiplexing (GFDM)

Fettweis is introduced a multi-carrier modulation method called GFDM. Binary source (input) is in the form of random bits that feds to K independent mappers. Each mapper transforms segment of bits into a data symbol which transmits K subcarriers. There are different modulation techniques which are used for different streams. As the mappers used are mutually exclusive from one another (Fig. 2).

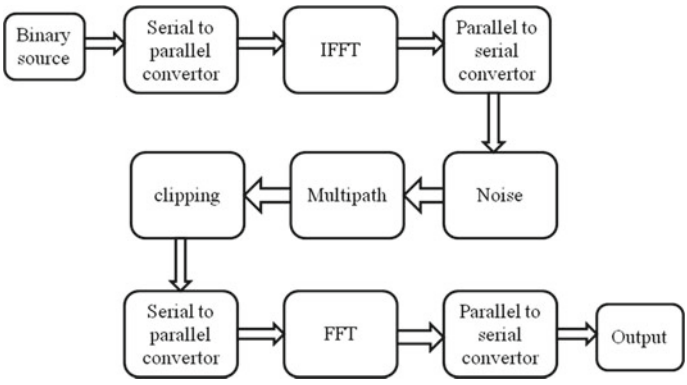

Fig. 1 Transceiver of OFDM

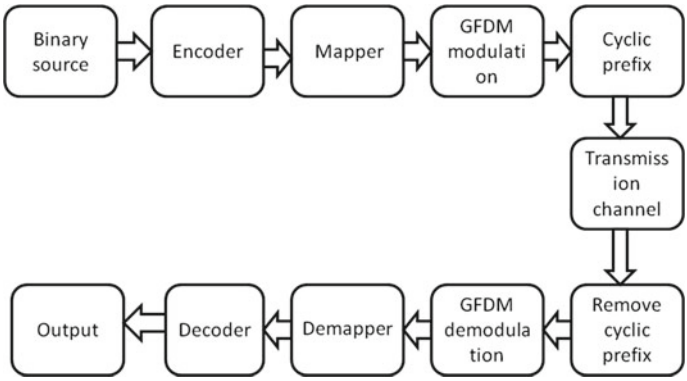

Fig. 2 Transceiver of GFDM

Using M time slots, M number of data symbols is transmitted with the same subcarrier. After distributing these data symbols across the K active carriers these data symbols within each subcarrier are further distributed across M active sub symbols and each sideband is pulse shaped using an RRC filter circuit. To fulfill the Nyquist rate, every symbol is tested N times which should be higher than or proportionate to the total number of subcarriers. There are total MN samples per each subcarrier. The GFDM modulator block contains series to parallel convertor and followed by up-sampler, prototype filter. Series to parallel convertor creates vector. In this process, all the signals are modulated as individual carriers and also added all those carriers to form a complete required GFDM signal. Destruction on the wireless channel is reduced by adding a cyclic prefix (CP). This cyclic prefix gives a guard interval that is utilized to dispense inter-symbol interference from the preceding symbols. By using the appropriate pulse shaping filters like sink filters, raised cosine filters or Gaussian filters we can shape the transmission pulse which controls the inter-symbol interference. The transmission of the transmitter output is done through a wireless fading channel. There is some effect of the fading channel at the receiver. This can be reduced by using suitable equalizer methods at the receiver such as Zero Forcing and least Mean Square error Equalization.

The cyclic prefix (CP) is eliminated, once the receiver signal is communized. The originally transmitted complex data block is recovered by using the Zero Forcing Receiver (ZFR). Once the ZFR also completed, this reconstructed original complex data symbols are down sampled and parallel to serial conversion has been one. After that decoding and de-mapping has to be done to reverse the data, as the transmitter uses mapper and encoder respectively. This final output is correlated with the actual data bits at the transmitter to find the performance of the error rate.

Table 1 Parametric analysis

Parameter	GFDM	OFDM
PAPR	Low	High
No. of subcarriers	128	2048
Modulation index	4	4
Modulation type	QAM	QAM
Pulse shaping filter	RRC	Capacitor

4 Result

An AWGN stream, a BPSK modulation, has been considered for this quality analysis, and interferences need to be tested. The results obtained indicate that as the signal-to-noise-power ratio improves following the conceptual curve. The receptors have increased their optimal performance. In addition to the simulation results the spectral properties of the signal transmitted by a ZFR pulse-shaped filter are added. The below Table 1 shows the comparison between OFDM and GFDM.

The peak to average power ratio (PAPR) in GFDM is low when compared to OFDM. The total number of subcarriers required, and modulation index of GFDM and OFDM are respectively 128 and 4. Quadrature amplitude modulation (QAM) is the technique used in both OFDM and GFDM.

5 Conclusion

OFDM has a high-rise peak to average power ratio, amplitude variations and large effective range, vulnerable to carrier offset and drift. To reduce these disadvantages we go for GFDM modulation. GFDM has a low PAPR which permits to diminish the hardware cost, power dispersion. It is a very crucial purpose to offer for future cellular systems. It provides a high amount of mould-ability in the design of the systems and efficient for multi-user scheduling.

References

1. Ba PN et al (2018) Performance evaluation of LTE and 5G modeling over OFDM and GFDM physical layers. In: IEEE conference
2. Ochiai H, Imai H (2002) Performance analysis of deliberately clipped OFDM signals. IEEE Trans Commun 50(1):89–101
3. Kou YJ, Lu WS, Antoniou A (2007) A new peak-to-average power- ratio reduction algorithm for OFDM systems via constellation extension. IEEE Trans Wireless Commun 6(5):1823–1832

4. Fettweis G, Krondorf M, Bittner S (2009) GFDM - generalized frequency division multiplexing. In: 69th IEEE vehicular technology conference (VTC Spring 2009), Barcelona, Spain, pp 1–4
5. Datta R, Michailow N, Lentmaier M, Fettweis G (2012) GFDM interference cancellation for flexible cognitive radio PHY design. In: IEEE vehicular technology conference (VTC Fall), Quebec City, Canada, pp 1-5
6. Michailow N, Gaspar I, Krone S, Lentmaier M, Fettweis G (2012) Generalized frequency division multiplexing: analysis of an alternative multi-carrier technique for next-generation cellular systems. In: International symposium on wireless communication systems (ISWCS 2012), Paris, France, pp 171–175
7. Wunder GG et al (2013) 5GNOW: challenging the LTE design paradigms of orthogonality and synchronicity. In: 77th IEEE vehicular technology conference (VTC Spring), Dresden, Germany, 2–5 June 2013
8. Michailow N et al (2014) Generalized frequency division multiplexing for 5th generation cellular networks. IEEE Trans Commun 99:1–18
9. Wang X (2005) OFDM and its application to 4G. In: 14th IEEE annual international conference on wireless
10. Wunder G et al (2014) 5GNOW: intermediate frame structure and transceiver concepts. In: IEEE Globecom workshops, pp 565–570, 8–12 December 2014
11. Michailow N, Lentmaier M, Rost P, Fettweis G (2011) Integration of a GFDM secondary system in an OFDM primary system. In: Future network & mobile summit, pp 1–8, 15–17 June 2011
12. Arslan MY, Sundaresan K, Krishnamurthy SV, Rangarajan S (2016) iBUS: an integrated beamformer and uplink scheduler for OFDMA small cells. IEEE/ACM Trans Netw 24 (2):901–914
13. Farhang-Boroujeny B (2011) OFDM versus filter bank multicarrier. IEEE Signal Process Mag 28(3):92–112
14. Ihalainen T, Viholainen A, Renfors M (2008) On spectrally efficient multiplexing in cognitive radio systems. In: Proceedings of the 3rd international symposium on wireless pervasive computing ISWPC 2008
15. Saltzberg B (1967) Performance of an efficient parallel data transmission system. IEEE Trans Commun Technol 15(6):805–811
16. Bellanger MG (2001) Specification and design of a prototype filter for filter bank based multicarrier transmission. In: Proceedings of the IEEE international conference on acoustics, speech, and signal processing, Salt Lake City, USA, May 2001, pp 2417–2420
17. Lee CS, Yoo KY (2004) Polyphase filter-based OFDM transmission system. In: Proceedings of the IEEE vehicular technology conference, Los Angeles, USA, September 2004, pp 525–528
18. Weiss TA, Hillenbrand J, Krohn A, Jondral FK (2004) Mutual interference in OFDM-based spectrum pooling systems. In: Proceedings of the IEEE vehicular technology conference, Milan, Italy, May 2004, pp 1873–1877
19. Mitola J (1999) Cognitive radio for flexible mobile multimedia communications. In: IEEE international workshop mobile multimedia communications, San Diego, USA, November 1999, pp 3–10
20. Kumar S, Kumar R, Vishwakarma RK (2019) Microstrip fed highly compact Bluetooth integrated wideband antenna for wireless application. Int J Electron Lett 7(2):166–181
21. Kumar S, Kumar R, Vishwakarma R, Srivastava K (2018) An improved compact MIMO antenna for wireless applications with band notched characteristics. Int J Electron Commun (AEÜ) 90:20–29

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An Overview of Biometrics and Face Spoofing Detection

Sista Venkata Naga Veerabhadra Sai Sudeep, S. Venkata Kiran, Durgesh Nandan, and Sanjeev Kumar

Abstract Biometric systems have been using widely and these systems have improved substantially which are being used for persons Authentication and verification. This Biometrics is playing a key role in Personal, National and Global security. The main approach of this paper is to tell the importance of Biometric systems. Different types of biometric systems have been used these days. These biometric systems are iris recognition, palm vein biometrics, voice recognition, face recognition. The main threat to all these Biometric systems is Spoofing. Facial recognition biometric system is being widely used when compared to other biometric systems. Different types of facial spoofing include mask attack; photo attack & video attack and Different methods used to detect Face spoofing are discussed in this paper. These face spoofing detection techniques include the use of LBP, DMD, SVM, PReLU, IDA, LFHOG and CNN. The Other Techniques Include a Combination of LBP, CNN, and IDA. However, the results strongly prove that the Implementation of the above techniques will detect Face spoofing.

Keywords 3DMAD · CASIA-FASD local binary pattern · Convolution neural networks · Image distortion analysis MathConvnet · Dynamic mode decomposition · HARALICK texture features

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_82

1 Introduction

Organizations have been traditionally using Pins, ID cards, and Passwords for authentication for identifying an Individual [16]. Due to advancements in technology and to Safeguard Information from Intruders, Most of the Organizations have been shifting from the Traditional method to Biometric Technology [17]. Biometric Technologies is defined as the use of technology for Personal Identification of an Individual, depended on some aspect of their Biology. Biometrics is mainly classified into two types. They are Physiological and Behavioral. Face Recognition, Fingerprinting, hand Geometry, Iris Recognition, DNA is included in physiological types the physiological Traits are unique and hence they provide Better Security [1]. But these biometric systems are at risk of spoofing attacks.

The spoofing attack is defined as an attempt made to obtain someone else's entitlement by using a different Substitute which may include a photo or video for an authorized face. These days, Face Biometric dependent entry control entities are omnipresent although they are Susceptible to spoofing attacks [17]. The improvements made in the acquisition of data made spoofing algorithms easier to model, which leads to an increase in spoofing. So, there is a Need to develop Spoofing detection Techniques. These systems are used to inhibit Spoofing.

2 Biometric System

A Biometric System is an entity used to identify an individual, depended on some biological information. A biometric system used for the security of an organization is termed as Biometric security. The types of biometric systems are: Fingerprint recognition searches for the peculiar patterns of Ridges, Valleys that are present in each fingerprint. Fingerprints are innate for every individual which cannot be lost. This Feature of Fingerprint makes it more reliable and accurate. Fingerprint technology can benefit organizations in different sectors which includes Government, industries, technology depended on Organizations, Retail enterprises, Educational Institutions, Workforce, Finance, etc. Iris is a unique identification for any individual. Iris is a protected internal organ of an Eye. The Patterns present in IRIS are very complex and of High dimensionality. IRIS has many peculiar features such as ligaments, furrows, ridges, crypts, rings, corona, freckles, etc. An IRIS code is obtained by the Demodulation of Iris Pattern. IRIS Based biometric technology is being used in Forensics, Driving Licenses, Anti Terrorism, Credit card Authentication, Internet Security, etc. Due to its unique features, IRIS is named as "**LIVING PASSWORD".** Palm vein Biometrics is an authentication Technology which uses vascular patterns as identification of an Individual. It is one of the fastest and accurate security solutions. Palm vein biometrics is based on comparing and authenticating stored vein patterns in the database with a vein pattern present in the

palm of a person. This Technology is mainly being used in North America, Europe, Latin America, and Europe. A voice Recognition works on the Principle of recognition of Voice of an individual. Nowadays, these are being used almost everywhere. Voice recognition is used in Banking systems, Home security systems, etc. Facial recognition is one of the biometric systems which are capable of solely identifying or verification of an individual by comparing and analyzing Face. It is mostly used for Authentication. Facial recognition technology has received important attention as it is capable of a wide range of applications. There is an increasing popularity in the face recognition system in the field of entry control. These face biometric systems are not only being used in industries and organizations but also in mobile phones for locking and unlocking and also for other security purposes. A typical biometric system consists of mainly 3 parts; they are a classifier, database, feature extractor. Feature extractor extracts the test images from training. Feature extractor is mainly used to distinguish real &fake images. Here images depend on the type of Biometric systems that are being used. For example, if we consider Iris, the images of eyes, similarly for face recognition, the images of the face and palm, the images of palm, for voice, the modular representation of voice as images. So, feature extractor is considered as one of the important parts of a Biometric system. The database is an essential part of any biometric system because it stores data which is extracted through Feature Extractor. The database consists of two types of datasets, test dataset & training dataset. Test dataset stores input images, whereas training dataset stores training images. Classifier plays a key role in the biometric system. The Classifier classifies the given input data into different numbers of classes. The Classifier only decides whether the given input is real or fake.

3 Spoofing Attacks

Research is going on from the last few years to prevent spoofing, but to detect spoofing, first, we have to know how spoofing is done. Spoofing is a technique to show that "**Fake is real**". Nowadays, organizations are using different types of Biometric systems that are described earlier in this paper, but the common threat to all these Biometric systems is spoofing. Spoofing became very common; many of the internet users are doing spoofing or commercial purposes. But, we have seen from different Biometric systems, Facial Recognition is the most commonly biometric systems for security purposes. But, these facial recognition biometric systems frequently are affected by spoofing attacks.

4 Importance of Face Recognition Biometric System

Face recognition is playing a major role in present biometric systems because of its applications in various fields

Track Attendance. Many organizations including educational institutions are also using facial recognition to track attendance. Through this biometric system, they save lots of time.

Scam Finding for Passports and Visas. Specialist is using the automatic face-recognition techniques in Passport offices to identify real faces and it was a useful implement to distinguish fraud. This is being used to make out documents such as driving license and immigration visa.

ATM and Banks Fraud. Numerous nations began utilizing face acknowledgment innovation in ATMs. The new money machine created utilizing this innovation guaranteed expanded security of the card client and worked by mapping facial information, coordinating it against the database.

Identification of Criminals. Face Acknowledgment innovation has altogether added to the space of examination and wrongdoing recognition. A few nations are building the facial acknowledgment database, to improve the nature of the examination.

Prevent Fraud Voters. Face detection is being used in elections to avoid duplicate voting. Numerous persons had attempted to take part in an election several epochs using dissimilar person's names. The carbon copy votes were prevented to a large level by using the face recognition method.

Keep Track of the Members. Several churches crossways the world is using face recognition method to continue a track of the citizens who are coming & leaving. The places include India, Indonesia.

5 Different Types of Face Spoofing

Face spoofing assaults are mainly classified into 2 types basing on the purpose, for normal face scanning; they are using 2D Spoofing which includes photo attacks and video attacks. For motion-based scanning of faces, they are using 3D Spoofing. Depended on their purpose, different spoofing mechanisms are included in these 2D & 3D spoofing Techniques.

Photo Molest: In this molest a Fraudulent (A FRAUD PERSON) attempts to attack the facial recognition-depended biometric system by keeping a photograph of the authorized person. People who aim to do spoofing can get photographs of authorized person in many ways. They can either capture the pictures from many

digital devices such as a camera or a mobile from a distance without informing the person and without taking permission from the genuine use. He/she can also acquire pictures from social media. The attacker simply prints the image of a person or displaying it on a digital device for deceiving the face recognition system. Nowadays this photo attack became very easy because a lot of pictures of a particular person are available Online, so the attackers are taking advantage of these social media platforms and attacking the facial recognition Biometric System.

Video Attack: Video attack is one of the most sophisticated methods used by attackers to face spoofing. In Video attack, the attacker uses different images of Authorized Users from different social media platforms. The different images are combined and made a video. This video was played at the Facial recognition Biometric system since different images of a video contain different behavioral traits of an individual. Video attack is also called a Replay attack since different images are replayed again and again. This video attack looks more realistic when compared to the Photo attack. So, most of the attackers are using this technique to face spoof.

Mask Attack: Mask attack is the most sophisticated method for face spoofing. This mask attack is done by attackers to make a more realistic experience. A mask attack is done by using the facial mask of the authorized user. The two types of facial masks are life-size Wearable and paper cut Cover-up. Paper cut mask means general masks, but life-size wearable is made of 3D effects. These Mask attacks are mainly used by attackers where facial recognition is more secured.

6 Different Techniques for Face Spoof Detection

Although face spoof detection techniques are being developed for a long time, the most advanced research is taking place in the field of this face spoof detection from 2015. So, in this paper, we will discuss various technologies used for face spoof detection from 2015.

In the year 2015, K. Zhang et al, have proposed their method for face spoof detection depending on Rectifiers. The state of Neural Networks is dependent on Rectifiers… In this work, they have studied neural networks, for image classification. Image classification can be done in two ways. First, they proposed a method named as robust initialization. This method considers the nonlinearities of Rectifiers. This method is mainly used for studying extremely deep rectified models. This method is mainly used to investigate wider networks. The second method was Parametric Rectified Linear Unit (PReLU). PReLU increases layout matching. This layout matching is done with a very low computational cost [4].

In the year 2015, Tirunagari et al, have proposed their method for face spoof detection depending on Local Binary Patterns (LBP), Support Vector Machines (SVM) and DYNAMIC MODE DECOMPOSITION Method (DMD) with

histogram intersection kernel. This was a Solution for 2D&3D Attacks. The use of LBP+DMD+SVM on databases like Print attack, Replay attack, and CASIA FASID, has given Good results. Dynamic Mode Decomposition algorithm generates N − 1 dynamic mode. N represents no. of Frames. LBP is implemented on each Dynamic Mode. LBP is to improve difficult Video attacks [6].

In the year 2015, Wen et al, have proposed their method for face spoof detection depending on Image Distortion analysis. The various features Of IDA are color diversity, chromatic moment, specula reflection. The IDA feature vector is formed by the Extraction of these features. This method is mainly used for Multi frames mainly in Videos. This technique was an Experiment on MSU, MSFD Databases, Google nexus 5 & Mac book Air mobile devices which are affected by a 2D Spoof attack. This Technique is implemented by using IDA features, an assembler classifier (4 SVM classifiers). This was the First mobile spoof Database [3].

In the year 2015, Vedaldi et al. explained their technology to face spoof detection depending on Convolution Neural Networks (CNN). MATCONVNET is an implementation tool for CNN in Mat lab. This Tool was very Simple & flexible, for building CNN Architecture, to develop complex models on large datasets like Image net ILSVRC. Matconvnet is used for experimenting with deep CNN, it is developing Fast, using deep learning concept [1].

In the year 2015, Lu et al. explained their technique for face parody location dependent on a reduced twofold face descriptor (CBFD). For the given picture they have separated pixel distinction vectors (PDVs) in neighborhood fixes by figuring the contrast between every pixel and its neigh exhausting pixels. They likewise proposed a coupled CBFD (C-CBFD) strategy by lessening the methodology hole of heterogeneous countenances at the element level. They have explored different avenues regarding this system on 5 databases. This strategy is fascinating when these techniques are applied to PC vision applications, for example, object acknowledgment and visual following to additionally exhibit their adequacy [2].

In the year 2016, Feng et al, have proposed an extendable multi-prompts incorporation system for face hostile to mocking uses a various leveled neural system. This strategy combines the picture quality prompts and movement signals for livens recognition. The proposed strategy combines SBIQF, the normal face OFM map, and normal scene OFM map utilizing bottleneck portrayals. SBIQF is better in portraying pictorial error betwixt genuine faces and phony countenances. This strategy was executed utilizing C Programs and MATLAB. This technique gave great outcomes when probed 3 Databases [7].

In the year 2016, Zhu et al, have proposed their strategy for face parody recognition dependent on Light. They utilized a novel descriptor in the light field, Depending on the rakish and the spatial data in the light field, they developed a light field histogram of inclination (LFHoG) descriptor. This was gotten from vertical, even and profundity. Evaluation end top to the bottom bearing is particular in the light field. The rightness and viability of the LFHoG descriptor are portrayed through trials led on various Databases. This technique was primarily applied to live face identification [8].

In the year 2016, Agarwal et al, have proposed their strategy for face parody identification dependent on Haralick surface highlights. This Haralick Texture highlights from repetitive discrete wavelet changed casings acquired from a video. This technique was for the most part utilized for Video mocking Attacks. Savvy and straightforward enemy of mocking calculation which concentrates square shrewd Haralick highlights from RDWT sub-groups. Utilizing this strategy tests are done on 3DMAD, CASIA-FASD, and MSU-MFSD face satirizing databases [5].

In the year 2017, Juefei Xu et al, have proposed their method for face spoof detection based on local binary Convolution (LBC). This method was an efficient alternative for Convolution layers in standard Convolution neural networks (CNN). it was a technique formed by combining, CNNs with LBC layers, which is termed as local binary Convolution neural networks (LBCNN). This method was used on a small scale, medium scale and large scale Datasets and Gave good results [9].

In the year 2017, Patel et al, have proposed their method for face spoof detection based on face movement cue like eye-blink as a measure and Deep Texture Features to identify spoofing. This method is applied for 2D attacks. In this method, they compared the stored frames with the images that are kept for Authentication. This method has been experimented on different Public based Databases and gave Good Results [12].

In the year 2018, Feng et al, have proposed their method for face spoof detection based on el end-to-end learnable LBP network. This method uses the likeliness' between LBP extraction and the Convolution neural network (CNN). This method reduces the number of network parameters by combining learnable Convolution layers with fixed LBP layers. This method provides better detection when compared to Deep learning Methods. This method was experimented on public databases like CASIA-FA and gave very good results [15].

In the year 2018, Sepas et al, have proposed a method for face spoof detection based on Light Field Local Binary Patterns (LFLBP). In this technique, the combination of LBP and Light Field Cameras is used. LFLBP descriptor is used to combine two components. They are the spatial, local LBP and the angular LBP. This method was experimented on a light field face database and gave good results [14].

In the year 2018, Lu et al, have designed a method for face spoof detection based on simultaneous local binary feature learning and encoding (SLBFLE). This SLBFLE is an unsupervised Feature that learns faces Representation from Raw Pixels. Coupled simultaneous local binary feature learning and encoding (C-SLBFLE) methods were also developed which characterizes the face samples. SLBFE is used for homogeneous and C-SLBFLE is used for heterogeneous face recognition. These methods are also applied to Public Databases [13].

In the year 2018, Duan et al, have proposed their technique for face parody recognition dependent on setting mindful nearby parallel component learning (CA-LBFL). This CA-LBFL abuses the logical data of contiguous bits by compelling a lot of shifts from various double bits. Pixel various vectors (PDV) are extricated from Local patches. A setting mindful nearby paired multi-scale includes learning (CA-LBMFL) technique is created to together gain proficiency with

different projection lattices for face portrayal. Coupled CA-LBFL (C-CA-LBFL) technique and CA-LBMFL (C-CA-LBMFL) strategy used to lessen the methodology hole of heterogeneous appearances. This procedure was the most progressive strategy to face parodying recognition [11].

7 Result and Discussion

From Table 1 shows the techniques used by different authors and their applications.

Table 1 various techniques utilized for face spoof detection and their applications

Year	Reference	Technique used	Applications
2015	[4]	Robust initialization Parametric Rectified Linear Unit (PReLU)	Adaptive activation function in Deep Neural Network
	[6]	Local Binary Patterns (LBP), and Dynamic Mode Decomposition Method (DMD), Support Vector Machines (SVM)	Detection of video-based spoofing
	[3]	Image Distortion analysis	Reduplication of identity for mobile app development
	[1]	Convolution Neural Networks (CNN). MATCONVNET	Image classification and document analysis
	[2]	Compact binary face descriptor (CBFD) & Coupled CBFD(C-CBFD)	Implemented by reducing heterogeneous faces at extract level
2016	[7]	Multi-cues integration framework using a hierarchical neural Network	Used in recognition of audio and video sensors
	[8]	Light field histogram of gradient (LFHoG) descriptor	Used in detection for Automotives in night light.
	[5]	Haralick texture features	Common texture descriptors in image analysis
2017	[9]	Local Binary Convolution neural networks (LBCNN)	Used in big data, Data cloud
	[12]	Deep Texture Features	Utilized for robust face spoofing detection
2018	[15]	End-to-end learnable LBP network	Used in computer vision applications
	[14]	Light Field Local Binary Patterns (LFLBP)	Used for pattern recognition
	[13]	Local binary feature learning and encoding (SLBFLE) & Coupled simultaneous local binary feature learning and encoding (C-SLBFLE)	Used for heterogeneous face matching
	[1]	Context-aware local binary feature learning (CA-LBFL)	Used in Real-time applications

8 Conclusion

In this paper, I want to conclude that, there are many face spoofing detection techniques that are being developed, but as per my knowledge the problem is not being solved and due to some technical issues, they are combining different technologies to form a new one. For example, in this paper, I have discussed various technologies. Convolution neural networks and light detection are two different technologies. Later on, these two technologies were combined to form a new technique. The main aim is to protect biometrics from spoofing as it is the only way we are having for personal authentication. In my future work, I will give a brief description of how spoofing detection by using different types of techniques shown above.

References

1. Vedaldi A, Lenc K (2015) MatConvNet: convolution neural networks for MATLAB. In: MM 2015 - Proceedings 2015 ACM Multimedia Conference, pp 689–692
2. Lu J, Liong VE, Zhou X, Zhou J (2015) Learning compact binary face descriptor for face recognition. IEEE Trans Pattern Anal Mach Intell 37(10):2041–2056
3. Wen D, Han H, Jain AK (2015) Face spoof detection with image distortion analysis. IEEE Trans Inf Forensics Secur 10(4):746–761
4. He K, Zhang X, Ren S, Sun J (2015) Delving deep into rectifiers: surpassing human-level performance on image net classification. In: Proceedings of IEEE international conference computer vision, vol 2015, pp 1026–1034
5. Agarwal A, Singh R, Vatsa M (2016) Face anti-spoofing using Haralick features. In: IEEE 8th International Conference Biometrics Theory, Applied Systems BTAS 2016
6. Tirunagari S, Poh N, Windridge D, Iorliam A, Suki N, Ho ATS (2015) Detection of face spoofing using visual dynamics. IEEE Trans Inf Forensics Secur 10(4):762–777
7. Feng L et al (2016) Integration of image quality and motion cues for face anti-spoofing: a neural network approach. J Vis Commun Image Represent 38:451–460
8. Ji Z., Zhu H, Wang Q (2016) LFHOG: a discriminative descriptor for live face detection from light field image. In: Proceedings of International Conference Image Processing ICIP, vol 2016-August, pp 1474–1478,
9. Juefei-Xu, F, Boddeti VN, Savvides M (2017) Local binary convolution neural networks. In: Proceedings of 30th IEEE Conference Computation Visual Pattern Recognition, CVPR 2017, vol 2017-January, pp. 4284–4293, 2017.
10. Li H, Wang S, Kot AC (2017) Face spoofing detection with image quality regression. In: 2016 6th International Conference Image Processing Theory, Tools Applications IPTA 2016
11. Duan Y, Lu J, Feng J, Zhou J (2018) Context-aware local binary feature learning for face recognition. IEEE Trans Pattern Anal Mach Intell 40(5):1139–1153
12. Patel K, Han H, Jain AK (2017) Biometric Recognition, vol 10568, no 61672496, pp 611–619
13. Erin E, Zhou J, Lu J, Liong V (2018) Simultaneous local binary feature learning and encoding for homogeneous and heterogeneous face recognition. IEEE Trans Pattern Anal Mach Intell 40(8):1979–1993
14. Sepas-Moghaddam A, Correia PL, Pereira F (2018) Light field local binary patterns description for face recognition. In: Proceedinggs of International Conference Image Processing ICIP, vol 2017-September, pp 3815–3819

15. Li L, Feng X, Xia Z, Jiang X, Hadid A (2018) Face spoofing detection with local binary pattern network. J Vis Commun Image Represent 54:182–192
16. Jha S, Sharma N (2018) FACE spoof detection and KNN. Int J Sci Res Comput Sci Eng Inf Technol 3(1):2456–3307
17. Kaur J (2019) A review on different face spoof detection techniques in biometric systems, vol 5, no 2, pp 3–5

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Efficient Dual Axis Solar Tracking System

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Abstract This generation is facing problems regarding energy crisis in an enormous way. Also the level of generation of electrical energy is not reaching the demand of this energy. In order to overcome this scarcity renewable energy would be a better answer. Using solar energy which is the most dominant resources of renewable energy could be a major solution to this problem. The performance of the dual axis solar tracker using Arduino is presented in this paper. This research helps to find which one is efficient among solar tracker and static solar panel. The work involves two parts, Software and Hardware. The hardware part resembles Light dependent resistors which detects the source from sun. Servo motors are used to move the solar panel to the place where the light source is maximum indicated by LDR. Software part is carried by using C programming. The result of this tracker is compared with static solar panel and can be found that solar tracker is more efficient capturing maximum light source and also produces more power.

Keywords Arduino · Light dependent resistor · Servo motors · Dual axis solar tracker

1 Introduction

It can be said that 19% of electricity generation is provided by renewable energy around the world [1]. The sources of renewable energy are derived from natural resources that is sunlight, rain, wind, tides [1]. Solar energy can be converted into

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_83

electrical energy using photovoltaic effect. But the efficiency of conversion is low because of the fact that the output is directly proportional to the intensity of light and also with the position of the sun which changes throughout the day. Instead of using fixed solar panels we can make use of solar trackers because the absorption efficiency of solar panels are less as per the above mentioned reasons [2].

Solar Trackers:- Solar tracker is one which orients a solar panel towards the sun. Solar trackers can be classified into two types (1) Single axis (2) Dual axis. We are using dual axis solar tracker since it can have both horizontal and vertical axis. Sun moves from east to west everyday. Here we are using LDR to trace light intensity of the sun. And more importantly Servo motors enables perfect tracking the sun. A solar tracker with LDR's accurately track the sun and jumps from its position in order to increase the result i.e. the energy [2]. So Microcontroller and LDR are used to track the sun and the rotation of motor is controlled through C programming. It can be notified that about 40% more power can be produced per year by making use of solar tracker [3–5].

In this research the output of solar tracker is compared with fixed solar panel and is proven to be more effective for capturing more sunlight for applications in the field of solar harvesting. Figure 1 shows the picture of a Dual axis solar tracker.

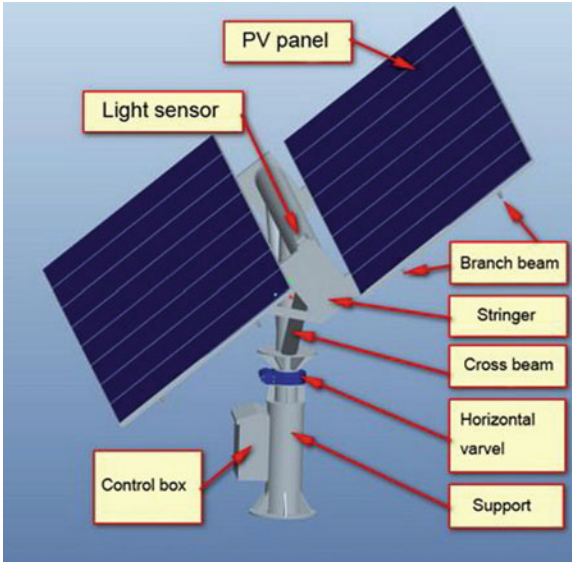

Fig. 1 Dual axis solar tracker

2 Methodology

As mentioned earlier, this research is differentiated into Hardware and Software.

2.1 Hardware

The main agenda of this paper is to know the performance of dual axis solar tracker. It resembles LDRs which gives the input, the controller part is done by Arduino and the output is the servo motor.

Figure 2 shows the block diagram of the complete system. From the block diagram it can be seen that the sunlight is sensed by LDR and the signal is next forwarded to Microcontroller. The servo motor is driven by the microcontroller to the position where light fell on sensor pairs are similar [6]. Servo motor can rotate 180°. It is controlled by PWM i.e the direction and position of motor. ADC converts PWM analog signals into digital signals. These digital signals are next moved to Arduino microcontroller [7–9].

Arduino is an open source board which is designed to use hardware and software in an easy way. It consists of 14 digital i/o ports (6 are PWM signals) 6 analog inputs. The microcontroller is programmed through C language regarding the work performed by the Arduino [2]. Figure 3 shows the picture of an Arduino UNO Microcontroller board.

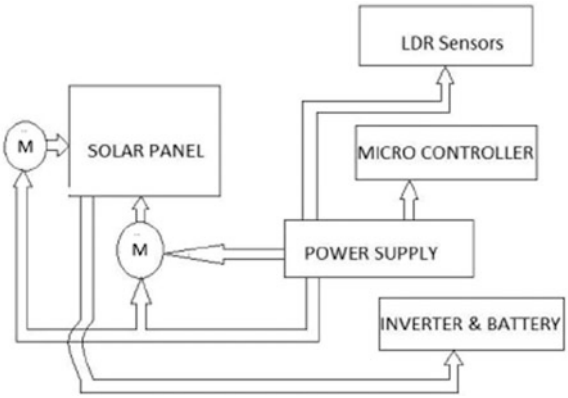

Fig. 2 Block diagram of complete system

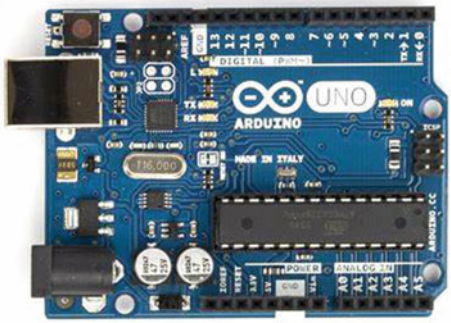

Fig. 3 Arduino UNO microcontroller board

2.2 Software

The software part involves codes built using C programming fed to Arduino board. As stated earlier LDRs are the inputs connected to analog pins of Arduino. These LDRs are located at different points like left, right, up, so that maximum tracing of sunlight can be achieved. The analog signals are converted into digital signals by ADC. The light with high intensity traced by LDRS are noticed and then servo motor helps to move solar panel. Since the servo motor can rotate about 180°, there could be 3 points; 0, 90, and 180°. Figure 4 shows the flowchart of the dual axis solar tracking system.

2.2.1 Hardware Implementation

The complete hardware system is shown below in the Fig. 5, which consists of Arduino, LDR sensors, servo motors and solar panel.

3 Results

An improved measurement using solar tracker is done after designing and implementing the system. After going through the output we came to know that the region of solar panel was one among the main things in storing the output voltage and current. Also the utmost illumination of the sun were the peak hours that is between 9 am to 4 pm.

Figure 6 shows the output power of the solar panel during the day time for the three cases of fixed panel, single axis and dual axis solar tracking systems. It is observed that during peak daytime both the single axis as well as the dual axis system give higher output power compared to the fixed panel. For the fixed panel the peak is obtained between 12 noon to 1 pm and then the output power gradually

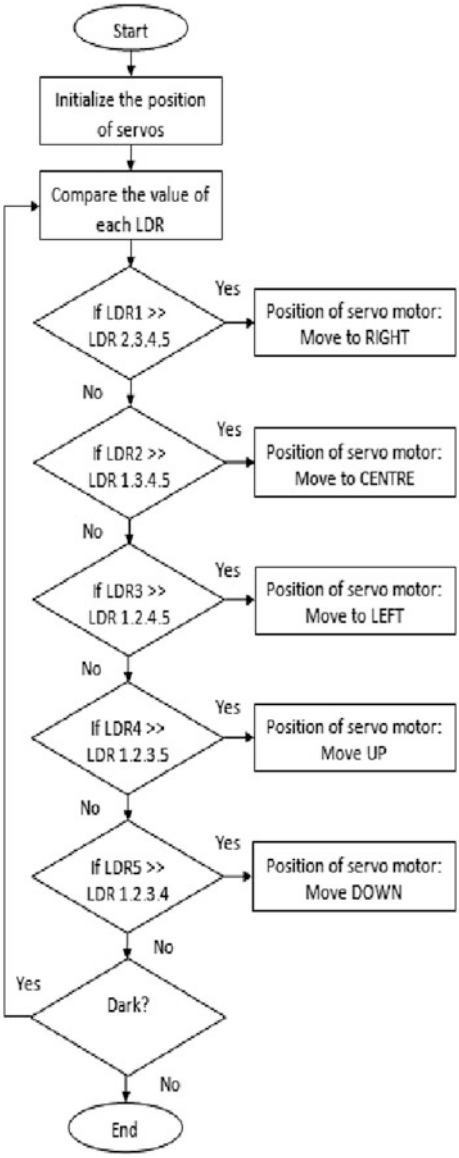

Fig. 4 Flowchart of the system

starts dropping. It is estimated that the efficiency of dual axis solar tracker is better than the static solar panel by about 40% more output power from the solar panel. The output power of the single axis is slightly lower than the dual axis system.

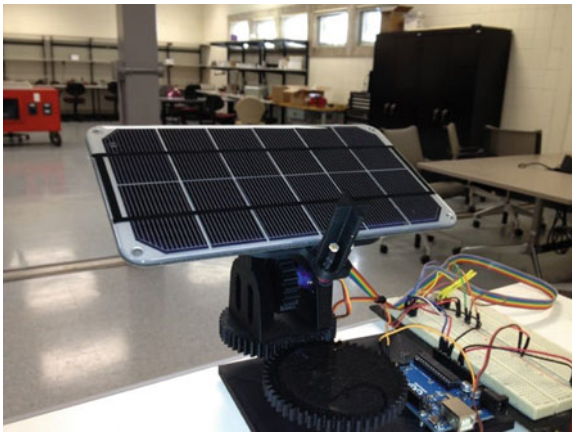

Fig. 5 Hardware assembly

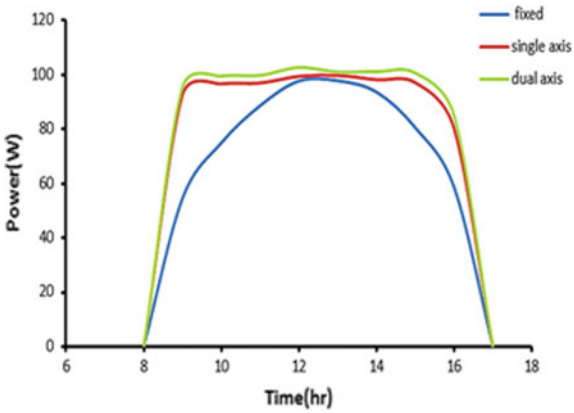

Fig. 6 Graph showing the output power for the solar panel in the case of fixed panel, single axis and dual axis solar trackers

4 Conclusions

The main intention of this research was to build a dual axis tracking system which has the ability to trace sunlight onto the solar panel and move according to the position of the sun to capture more light. Some of the other conclusions from this study are:

1. Since Arduino is used it is easy to program and also easy to upgrade if any changes are required.
2. This system is of low cost and better when compared to other similar systems.
3. The output energy is increased by about 40% of the static panels.

Acknowledgements The authors express gratitude to Accendere Knowledge Management Services Pvt. Ltd. for the assistance provided in preparing the manuscript.

References

1. Othman N, Manan MI, Othman Z, AI Junid SAM (2013) Performance analysis of dual-axis solar tracking system. In: International conference on control system, computing and engineering, 29 November– 1 December 2013, Penang, Malaysia, pp 370–375
2. Mishra J, Thakur R, Deep A (2017) Arduino based dual axis smart solar tracker. Int J Adv Eng Manag Sci (IJAEMS) 3:532–535
3. Yazidi A, Betin F, Notton G, Capolino GA (2006) Low cost two-axis solar tracker with high precision positioning. In: Proceedings of the international symposium on environment, identities & mediterranean area (ISEIM 2006), 10–13 July 2006, Corte-Ajaccio, France, pp 211–216
4. Clifford MJ, Eastwood D (2004) Design of a novel passive solar tracker. Sol Energy 77:269–280
5. Lorenzo E, Perez M, Ezpeleta A, Acedo J (2002) Design of tracking photovoltaic systems with a single vertical axis. Prog. Photovoltaics 10:533–543
6. Walled A, Hassan KM, Virik US (2014) Designing a dual axis solar tracker for optimum power J. Electr Eng 4(12):168–173
7. Chhoton AC, Chakraborty NR (2017) Dual axis solar tracking system: Bangladesh context. In: International conference on advances in electrical engineering (ICAEE), 28–30 September 2017, Dhaka, Bangladesh, pp 421–426
8. Farhana A, Titirsha T, Sanjidah S, Siddique ARM, Rabbani A (2013) Installing dual axis solar tracker on rooftop to meet the soaring demand of energy for developing countries. In: 2013 Annual IEEE India Conference (INDICON), pp 1–5
9. Siddique ARM, Titirsha T, Sanjidah S, Afrin F, Rabbani A (2014) An analytical approach to design a cost effective dual axis solar tracker based on CSP and PV technology

Prediction of Water Consumption Using Machine Learning Algorithm

P. Poornima and Sushmitha Boyapati

Abstract Machine Learning has been successfully implemented in the real-world problems, its use in real world problems is to extract and identify valuable and new knowledge from the given data. In this paper a model which can predict water consumption by a person annually is developed. These days, water scarcity is major problem in metropolitan cities, so the main goal is to predict the water usage for upcoming years. The prediction of water consumption per year is crucial for conservation of water for future generations. In this regard, on regular basis important data and information are gathered and in order to maintain the quality set they are considered at appropriate authorities and standard. We collect the data of water usage by a person in the past few years, and integrate the data and utilise it. The gratification of the analysis of water consumption is attained by converting this data into knowledge. The supervised algorithms are used to predict the amount of water consumed and based on their accuracy predicted, user-friendly characteristics and ease of learning the performance of the learning methods were evaluated.

Keywords Machine learning · Supervised learning · Regression

1 Introduction

An accurate water consumption prediction model can help planners meet user demands. The previous researches indicates that the water consumption is strongly correlated with the population in the city.The focus of this paper is on developing an accurate prediction.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_84

i. **Problem Statement**
Nowadays, there is a lot of wastage of water due to the lack of knowledge of amounts that are being consumed. Machine Learning can be used to predict the amount of water consumed per person in a city using Random Forest algorithm. The predicted value can be used to estimate the consumption levels and predict the future demand of water in the upcoming years.

ii. **Existing System**
Several models have been developed for consumption of water. Many others models using established methods have been developed for prediction and have published their underlying affect online while the provenance of other online tools is unknown. All the systems developed where used to find the water consumption in the upcoming years by using previous years data. The systems were trained with the data which was recorded in a particular area. The systems trained are used to predict the amount of water consumed in the upcoming 5 years with some attributes like age, name, gender etc.
Disadvantages

1. For new data the predictive values may not be accurate.
2. Can be used for prediction of water consumption only for a population of particular locality.

iii. **Proposed System:**
In this paper the system is trained by collecting the data of amount of water consumed at different stages.The trained system predicts the amount of water consumed with good accuracy. It helps in early estimation of the amount of water consumed.
Advantages:

1. Can be used for predicting the amount of water consumed.
2. Prediction is accurate.

iv. **System Requirements:**

a. **Hardware Requirements:**

1. System: Pentium Dual core
2. Hard Disk: 120 GB
3. RAM: 1 GB
4. Input Devices: Keyboard, Mouse

b. **Software Requirements:**

1. Operating System: Windows 7 or Windows 10
2. Tool: Anaconda Navigator (Jupyter Notebook)
3. Software: Python 3.5

2 Literature Survey

i. **Wei Bigui, Zhang Hongwei (19–21 Oct. 2012)**
The Grey model (GM) method is used to increase the precision. This method calculates the minimum of the total residual sum of squares. When this model is used to estimate the amount of water required in a random city, the result shows that the mean absolute error percentage and the maximum absolute percentage error are 3.56, and 12.58% respectively.

ii. **Weilin Liu,Kangning Chen, Lina (15–17 July 2011)**
The important issue encountered in water supplies system is forecasting of the usage accurately. To solve this water consumption forecasting problems, least square support vector machines were used for the past few years. The use of least square support vector machines is limited because the parameters are defined by their corresponding user only.

iii. **NiuZhi-guang; ChenFa; Lu Ren-qiang (14–16 Aug. 2009)**
In this paper, the authors used the fractal prediction model to estimate the hourly water usage in the urban areas based on the theories developed by the methods. For this purpose, the historical data containing the hourly water consumption details of the North China was taken as an example and the rescaled range analysis method was used to calculate the Hurst component H. The fractal characteristics are presented as a result of H was 0.9158.

iv. **YongchangRen, Tao Xing, Xiaoji Chen, Xu E, Ying Zhao (June 5–June 6 2010)**
Neural network model is used here for forecasting the water demand in the urban areas. The authors have used the feed-back neural network model and the feed-forward neural network model to study the weight function based on the learning algorithms.

v. **Bao-zheng Liu, Ding-wei Wang (31 May–2 June 2014)**
The main factors in deciding water consumption in the urban areas is the gray relational model with the water consumption according to Data Mining. The main factors which influence the water consumption in urban life are discussed here. A grey prediction model on urban life water is built by the gray forecasting of the trends that are developing with the main impact factors. An instance is taken to prove that the data is fit better. This model mainly forecasts the population in urban areas in per capita units in order to predict the annual/yearly consumption of urban water in the life.

3 Design Methodology

i. **Block Diagram**
A block diagram shows schematic form of the general arrangement of the parts or components of a complex system or process.

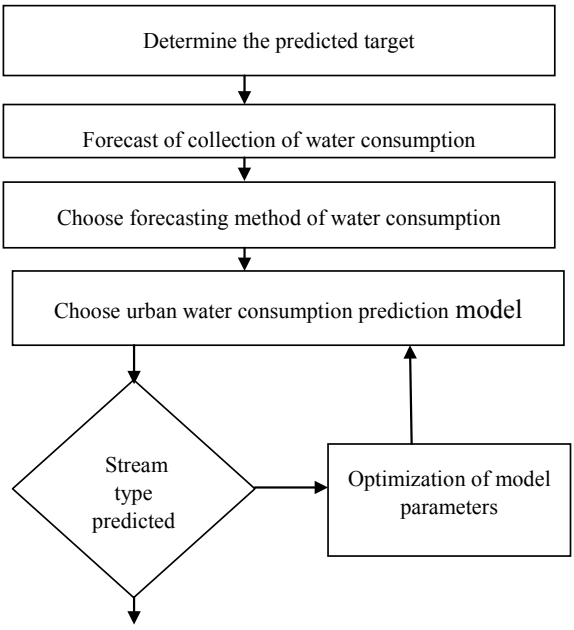

Fig. 1 Block Diagram for Water Consumption model

In Fig. 1, the block diagram for the Water Consumption model is explained. The target that we want to achieve and search for respective datasets that best suits the requirement is determined. A forecasting method for training the model is chosen. The parameters used in the dataset are optimized according to our priority. The models are chosen until the best satisfied model is that gives us the best accuracy is taken. The results for the model we have chosen are analysed.

ii. **UML Diagrams:**
Unified Modelling Language is a standard language for writing software blueprints and also shows the communication with its users in efficient way.

a. **Data Flow diagram**
The graphical representation of the flow of the data through modelling of an information system and its process aspects is known as Data Flow Diagram. To create an overview of the system it is used often as preliminary step. It also reveals about what kind of information will be given as input to and output from the system, also how and where the data will advance through the system, will be stored in the system. But this DFD does not show information about timing, sequence or parallel flow of the processes, unlike a traditional structured flowchart that focuses on control flow of processes.

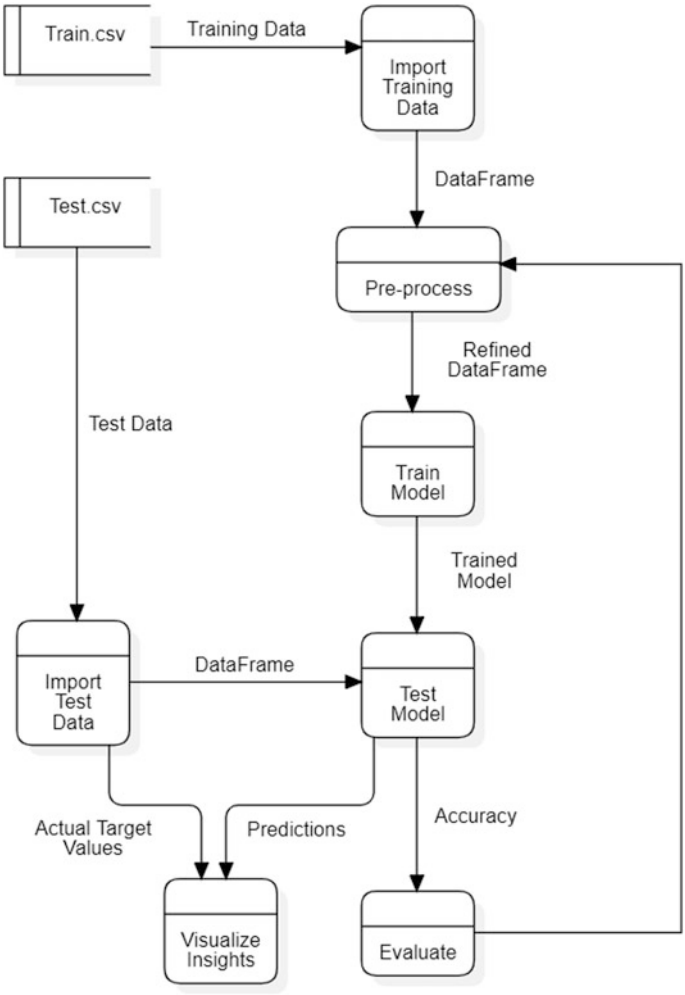

Fig. 2 Data Flow Diagram for training and testing

In the Fig. 2, the Data Flow diagram is shown. The dataset chosen is imported in .csv format and pre processed. Pre processing is necessary because real world data contains noise. Therefore, data is cleaned to make the model more accurate. The model is then trained by splitting the dataset into training part and testing part. After successful training the model is validated across the actual dataset by evaluating the accuracy for the corresponding model. Then comparison is done between the predicted values and the actual targeted values and the results are visualized.

b. **Sequence Diagram**
Sequence diagram illustrates the sequence of set of processes that are to be done until the results are obtained.

The steps illustrated in the Fig. 3 are as follows:

1. The kernel is initiated by starting the server.
2. An instruction is sent to the browser to open up a jupyter notebook.

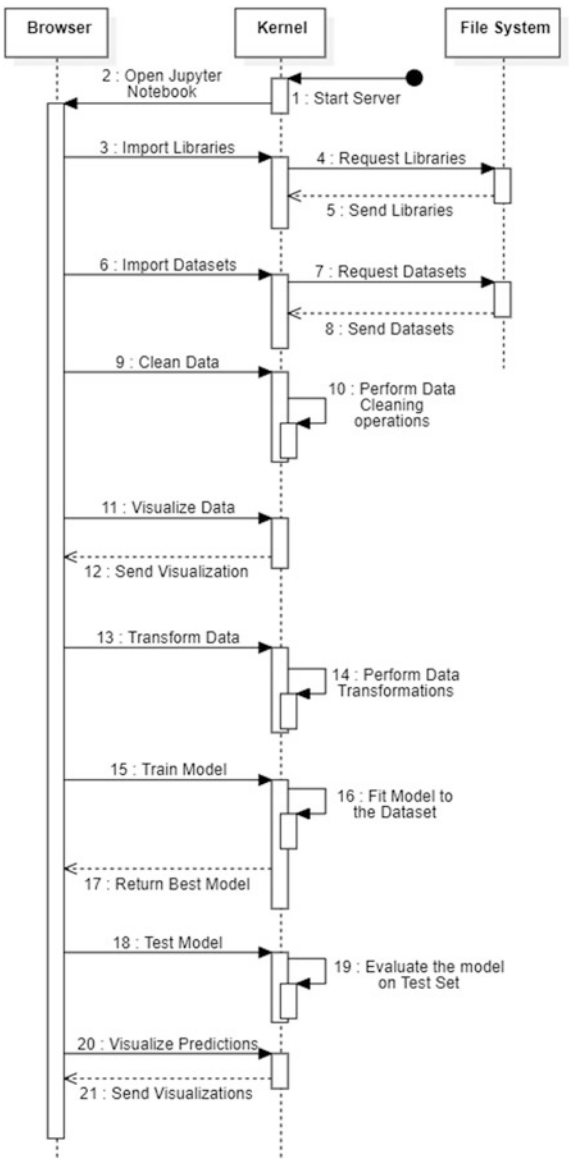

Fig. 3 Sequence Diagram for Water Consumption model

3. The browser asks for libraries from the file via kernels.
4. The Kernel interacts directly with the file system and requests for the required libraries.
5. The file system sends a reply to the request made by the kernel by fetching the libraries that were requested.
6. The browser requests for the dataset that is associated with the problem statement.
7. The Kernel passes the received request to the file system.
8. The file system fetches the required dataset and sends it to the browser.
9. Browser requests cleaning steps over the dataset selected.
10. Cleaning operations are performed on data to get higher accuracy.
11. The target data is visualized to understand its behaviour.
12. The kernel responds with visualizations that were requested by the browser.
13. To normalize the attribute values data transformation techniques are performed in the data set.
14. Over the data frame different transformation techniques are applied by the Kernel.
15. A model is trained over the data frame.
16. The model is fitted for the data set to provide a high accurate model.
17. The associated predictions over the test data are visualized to analyze it's accuracy in comparison to the actual house prices.
18. Requested visualizations are displayed over the browser to better understand the accuracy of the trained model.

4 Modules

i. **Data Acquisition**

Data acquisition is the process of importing the unprocessed data sets into the analytical platform. It can be acquired from traditional databases, remote data, text files, No SQL storage, etc. Data acquisition involves the identification of data sets, retrieval of data, query of data from the dataset.

The Water Consumption dataset is extracted from the Kaggle platform. It consists of 50 samples for training and 50 samples for testing. The following are the features present in the dataset:

1. Year
2. New York City Population
3. NYC Consumption (Million gallons per day)
4. Per Capita (Gallons per person per day)

ii. **Data Exploration**
The paper makes use of the following exploration strategies - finding correlation between variables in the data set to remove redundancy of feature attributes thus improving the training time and efficiency.
Plotting outliers to correct errors and discover rare events. The dataset consisted of a significant outlier that dropped the accuracy of the predictor by 7%. Hence, detection and removal of the outlier sample was important for the prediction.

a. **Pre-Process Data**
Pre-processing of data involves 2 criteria:
Data Cleaning: Data cleaning involves removal of inconsistent values, duplicate records, missing values, invalid data and outliers.
Data Munging/Data Wrangling: Data Wrangling techniques involve scaling, transformation, feature selection, dimensionality reduction and data manipulation. Scaling is performed over the dataset to avoid having certain features with large values from dominating the results. The transformation technique reduced the noise and variability present in the dataset. Multiple features are handpicked for the removal of redundant/irrelevant features present in the dataset. Dimensionality reduction helped in eliminating irrelevant features and made analysis simpler.

iii. **Data Analysis Module**
The data analysis scenario comprises of feature selection, model selection, creation of insights, and analysis of results.
Many methods can be used while predicting future the values. Usually, when creating a forecasting model number of different methods are applied and then compared to each other. Forecasting approaches can be divided into two main categories and the choice of which one is appropriate depends largely on what kind of data is available. The two approaches are called qualitative forecasting which is used when historical data is limited and quantitative forecasting which is used when numerical information about the past is available. The second approach will be the one used in this thesis since all prediction are based on historical data. The ideology of the methods used in this thesis was to start with a simple method called multiple linear regressions and uses it as a benchmark for other more complicated methods within the field of machine learning. In the second part the machine learning methods will be explained with the goal of understanding their advantages and the principle of how they work.

a. **Regression analysis:**
To analyze quantitative data a well-known statistical technique called regression analysis is used. For estimating relationships among variables, a set of statistical processes called Regression analysis can be described. Of course, this method can be classified as machine learning method, as it is based on training and testing data. However, the goal of applying these

methods was first and foremost to analyze the data and the relationships among variables. Regression is often used when models involve several variables where the aim is to establish a relationship which is mathematical between a variable which is dependent and one or more variables which are independent. Specifically, it can help us in understanding whenever any of the independent variables is varied how the value of the dependent variable changes. There are several different names used for the variables. The dependent variable is usually called the response variable or the target and the independent variables are called the predictors or the explanatory variables. To make it simple, dependent and independent variables will be used from now on in this thesis. There are several kinds of regression techniques to make predictions. The number of independent variables, shape of the regression line and the type of the target variables are the main factors to take under consideration when choosing a technique. In this chapter the focus will be on linear regression.

b. **Simple linear regression:**
This is the simple form of regression among all the methods. Those variables have linear relationship between themselves is assumed. The goal of applying this method can either be to predict a future value of the variable that is dependent on another or to quantify the the relationship between the dependent and the independent variables. These methods were used in the very beginning of the thesis to understand the relationship between the variables. Mathematically the linear relationship can be described with the following equation:

$$Y = \beta_0 + \beta_1 X + \varepsilon \tag{1}$$

where Y is considered as the variable that is dependent and X is considered as variable that is independent. The error term is then marked with the ε and β_0 andβ_1 are the unknown parameters of the model usually called regression coefficient. β_0 is the intercept and β_1 is a constant. The idea of this method is to use training data to produce estimates for the model coefficients and then predict future value of the dependent variable by computing

$$\hat{Y} = \widehat{\beta}_0 + \widehat{\beta}_1 x \tag{2}$$

where the ^ indicates the predicted value of Y and the estimated value of the coefficient parameters after training the data.

c. **Multi linear Regression:**
The extension of simple linear regression is Multi linear Regression and is also called as the least squares method. In practice there are usually more than one independent variable that are related to the dependent variable. Both of these models are called linear regression models as they can be written as linear combinations of the β coefficient parameters in the model.

The main purpose of this method is to model the relationship between two or more independent variables (xi) and a dependent variable (yi), which is achieved by fitting a linear equation to the data that is observed. Assume that the model includes p independent variables X_1, X_2,….,X_p, the equation takes the following form:

$$\widehat{Y} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p + \varepsilon \quad (3)$$

The predicted value of the variable which is dependent is $\widehat{Y}$. The X_1 through X_p are the predictors or the independent variables. Both in simple linear regression and multiple linear regressions the coefficients are estimated using the least square approach. The method of least squares is based on minimizing the sum of the squared vertical distance between the observed value and the predicted value.

d. **Machine learning methods:**
Arthur Lee Samuel known as a American pioneer has introduced the term Machine Learning in 1959 in the field of computer gaming and artificial intelligence created the world's first self-learning program. In his study, [3] he stated that programmed computers are able to play better game of checkers than the person who wrote the program. The term machine learning refers to the automated detection of patterns recognition in data [4] and relies heavily on the availability of data and computing power. The main difference of machine learning algorithm and other statistical approaches is that there is no need of prior assumptions. To split the data into train set and test set is the main principle of machine learning is approached. To tune the parameters of the model the training set is used, while in order to estimate the model performance, testing set is used. Machine learning algorithms can be split into supervised and unsupervised leaning algorithms. In supervised learning, the data is labeled and the prediction of the output is learned from the input data. In unsupervised learning, the algorithm only depends on input variables with no corresponding output values. Since the output is available in this paper, all applied ML algorithm are based on supervised learning. In this thesis, it was decided to apply three different ML learning algorithms called random forest, neural network and support vector machine.

e. **Random forest:**
Random forests (RF) are one of the most used supervised machine learning algorithms. One of the main advantages of the algorithm is that it can used for both classification and regression tasks and is an effective tool for making predictions. The algorithm is defined as an ensemble method that is based on constructing combinations of many decision trees [5]. The concept ensemble learning method refers to the idea of aggregating multiple methods with goal of improving the model performance [6]. The algorithm was first introduced by Tin Kam Ho which used the random subspace

method where a sample of features is randomly selected from the entire set of features [7]. Leo Breiman and Adele Cutler extended the algorithm by combining boot strap aggregating also called bagging and the idea of random selection by Ho after few years [5]. The algorithm can be described in the following steps:

1. It is assumed that the number of cases in the training set is ON. Then randomly N number of case samples is taken with replacement.
2. At each node m < M is specified for M input values where m variables are randomly selected.
3. To the largest extent possible each tree is grown, there pruning is not done.
4. By aggregating the prediction of the n trees, predict new data.

This method was applied by taking advantage of the "Random Forest" package in R.

When the members are not similar, it performs well and obtains variations among them using two sources and each tree is built on separate bootstrapped samples of the training data. But at each node in building the individual trees only a randomly selected subset of data attributes is considered. Therefore Random forests combine the concepts of bagging and the random subspace method

f. **Logistic Regression:**

Logistic model is used in order to model the probability of certain class. The Logistic regression also known as the logistic regression is defined in estimating the parameters of a logistic model in the binary regression form. A binary logistic model has a dependent variable mathematically with pass/fail as two possible values, that is represented by an indicator variable, where the two values are labelled "0" and "1". In the logistic model, the log-odds (the logarithm of the odds) for the value that has a label "1" is a linear combination of independent variables or predictors. The probability of the value that has a label "1" can be between 0 and 1. The function which estimates the log-odds to probability is defined as the logistic function.

Out[33]:

	Year	NYC Consumption(Million gallons per day)	New York City Population	Per Capita(Gallons per person per day)
0	1979	1512.0	7102100.0	213
1	1980	1506.0	7071639.0	213
2	1981	1309.0	7089241.0	185
3	1982	1382.0	7109105.0	194
4	1983	1424.0	7181224.0	198
5	1984	1465.0	7234514.0	203
6	1985	1326.0	7274054.0	182
7	1986	1351.0	7319246.0	185
8	1987	1447.0	7342476.0	197
9	1988	1484.0	7353719.0	202
10	1989	1402.0	7344175.0	191

Fig. 4 Original dataset

```
In [34]: series.describe()
Out[34]: count      40.000000
         mean     1228.540000
         std       176.152726
         min       990.200000
         25%      1061.500000
         50%      1228.350000
         75%      1372.250000
         max      1512.000000
         Name: NYC Consumption(Million gallons per day), dtype: float64
```

Fig. 5 Data description

Data Visualization

The data in chosen dataset is as follows:

In Fig. 4, the dataset that is chosen is displayed.

In Fig. 5, the data description is shown which shows the aggregate values for the dataset.

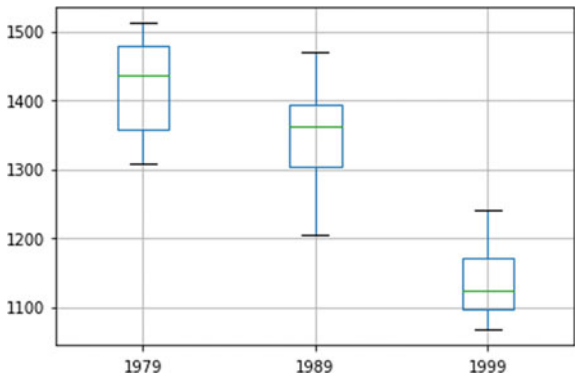

Fig. 6 Boxplot for the data

BOXPLOT

In descriptive statistics, a box plot is a method for graphically depicting groups of numerical data through their quartiles.

In Fig. 6, the boxplot obtained for the data. The outliers can be visualized.

HEATMAP

Heat map shows the data in graphical form in which the individual values are put in a matrix and are represented with different colours. The heat map obtained for the data is as follows:

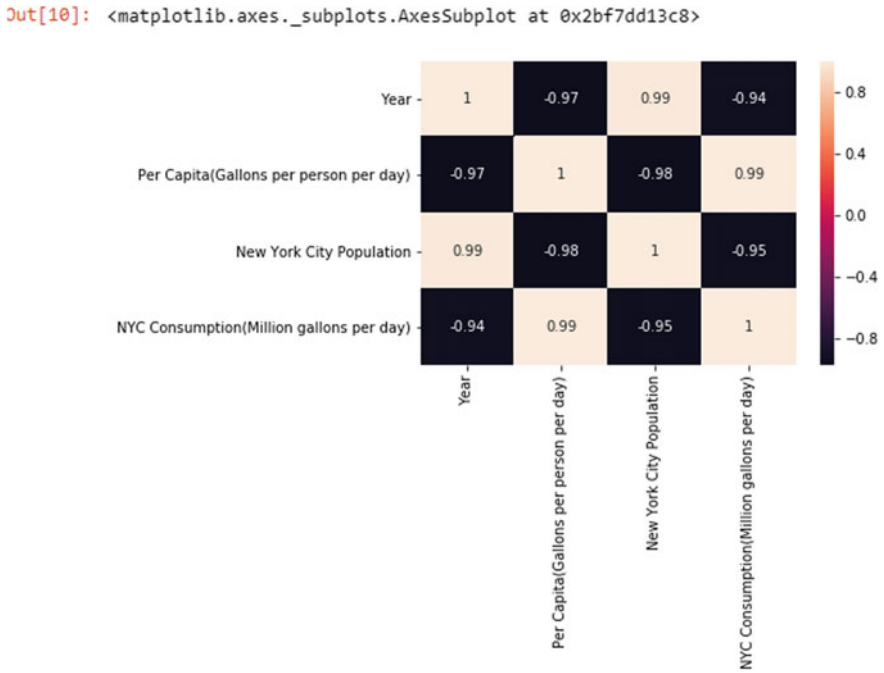

Fig. 7 Heat map for the data

In Fig. 7, the heatmap for the chosen dataset is shown. It shows the individual values contained in a matrix are represented as colours.

5 Testing and Results

Training is first done using Linear and Polynomial regression; it produced an accuracy of 54%.

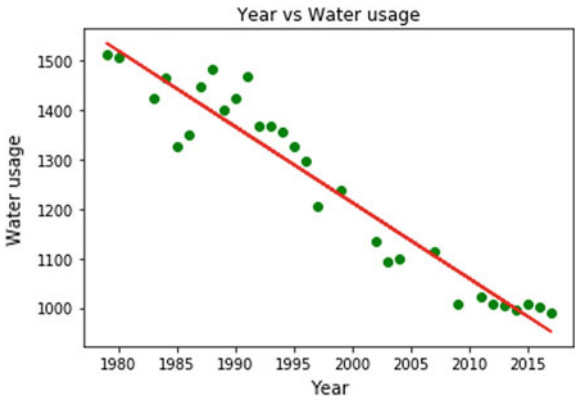

Fig. 8 Year vs Water usage graph for linear regression

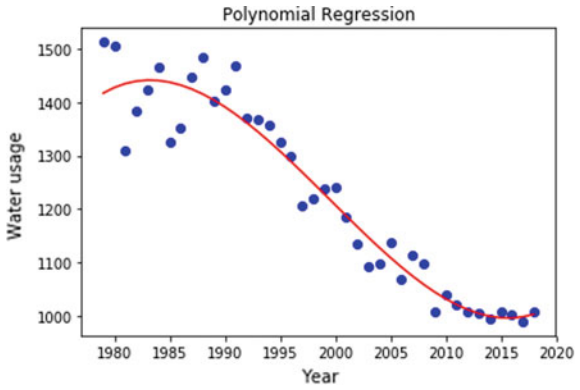

Fig. 9 Year vs Water usage for polynomial regression

In Fig. 8, the graph for the fitted data is shown:

In Fig. 9, training is done using Polynomial regression. The Random forest model is tested with various parameter values to get the best possible set of results. This process included giving various parameters to get the best set of possible values for parameters, which gave the best Random forest model. The results for the model are given below:

```
>Predicted=1368.500, Expected=1358
>Predicted=1357.700, Expected=1326
>Predicted=1325.700, Expected=1298
>Predicted=1297.900, Expected=1206
>Predicted=1205.500, Expected=1220
>Predicted=1219.500, Expected=1237
>Predicted=1237.200, Expected=1240
>Predicted=1240.400, Expected=1184
>Predicted=1184.000, Expected=1136
>Predicted=1135.600, Expected=1094
>Predicted=1093.700, Expected=1100
>Predicted=1099.500, Expected=1138
>Predicted=1138.000, Expected=1069
>Predicted=1069.000, Expected=1114
>Predicted=1114.000, Expected=1098
RMSE: 42.275
```

Fig. 10 Results predicted and expected values for the data

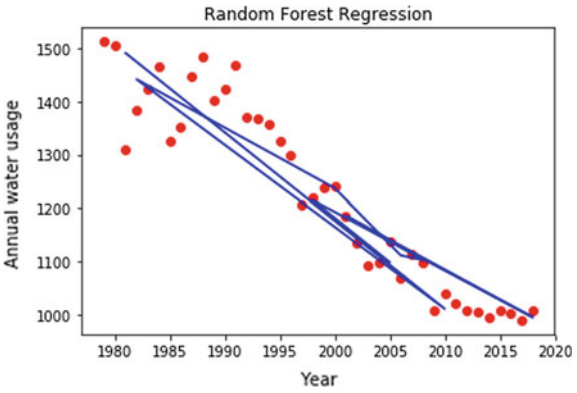

Fig. 11 Year vs Water usage for Random forest regression

In Fig. 10, the predicted result and the expected values in the dataset are compared.

69% accuracy was obtained on the dataset with the above parameters' values. The accuracy score for Random Forest model is displayed.

```
from sklearn.ensemble import RandomForestRegressor
print("Accuracy score of Random Forests :", regressor.score(val_X,val_y)*100)
Accuracy score of Random Forests :69.0732457575399
```

In the following Fig. 11, the graph obtained for the Year and Water usage for Random forest regression is shown.

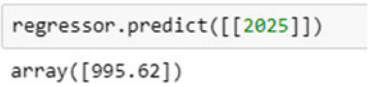

Fig. 12 Prediction results for the test sample

The accuracy for the models is:
Linear Regression: 54%
Random Forest Regression: 69–70%.

i. **OBSERVATION:**

Since the accuracy of Linear regression is much less than the Random Forest regressor, Random Forest regression is preferred for the Prediction of Water Consumption.

The prediction result is as follows:

In the Fig. 12, the prediction result for the test sample is taken as input parameter (Year) and an array containing the output value (The amount of water consumed in gallons) is obtained.

6 Conclusion and Future Scope

The Prediction of water consumption paper is completed successfully. The goal of the paper is achieved and the problems were solved. The Random forest model is successfully developed to fit the training data consisting of 50 samples. The trained model now predicts amount of water consumed (in gallons) over the unseen data in New York area up to an accuracy of 69%.

The model's accuracy is subject to change with change in the dataset used. Thus, the model needs to be updated with the new data at finite intervals.

A comparison between various algorithms, such as linear regression, Polynomial regression, Random forest can be performed to get even better results. A dataset specific to New York City was used in the paper. However, a nation-wide dataset can be collected to train a model in order to make it industry ready.

References

1. Liu W, Chen K, Liu L (2011) Prediction of water consumption using least square support vector machine optimized by hybrid intelligence algorithm. In: Second International Conference on Mechanic Automation and Control Engineering
2. Zhi-guang N, Fa C, Ren-qiang L (2009) Study on fractal prediction model of urban hourly water consumption. In: Natural Computation a Fifth International Conference
3. Samuel AL (1969) Some studies in the machine learning using game of checkers. II-Recentprogress. https://doi.org/10.1158/0008-5472.can-11-3472
4. Bishop CM (2006) Patterns recognition and machine learning. https://doi.org/10.1016/b978-044452701-1.00059-4. 978-0-387-31073-2

5. Breiman L (2001) Random forests. Mach Learn 45(1):5–32. https://doi.org/10.1023/a:1010933404324
6. Han J, Kamber M, Pei J (2011) Data Mining, Concepts and Techniques. The Morgan Kaufmann Series in Data Management Systems, 3rd edn. Technical report
7. Ho TK (1998) The random subspace method for constructing decision forests. IEEE Trans Pattern Anal Mach Intell https://doi.org/10.1109/34.709601

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Simulation of Cascaded H-Bridge Multilevel Inverter Using MATLAB/ SIMULINK

C. Hithashree, M. K. Bharath, and H. N. Shashank

Abstract The growing demand for power finds wide range of applications in hybrid/electric vehicles, portable consumer device, industrial control systems, and solar power systems. Since a multilevel inverter has low harmonics, these are widely used in energy distribution and control. Cascaded or H-Bridge inverter topology is preferred the most because of simple control, reliability and capacitor balance. Sinusoidal Pulse Width Modulation (SPWM) is commonly implemented in an inverter circuit since it improves efficiency. This paper consists of the basic theory of a single phase and three phase multilevel inverter of different levels using SPWM technique, its Simulation model, result and its switching pattern. The design is made by the H-bridge topology using MOSFET as a switch. The simulation for the system is constructed with the help of MATLAB/SIMULINK.

Keywords Cascaded H-bridge Multilevel Inverter (CHMLI) · SPWM · Multilevel inverter (MLI)

1 Introduction

Inverter is a device that converts DC to AC. In recent times, due to the improved technology, inverters find wide applications in motor drives, UPS and power system utilization. Earlier a two level inverter was used for the purpose of obtaining a controllable voltage. A two level inverter or a conventional inverter which were used before had certain disadvantages like high THD in output waveform and high

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_85

switching losses which caused the increase in the total losses of a system. In order to overcome these limitations, it led to the invention of a new inverter design in the year 1975. This new inverter design had an improvement of more than two levels. This invention also helped in decreasing the percentage of losses and it was named as a multilevel inverter topology. The first inverter developed with this design was a converter of three levels and it was observed that the power rating can be increased with increase in the number of voltage levels [1].

2 Cascaded or H-Bridge Multilevel Inverter

A cascaded or H-Bridge inverter is made of a series connected H-Bridges which are supplied by isolated DC source. Batteries, fuel cells or ultra-capacitors can be used for this purpose [2]. Through the different arrangements of the switches used in the circuit, each cell creates three voltage levels +Vdc, 0, −Vdc [3]. CHMLI generate sine wave with switching only once and high efficiency is obtained [4].

A Pulse Width Modulation (PWM) is used in modulating DC motors. There are various types of PWM techniques that are commonly used. In this paper, SPWM technique which is commonly used is discussed and applied for simulation purpose.

3 Sinusoidal Pulse Width Modulation (SPWM)

SPWM is a modulation technique used in inverters. The modulation signal is sinusoidal in nature. This technique is carried out by two types of waveforms where one will be the reference wave and the other is a carrier wave. The peak frequency of carrier signal is always greater than the peak frequency of the modulating signal.

The above Fig. 1 shows the output voltage of SPWM. Sinusoidal waveform is the reference waveform with fundamental frequency and the triangular wave with high frequency is taken as the carrier waveform. The inverter output frequency is determined by the reference waveform [5, 6].

4 Proposed Technique

4.1 Single Phase Multilevel Inverter

In this single phase inverter a single DC source is connected to each phase and each level generates three voltages +Vdc, −Vdc and 0 with different combination of switches. The inverter is said to be ON when the two switches in criss-cross

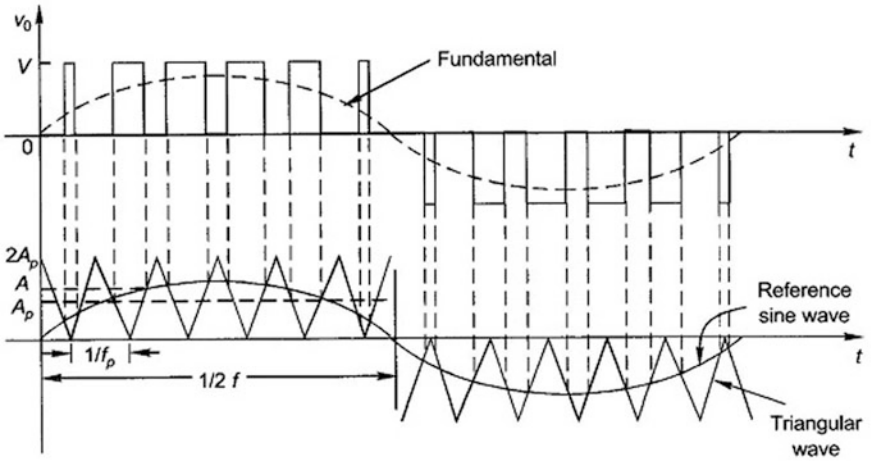

Fig. 1 SPWM output voltage

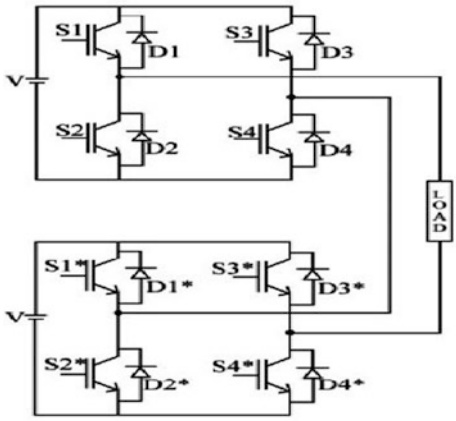

Fig. 2 Single phase 5 level CHMLI

positions are ON and the inverter remains OFF when all the inverter switches that are ON are OFF.

Figure 2 represents the basic circuit diagram of a single phase 5 level CHMLI. It uses 8 switching devices to control and gives 5 levels of output V1, V2, 0, −V1, −V2. By switching on different combinations of the switches S1, S2, S3 and S4 that are used in the inverter circuit, the above output voltages are obtained. Table 1 shows the switching sequence of the proposed inverter.

MATLAB Simulation:

The simulation model and the simulation results are given below. Figure 3 shows the simulation model of a single phase 5 level CHMLI and Fig. 4 shows the output voltage of 5 level inverter.

Table 1 Switching sequence table of 5 level CHMLI

Output voltage	S1	S2	S3	S4	S1*	S2*	S3*	S4*
0	0	0	0	0	0	0	0	0
V1	1	1	0	0	0	0	0	0
V2	1	1	0	0	1	1	0	0
0	0	0	0	0	0	0	0	0
−V1	0	0	1	1	0	0	0	0
−V2	0	0	1	1	0	0	1	1
0	0	0	0	0	0	0	0	0

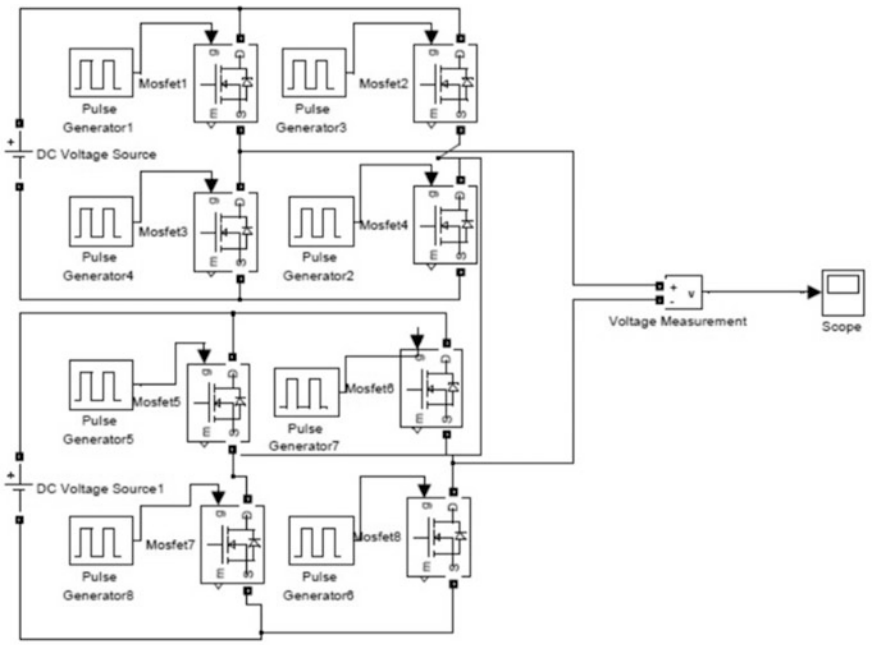

Fig. 3 Simulation model of a single phase 5 level CHMLI

4.2 Three Phase Multilevel Inverter

A three phase multilevel inverter converts DC to three phase AC and each phase is having a phase shift of 120°. Here a three phase seven level inverter is built by using a three single phase cascaded inverter with 120° phase shift. The pulse generation method used is SPWM technique. For each phase two single phase inverter is used as cascaded method and forms the output. The Simulation model and results are shown below.

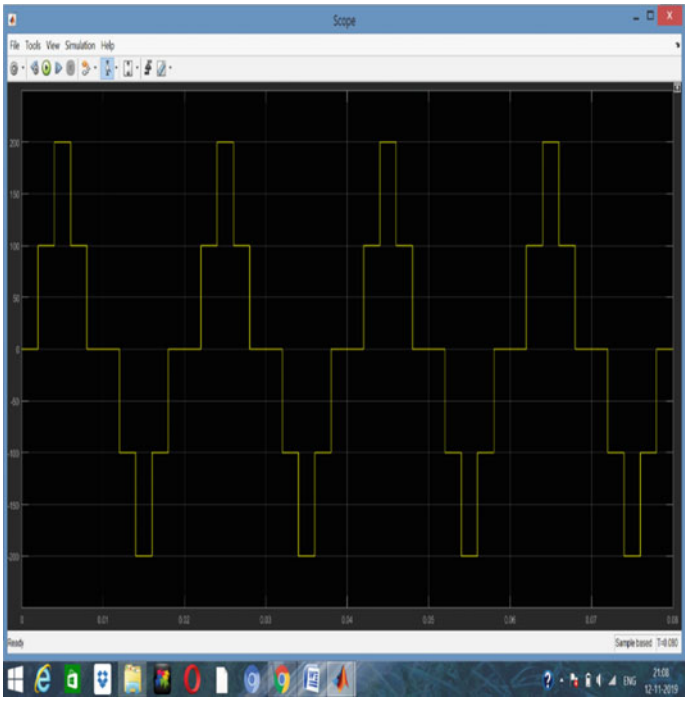

Fig. 4 Output voltage of a five level inverter

MATLAB Simulation:

Figure 5 shows the simulation model of a three phase seven level inverter. Figures 6, 7, 8, 9, 10 and 11 show the Phase-A, Phase-B, Phase-C, Phase A1, Phase-B1, Phase-C1 subsystems, respectively.

Figure 12 shows the output voltage of a three phase seven level inverter and Fig. 13 shows the layout view of the output voltage waveform showing the phase shift. The three phase inverters are designed for operating three phase equipment purpose. The three phase design includes three sinusoidal signals at different phase angles, such that is 0, 120 and 240°. These three sinusoidal waveforms are compared with a positive and a negative carrier waveform to produce PWM pulses for the inverter, which should be given to the switching devices [7–9].

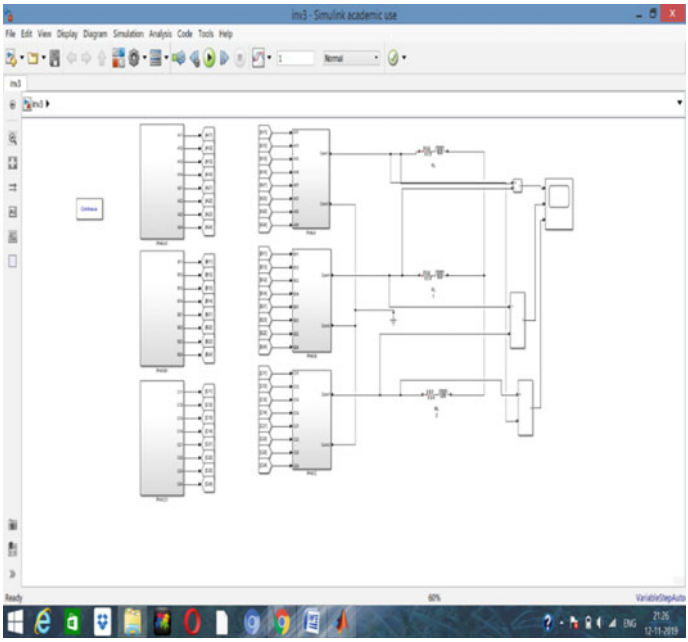

Fig. 5 Overall Simulation model of a three phase seven level inverter

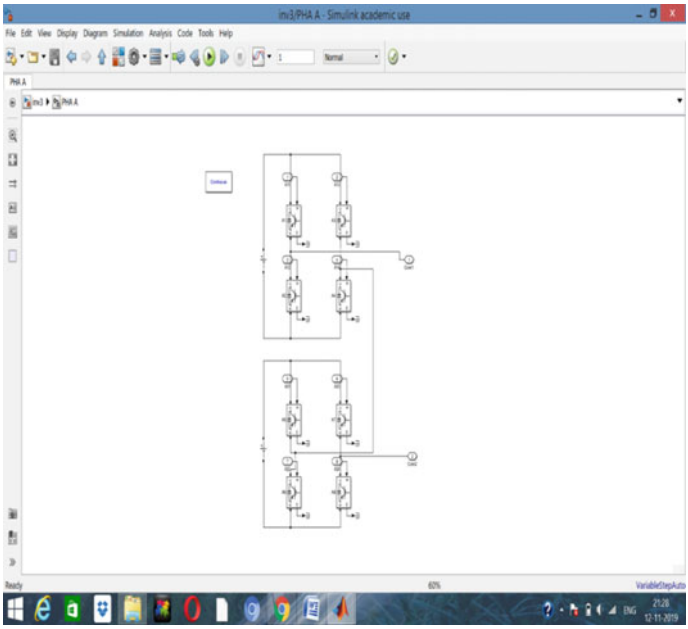

Fig. 6 Phase-A subsystem

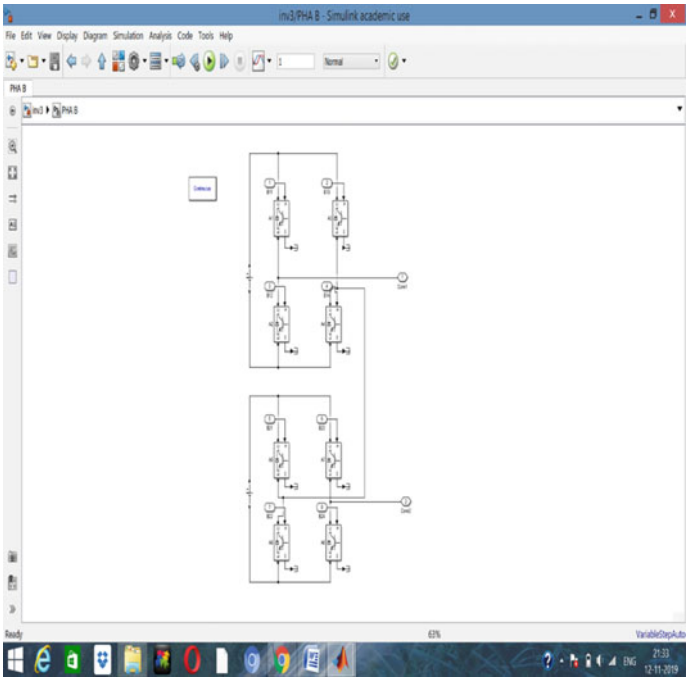

Fig. 7 Phase-B subsystem

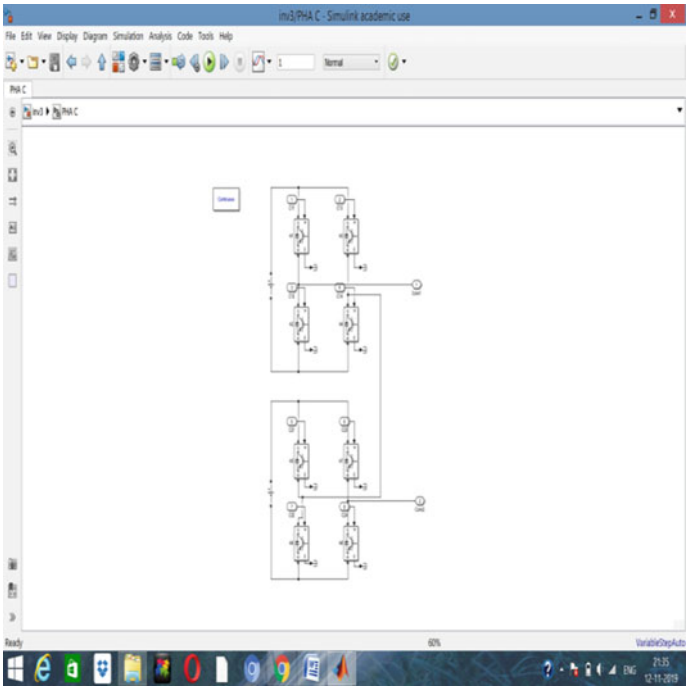

Fig. 8 Phase-C subsystem

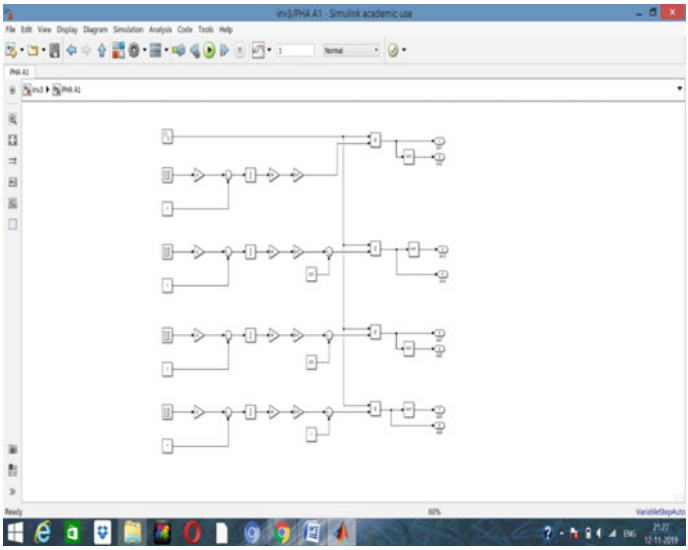

Fig. 9 Phase-A1 subsystem

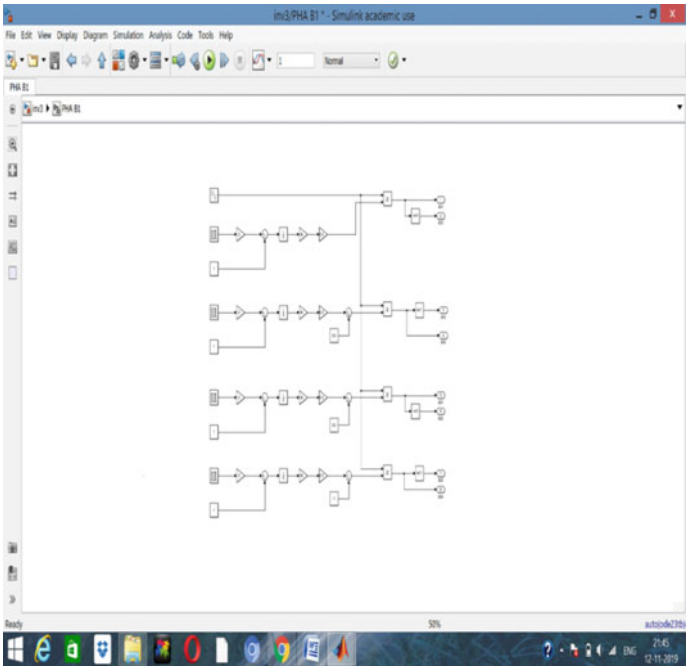

Fig. 10 Phase-B1 subsystem

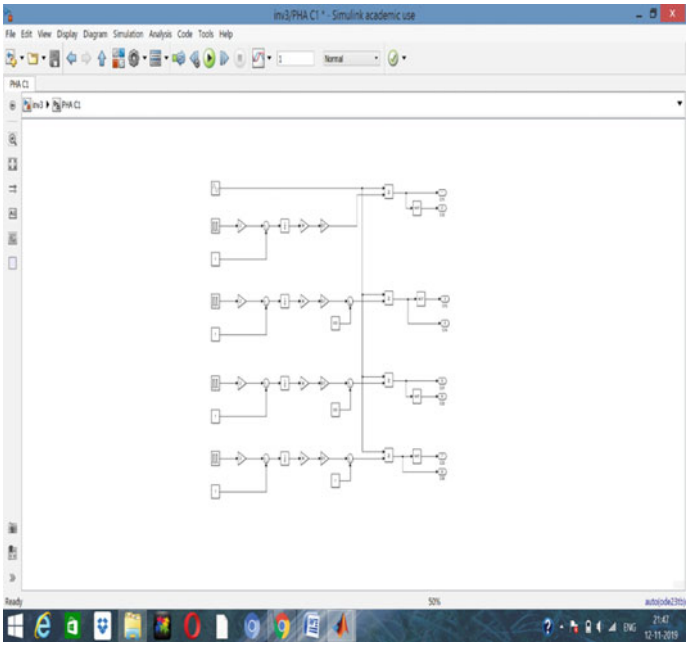

Fig. 11 Phase-C1 subsystem

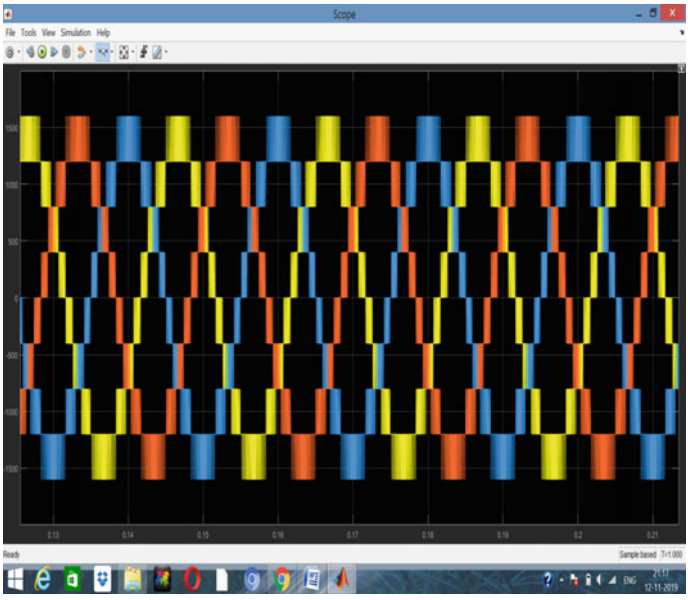

Fig. 12 Output voltage of a three phase seven level inverter

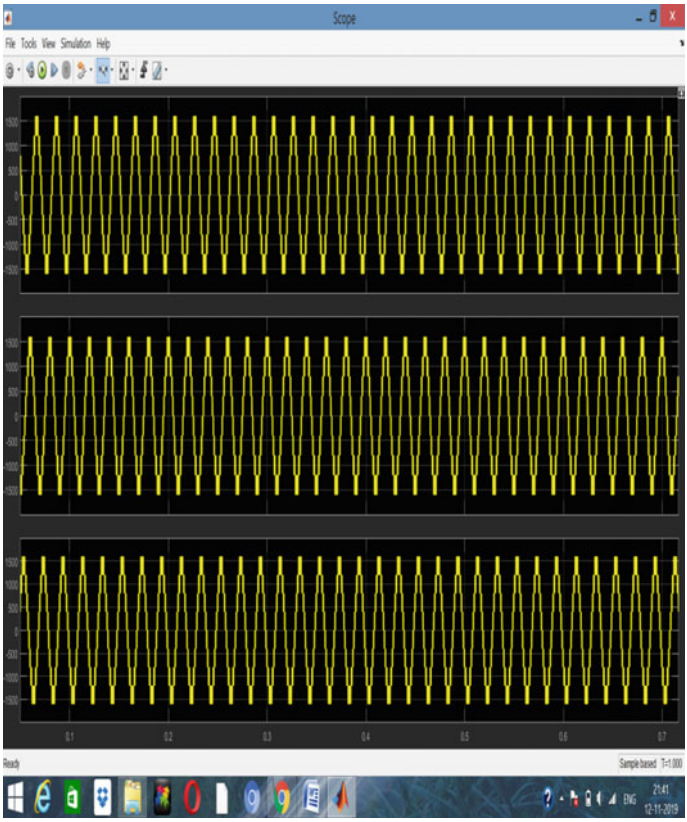

Fig. 13 Layout view of the output voltage waveform showing the phase shift

5 Conclusions

This paper mainly aims on simulating a single phase and three phase inverter models with SPWM technique using MATLAB/SIMULINK. The waveform results obtained are shown for both the simulations. It is observed that the output obtained were of the desired output voltage with expected frequency and amplitude. For the simulation, the unfiltered voltage and IGBT/diode current waveforms were of similar nature. Also the types of multilevel inverters with their applications are discussed.

Acknowledgements The authors express gratitude to Accendere Knowledge Management Services Pvt Ltd for the assistance provided in preparing the manuscript.

References

1. Singh AV, Singh RS (2018) A comparative study of multilevel inverter topologies. Int Res J Eng Technol (IRJET) 05(03)
2. Khoucha F et al (2011) A comparison of symmetrical and asymmetrical three- phase H-bridge multilevel inverter for DTC induction motor drives. IEEE Trans Energy Conver 26(1):64–72
3. Prayag A, Bhodke S (2018) A comparative study of symmetrical and asymmetrical cascaded H-bridge multilevel inverter topology for industrial drive. Int Res J Eng Technol (IRJET) 05 (02)
4. Sanju B, Paul RT, Grace, M, Mohanan A (2019) THD analysis in cascaded H-bridge multilevel inverter. In: 2019 National conference on emerging research trend in electrical and electronics engineering (ERTE 2019), May
5. Jung E, Sul S-K (2009) Implementation of grid – connected single phase inverter based on FPGA. In: 2009 24th Annual IEEE conference on applied power electronics and exposition, pp 889–893
6. Maharshi S, Kampariya P (2014) Simulation of single phase SPWM (unipolar) inverter. Int J Innov Res Adv Eng (IJIRAE) 1(9):12–18
7. Sharma MK, Swaroop R, Kuldeep MK (2016) Cascaded connection of single-phase and three-phase multilevel bridge type inverter. Int J Digit Appl Contemp Res 5(1)
8. Padaki RG, Dodakundi M, Layadgundi A (2015) Implementation of cascaded H-bridge multi-level inverter. Int J Modern Trends Eng Res (IJMTER) 02(01)
9. Ngarajan R Yuvaraj R, Dinesh Kumar K, Dinesh Babu, R Manikandan M, Meiyanbu S (2016) Implementation of SPWM technique for inverter. Int J Adv Res Biol Eng Sci Technol (IJ ARBEST) 2(9)

Design of Two Way Solar Tracking

M. Ashwin and S. Yashwanth Gowda

Abstract Solar tracking has created a great trend in the field of producing renewable source of energy. In this paper we propose a two way solar tracking system which would increase the total efficiency, this involves tracking of the sun in dual axis. To accomplish this we have used two motors for the movement in two axis. This paper would imply that the use of the mentioned method would result in more power consumption, high operating cost.

Keywords Solar panels · Solar tracking · LDR · Servo motor

1 Introduction

The most sustainable source of energy is the solar energy. Nowadays the extraction of energy from it has become the biggest challenge, the better way extracting the energy is use of solar panels. Solar panels are the devices which harness the solar energy produced by the sun and converts the available solar energy to electrical energy. The main disadvantage of this was, it couldn't generate the same amount of energy at different time of the day. So the concept of solar tracking came into picture, now this works on the principle of the moving the solar panel based on intensity of sunlight. We know that the sun does not exactly move from East to West, it follows [1] some direction pattern, the conventional solar tracking was about moving the solar panel vertically, this project aims in moving the solar panel in both horizontal and vertical axis so that the panel can track every movement of the sun and thereby increasing the efficiency of the solar panel.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_86

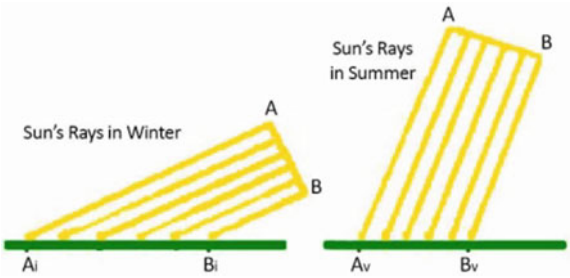

Fig. 1 Showing the types of rays in different season

Figure 1 shows the sun's ray when it is incident on the surface in winter and summer. From the image we can infer that during winter it has maximum slope and the sunlight energy is minimum. And due to rotation the sun's visibility is low. During summer the sun moves inside the orbit which takes high in sky and remain there for most of the day. Due to this there is perpendicular incidence of the sunlight and has greater efficiency. As we move towards equator this effect is emphasized. In polar region the days are longer in summer and shorter in winter, while in other regions there would be slight variation in the length of day and night.

Due to this reason the solar path would change depending on the latitude and they are mainly affected by the angle of incidence of the sun's ray which plays an important role in production of solar energy. The variation is expressed as follows i.e., as the angle of incidence increases the energy production increases, therefore the main aim is to know the aligning of the location. For calculating the slope PVGIS (photovoltaic geographical information system) is the important tool, it also allows the operator to know the production of energy according to the location.

Recently many innovative methods have been developed to increase the solar energy collection from solar cells. [2, 3] However there are numerous limitations [4] in all these methods, which can be overcome and the solar energy collection can be maximized by precisely controlling and optimizing the solar tracker systems [5].

2 Different Classes of Solar Trackers

Solar tracker consists two parts one is the fixed part and the other is movable part which has the criteria of following the sun's movement. The goal here is to increase the amount of energy accumulated by the solar panel which consequently increases the efficiency. It consists of two major kinds of solar trackers which depend on their movement.

- **Single axis**: This kind of tracker rotates on a single axis the azimuth angle, usually tracking the Sun's movement from East to West [6–10].
- **Two axis**: Along the horizontal azimuth angle, this kind of tracker will follow the elevation i.e. the solar zenith angle, thus attaining a full tracking [11–14].

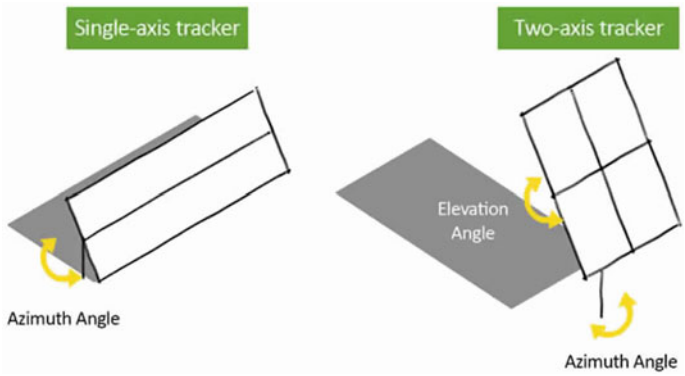

Fig. 2 Showing the types of solar tracker

Figure 2 shows the single axis and dual axis tracker movement orientations. The production of energy can be increased by 30% with respect to single axis and 40% with respect to dual axis solar tracker.

3 Miniature Prototype Details

1. PROTOTYPE UNIT

   1.1 Components used
   1.2 Methodology

2. SOFTWARE PART

   2.1. Servo-motor initialization
   2.2. LDR pin connection
   2.3. Servo connections

3.1 Components Used and Specification

(1) 1 Arduino Uno ATmega32P- 8bit AVR Family microcontroller
(2) 9 g Micro-servo motors with service arms Torque-1.5 kg-cm
(3) Sensor shield
(4) 5 and 4 port screw terminal blocks
(5) Jumper cables
(6) 4 light detecting resistors (LDR)
(7) Solar cell 6 V, 200 ma

(8) Woods
(9) Miscellaneous

4 Methodology

This solar tracking involves light detecting sensors which sense the peak light intensity and track the solar panel accordingly. Here for tracking purpose in required direction the Arduino is programmed in such a way that the solar panel would track the solar panel in the direction of the maximum amount of solar intensity received by the light detecting resistor. The programming of Arduino would be explained in the upcoming section. For the prototype we have used the MDF Materials i.e. the medium density fiber board, our prototype involves of tracking the sunlight in two-way since the movement of the sun during an ordinary day is not exactly from East to West. For horizontal tracking we have mounted the servo motor where the shaft is facing upwards as shown in the Fig. 3 below.

For the vertical movement the servo-motor is mounted side-wards so that when programmed the servomotor would coordinate with each other and track the solar panel. Figure 4(a) shows the mounting of servomotor on the MDF board facing sideward.

For tracking of the sunlight we have used LDR (Light detecting resistors) which are mounted and programmed in such a manner that whenever the light falls on respective designated resistors the solar panel should be tracked in that direction which is shown in Fig. 4(b).

The Fig. 5 shows the connection of LDR and servo-motor to the Arduino board. The LDR has two leads, one lead is connected to the 5 V supply and the other lead is connected to the ground through the resistor of 100 k and the same lead is connected to the analog pins of the Arduino.

The servo motor consists of three leads one is for supply, one is for ground and the other is connected to digital pins (PWM) as shown in the figure.

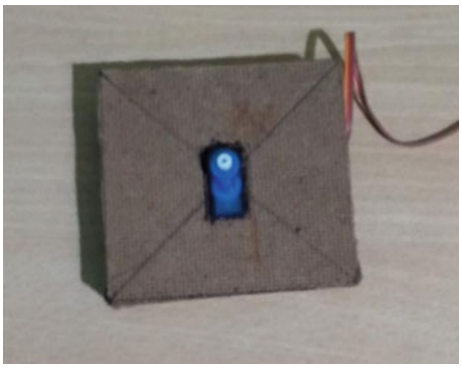

Fig. 3 Showing the mounting of servomotor facing upward

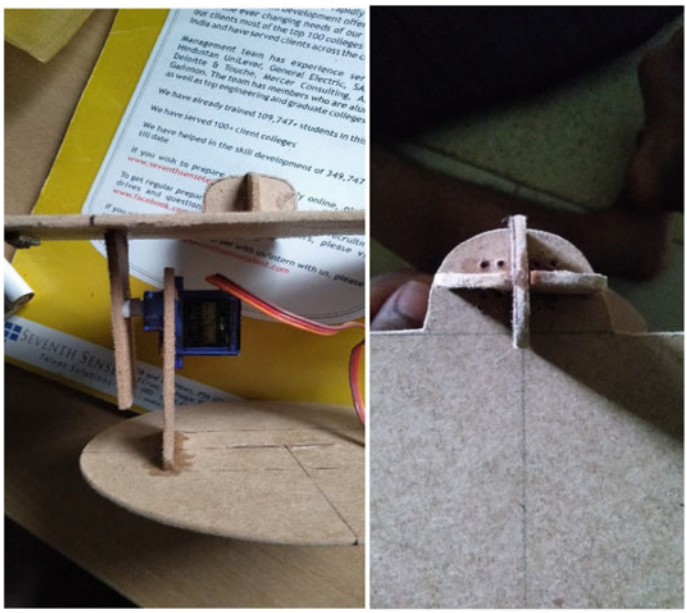

Fig. 4 **a** Showing the mounting of servomotor facing sideward **b** Positioning of LDR's

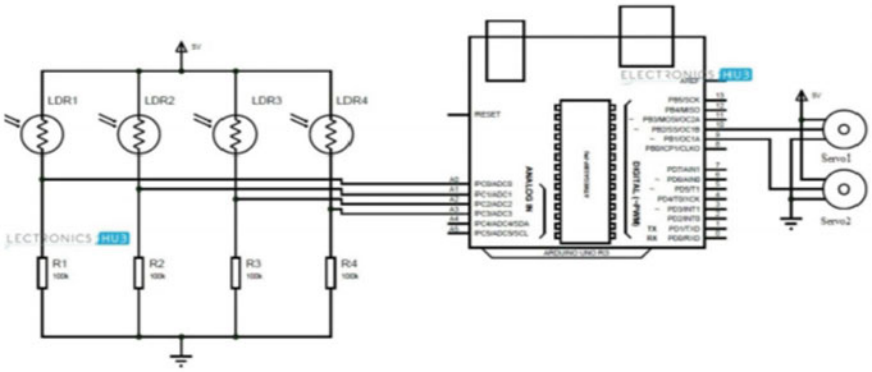

Fig. 5 Showing the connection of LDR circuit to Arduino Uno

4.1 Tracker Flow Algorithm

Figure 6 shows the flowchart of working of the solar tracker depending on the intensity of the solar rays on the LDR (light dependent resistor). The solar tracker is programmed in such way that it takes the average values from the 2 LDR and sends

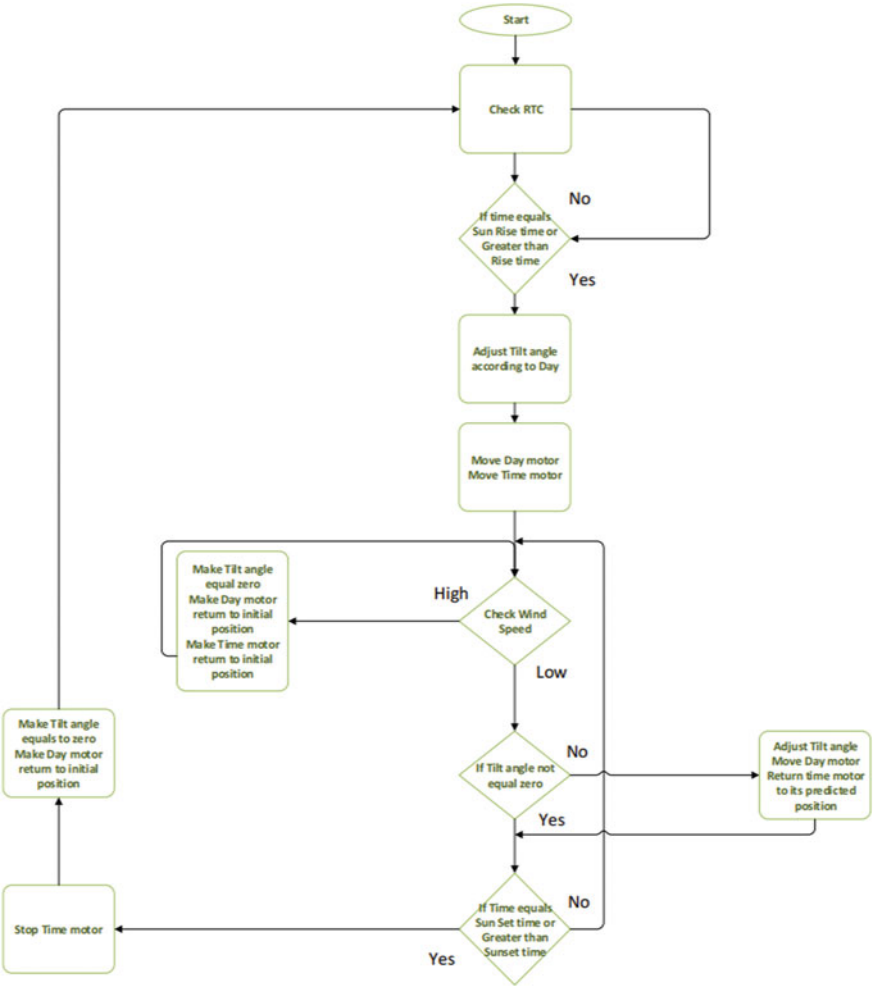

Fig. 6 Showing flowchart of solar tracker

signal to the tracker from the corresponding movement which is efficient when compared to single axis solar tracking Fig. 7.

4.2 Scalability

The project involves the use motors having the torque 1.5 kg-cm, so these need to be scaled for the real utilization of the solar tracker so the calculation is done to

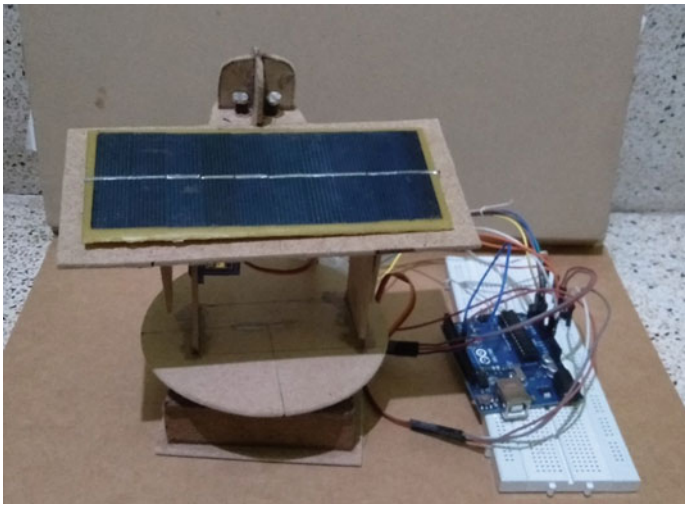

Fig. 7 Showing the prototype of two way solar tracking

know the torque of the motor when it is used in real scale. In real scale we will use the solar panel of 200 W whose specification is mentioned below

Length = 1320 mm
Breadth = 992 mm
Thickness = 35 mm
Weight = 14.5 kg

4.3 Calculation of Torque

- Horizontal Motor

For horizontal motor the load need to be pivoted at the center, so the uniformly distributed load needs to be converted [15] into point load. And this motor needs withstand an extra load of the setup of approximately 3 kg, so the total weight is 14.5 + 3–18 kg.

For calculating torque in kg need to converted into newton

1 kg = 9.81 N
For 18 kg, 18 * 9.81 = 176.58
Torque is given by, T = F * d, here d is to be divided by 4 for point load conversion
Where f is force and d is distance
Therefore, 176.58 * 1320/4 * 10 – 3 = 58.27 Nm

- Vertical Motor

  Again for this motor T = F * d
  Since it supported at one end
  7.25(9.81) * 486 * 10 – 2 = 345.67 kg-cm
  By converting kg-cm to Nm
  345.67 kg-cm = 33.89 Nm

4.4 Power Consumption

Since we have used 200 W solar panel assuming the ideal condition it would produce 1.6 kwh if it operate for 8 h a day. But as we are using the solar panel in two way axis it would produce 81.68% [16] higher than the fixed panel. So the total amount of power produced is

1.6 kwh + 81.68% (1.6) kwh–2.90 kwh

Motor power consumption

For horizontal motor having the torque of 58.27 Nm the market availability is 60 Nm–600 kg-cm and its specification are as follows,

(1) Operating voltage 48−170VDC
(2) Torque = 600 kg-cm
(3) Current 6 A

Therefore power consumption P = VI.

109 * 6 = 654 W.

For vertical motor having the torque of 34.59 Nm the market availability is 40 Nm–400 kg-cm.

The power consumption for vertical motor is same as that of the horizontal motor hence 654 W.

The total power consumption 654 * 2 = 1308 W.

5 Result

From the project the output of the two way solar panel tracking is 2.90 kw and the power consumption of the two motors used is 654 W each. And total available power for the utilization is about 1.6 kw.

6 Conclusion

The project gives both power output of the tracking and the power consumed by the motors, since the power consumed by the motors are load the power output remaining for the useful purpose is slightly less when compared to the stationary

solar panel of about 15%. Since the power output is slightly less when compared to stationary panel, it can be overcome by reducing the power consumption of the motor or by using linear actuators instead of motors, this increases efficiency of the two way solar panel tracking.

Acknowledgements The authors express gratitude to Accendere Knowledge Management Services Pvt Ltd for the assistance provided in preparing the manuscript.

References

1. Prinsloo GJ, Dobson RT (2005) Solar tracking. SolarBooks, Stellenbosch ISBN 978-0-620-61576-1, pp 1-542
2. Mane SG, Korachagaon I, Hans MR, Sawant AS (2018) Simulation of dual axis solar tracking system. In 2018 International conference on information, communication, engineering and technology (ICICET)
3. Shi L, Chew MYL (2012) A review on sustainable design of renewable energy systems. Renew Sustain Energy Rev 16:192–207
4. De Castro C, Mediavilla ML, Miguel J, Frechoso F (2013) Global solar electric potential: a review of their technical and sustainable limits. Renew Sustain Energy Rev 28:824–835
5. Bentaher H, Kaich H, Ayadi N, Ben Hmouda M, Maalej A, Lemmer U (2014) A simple tracking system to monitor solar PV panels. Energy Convers Manag 78:872–875
6. Sallaberry F, Pujol-Nadal R, Larcher M, Rittmann-Frank MH (2015) Direct tracking error characterization on a single-axis solar tracker. Energy Convers Manag 105:1281–1290
7. Li Z, Liu X, Tang R (2011) Optical performance of vertical single-axis tracked solar panels. Renew Energy 36:64–68
8. Li Z, Liu X, Tang R (2010) Optical performance of inclined south–north single-axis tracked solar panels. Energy 35:2511–2516
9. Chang TP (2009) Performance study on the east–west oriented single-axis tracked panel. Energy 34:1530–1538
10. Chang TP (2009) The gain of single-axis tracked panel according to extraterrestrial radiation. Appl Energy 86(7):1074–1079
11. Sun J, Wang R, Hong H, Liu Q (2017) An optimized tracking strategy for small-scale double-axis parabolic trough collector. Appl Therm Eng 112:1408–1420
12. Eke R, Sentruk A (2012) Performance comparison of a double-axis sun tracking versus fixed PV system. Sol Energy 86:2665–2672
13. Arbab H, Jazi B, Rezagholizadeh M (2009) A computer tracking system of solar dish with two-axis degree freedoms based on picture processing of bar shadow. Renew Energy 34:1114–1118
14. Song J, Yang Y, Zhu Y, Jin Z (2013) A high precision tracking system based on a hybrid strategy designed for concentrated sunlight transmission via fibers. Renew Energy 57:12–19
15. Deepthi S, Ponni A, Ranjitha R, Dhanabal R (2013) Comparison of efficiencies of single-axis tracking system and dual-axis tracking system with fixed mount. Int J Eng Sci Innov Technol **2**: 425–430
16. Dhanabal R, Bharathi V, Ranjitha R, Ponni A, Deepthi S., Mageshkannan (2013) Comparison of efficiencies of solar tracker systems with static panel single-axis tracking system and dual axis tracking system with fixed mount. IJET 5(2):1925–1933

Authenticated and Privacy Ensured Smart Governance Framework for Smart City Administration

Srinivas Jangirala and Venkamaraju Chakravaram

Abstract Managing cities efficiently requires a great combination of top-down and bottom-up ICT-enabled methodologies in order to make the city governance a complex phenomenon. To develop the Smart City solutions, the upgrading of a major source of urban, socio-economic and environmental data needs to be considered. This builds the notion of Smart Cities a huge momentum and attracts the researchers to work on this issue in the past decade. From the administrator's point of view, the ICT potentially collects and processes the city data to aim for secure effectiveness and efficient city planning, decision making, and smart governance. We understand that, the developing innovative domain-specific applications to access the urban data and administrate the city with the help of Smart devices is a challenging task. There arises a strict need for privacy and security issues to be handled by the administration. We suggest the studies to ensuring the security which gives various benefits, such as uninterrupted smart governance, authentication and ensuring security with the potential help of high-performance computing paradigms like cloud computing enrich the Big Data management approaches to provide the smart governance.

Keywords Authentication · Big data · Cloud computing · Smart city · Smart governance

1 Introduction

The association solidifies each directing arrangement of political, social, fiscal, illuminating, progress, city foundation and authoritative work to improve the accomplishment and headway in the urban systems comparatively as nation. The

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_87

possibility of association impacts the improvement of urban systems. The savvy urban areas are an ICT drawn in city, which enables rapid correspondence, ceaseless data to local people, quality life, all around related transport, better metro associations, thriving work environments, resolute vitality and water supply, condition shielding and fitting utilization of typical assets.

To keep up the watchful idea of unbelievable urban domains, local people are required to recover all data and take an interest feasibly in the association works out, progress plans, and future frameworks, and so on. For the amazing sharp urban systems, occupants' suggestions, support and responses in government process are fundamental. Subsequently, there is essential for a suitable association system and the two different ways correspondence channels profitable magnificent city affiliation.

1.1 The Concept of Smart City

The smart city concept involves various application areas. So far from the studies we identified the application-based areas as 12 which are related to smart cities (See Fig. 1) such as "smart device, smart home, smart environment, smart transportation, smart energy, smart logistics, smart health, smart building, smart farming, smart security, smart education, and smart hospitality." The classification of these areas is presented in a hierarchical graphical structure of smart cities as shown in Fig. 1. The advantage of connecting the smart devices with the smart environment, key resources facilitate the citizens, companies, governments, and local resources in collecting the data that can facilitate the resources and help the stakeholders. This associates in development of different shrewd associations to the accessories, for example, gifted success associations, unbelievable vitality associations and smart transportation office. This gives us an understanding that the stake holders can interact with each other and redevelop or recreate the value of the services. This shows that to fix/fit all these elements to incorporate we observe smart cities takes the top place in the hierarchy [1].

Thus, such tremendous volumes of information or huge information are at the point of convergence of the associations rendered by the IoT. The miracle of enormous information has for a long time been portrayed by volume, speed, and an accumulation of information types that have been made at dependably expanding rates. Epic information offers the potential for the city to get fundamental bits of gaining from a lot of information amassed through different sources. Obviously, the characteristics of such information by and large join unstructured highlights separated and tremendous information amassed by different methodologies. Figure 2 speaks to the scene of the sharp headways with colossal data and dispersed registering, in which diverse sharp applications exchange information using introduced sensor contraptions and distinctive devices composed with the circulated figuring establishment to make a great deal of unstructured data.

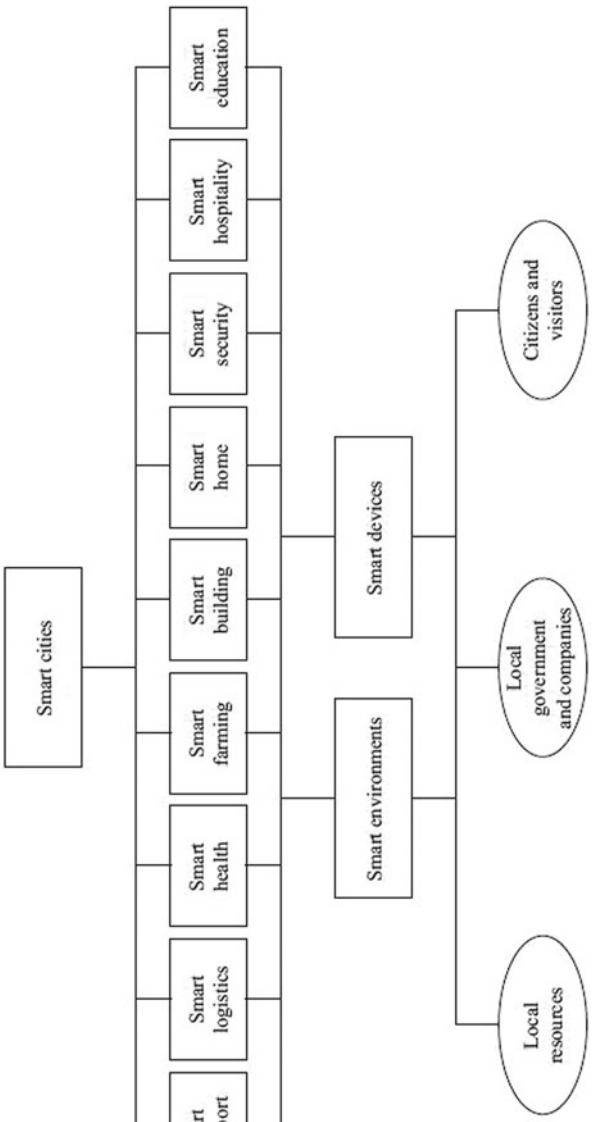

Fig. 1 Landscape of the smart city and big data technologies

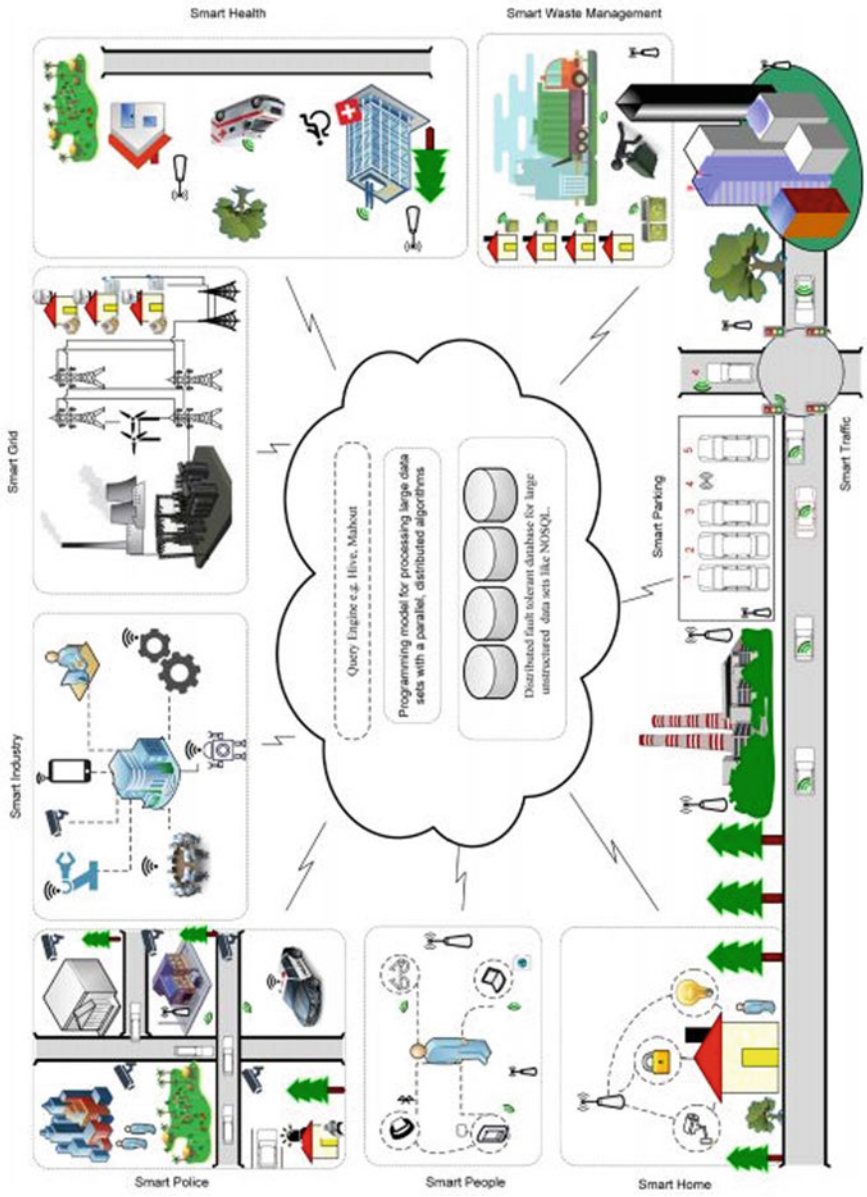

Fig. 2 Hierarchical structure of application areas related to smart cities

1.2 The Concept of Big Data

In Big Data conditions, Big Data organizations must be given wherever, at whatever point customers need them. While a customer arranged in a specific area where Big Data organization is offered moves to another domain, the server giving Big Data organization needs to apply the individual information of the customer in Big Data organization district to the security work and certification that the individual information of the customer isn't introduced to an untouchable in the midst of the organization time period. At the present time, there must be more than one server giving Big Data, and the servers can't be arranged in a comparative spot. Customers tolerating Big Data organizations should in all likelihood get Big Data services at their desired locations, not from a specific server.

2 Smart City Applications and Developments Using Big Data and ICT

Among the changing bits of sharp urban zones, the ICT perspective is key for the improvement of clever city applications. Pros have investigated ICT-driven exercises and strategies toward structure up a smart city. Diverse progressing existing examinations have deliberated the effectiveness of numerous ICTs aimed at the improvement of applications to develop astounding city, for instance, IoT, smartcards, sensors, tremendous data examination, security the administrator's systems, geographic information structures, and PC created reality. Permitting to a printed examination of 5378 papers, ICTs for adroit urban zones can be arranged into "4Cs" development factors, to be explicit, such as: Collection of data for setting care, Connection among people and things, Computation in the cloud, and Communication by remote techniques [2].

Yet all of these developments must be deliberated in a smart city application improvement adventure, the framework for ICT-engaged organizing of splendid urban networks exhibits the usefulness of the data compelled strategy for keen urban networks. Other progressing examinations have seemed strong capacity of urban gigantic data masterminding and procedure improvement for smart cities.

3 Literature Study

Regardless of making Fig. 1 (quantitative examination), a down and out unique outline of the structure finds that the smart city thought joins alternate points of view, ICT, sensible budgetary improvement, high check of life [3], Bakici et al. [4] discussed in their work regarding the hig-tech intensiveness applicability and the connectivity required to enrich the smart city facility, Barrionuevo in 2012

discussed about the intelligence information, and applicable integrity so as to utilize the smart city [5], Giffinger et al. 2007 come up with an awareness citizens concept in the smart city [6], Komninos, in 2015 discussed about the learning, inventiveness or creativity needed in the applicability of smart city [7], information reality, and high viability was discussed by Kourtit et al. [8] in 2012, vigilant economy, able individuals, sharp association, wonderful adaptability, canny condition, and mind blowing living was discussed by Lombardi et al. [9] in 2012. These are only a limited event of the different bits of the talented city suspected that show the transdisciplinary thought of sharp city research. The quick city thought lies in a gathering of city affiliation, occupant respect creation, nearby business, ICT progress and application, urban gigantic information, fiscal issues, and humanism, among others.

The online frameworks organization could be utilized for neighbourhood fortifying and emergency conditions. Robotization in association through e-association has improved the ability and straightforwardness in the association strategies and associations. The association can utilize web frameworks organization to talk about execution challenges, new associations, checking the strategy, unreservedly supporting over different issues to get the fitting courses of action [1, 10–12].

4 Role of Bigdata in Smart Governance

Currently, in the real-world big data connected with the smart city environment the applicability is divided into four projects such as for customers the information based designing, analysis of existing data-based on the availability of the public service as a part of cases considered in multiple cities, based on the reviews and interviews dealt with experts and analysts to the participants as a part of practitioners experience related to the public data who are utilizing the public-services in developing the smart cities, and designing and evaluation of new data-based public-services in the smart cities. These tasks are highly rated and requires much organized and efficiency to conduct coherently the design work so as to attractively done and enrich the public services which can be workable using databases. We by then perceived troubles related to the difference in data to information reliant on the four exercises. Plus, we recognized things that should be considered in data use for astute urban networks. The goal of this examination is to offer an extensive investigation of colossal data in splendid urban networks, even more expressly, the activity of gigantic data for sensibility and improvement for the desires for regular solaces in urban territories. After several iterations, we arrived at the six challenges in Sect. 5 and the framework for smart governance is discussed in Sect. 6. We then present the best practices which can be possibly considered in smart governance in Sect. 7. Finally, we draw out the conclusions in Sect. 8.

5 Challenges

In this Section, we discuss the challenges obtained in handling and designing the smart city development and transforming the data into information for smart cities has been classified into six. The initial Challenges (1–3) more or less relate to the data handling than to the actual information dealing with, whereas the other Challenges (4–6) are more related to the evidence generated than to information dealing.

1. **Managing the data quality:** A basic for recognizing responsible smart city data is the idea of urban data. The idea of available data should be considered, and ways to deal with redesign the eminence must be perceived in data driven smart city headway adventures for gaining ground in the organized endeavor.
2. **Integrating different data:** In this, the combination of information from various sources is supervised. Various sorts of information are gathered from various sources in present day urban regions. The key is to relate indisputable sorts of information to make an abnormal state of learning and top of the line data for occupants and city specialists. Regardless, interfacing information from various sources is troublesome considering the way that different affiliations utilize obvious information structures to deal with the information. Thusly, verifying gainful information for a sharp city and getting ready for information joining ought to be facilitated in information based adroit city improvement attempts to welcome the endeavour extension and potential for its headway.
3. **Addressing privacy issues:** In this, different people were worried over their security. Despite how local people were responsive of the new respect that new associations can make, some imparted unequivocally that a fundamental of association execution ought to be an affirmation of their security. Investigating the security issues and watching out for these burdens are fundamental in information-based awe-inspiring city improvement activities to make critical and reasonable stimulus for local people and guests.
4. **Understanding the needs of employees, citizens, and visitors:** This test proposes understanding the necessities of occupants, guests, and representatives. A fundamental of gigantic information use is seeing the correct data for occupants; the necessities of workers are additionally essential. The recipients of enormous information is magnificent urban systems join city specialists and masters of neighborhood affiliations. These representatives expected to utilize information for the affirmation and usage of focus structures for their diverse occupations and the particular check of authorities who required further arranging or remarkable idea. This outcome demonstrates that workers of neighborhood master focuses advantage fundamentally from urban enormous information. Picking pleasing data for local people, guests, and authorities is fundamental in information assembled sharp city movement experiences as for the grounds that seeing the data to pass on to clients is unequivocally associated with the respect and enthusiasm of an association.

5. **Enhancing geographic information delivery methods:** This test relates to advance of geographic data transport systems. Different enormous information use cases hope to isolate the information and pass on apparent data as per a geographic unit (e.g., zone and building). Different stars demonstrate that the key achievement feature of colossal information use in sharp urban regions is the abundancy of data depiction and transport utilizing GIS. In information based sharp city movement experiences, depictions of data substance ought to be clear and liberal to improve data attestation by local people, guests, and representatives.
6. **Designing smart city services:** This system improves the profitability of unending regard co-creation. Everything considered, the headway of an organization that passes on smart city information can be beneficial to locals & adjacent administrations. Organizing a data driven sharp city organization is indispensable in light of the way that this task facilitates most of the effects from the information examination, ideation, and information satisfies the arrangement for a smart city.

These challenges are interrelated as the collection of data and creation of information, and delivery of the information to enhance the information-driven smart cities which are considered as the dependent actions. For example, based on the requirements of the citizens, employees, visitors are taken care by the Challenge 4 as a criterion to integrate the data properly. This can be dealt in Challenge 2, and Challenge 6 is faced during the conniving eye-catching and doable smart city businesses which requires and considers all the five challenges. This indicate that the six challenges collect huge amount of big data that is produced by the citizens or visitors of the smart cities certainly requires different kinds of validated proficiency, which includes the city administration, knowledge of citizens, data analytics, data management, law, and service design. For example, while addressing the Challenge 1 a serious amount of expertise is required in producing and handling the data management, furthermore, Challenge 3 needs thorough expertise in regulations in defining the laws. Challenge 4 requires an expertise in marketing which would contribute in addressing all the hurdles. Meanwhile, through the integration of a diverse range of expertise can only be addressed in Challenge 6.

6 The Framework for Smart Governance

In the smart city we assume the system structure can be represented as in the Fig. 3, which represented by segregating into multiple layers to enable our understanding on the development of smart city technology and big data management. Each layer looks out for the potential solace of mammoth data sharp city parts. The standard layer is the methodology of things and contraptions related through close-by or possibly wide-region structures. A monstrous locale of these articles and devices successfully make a gigantic dimension of unstructured data reliably. In the second

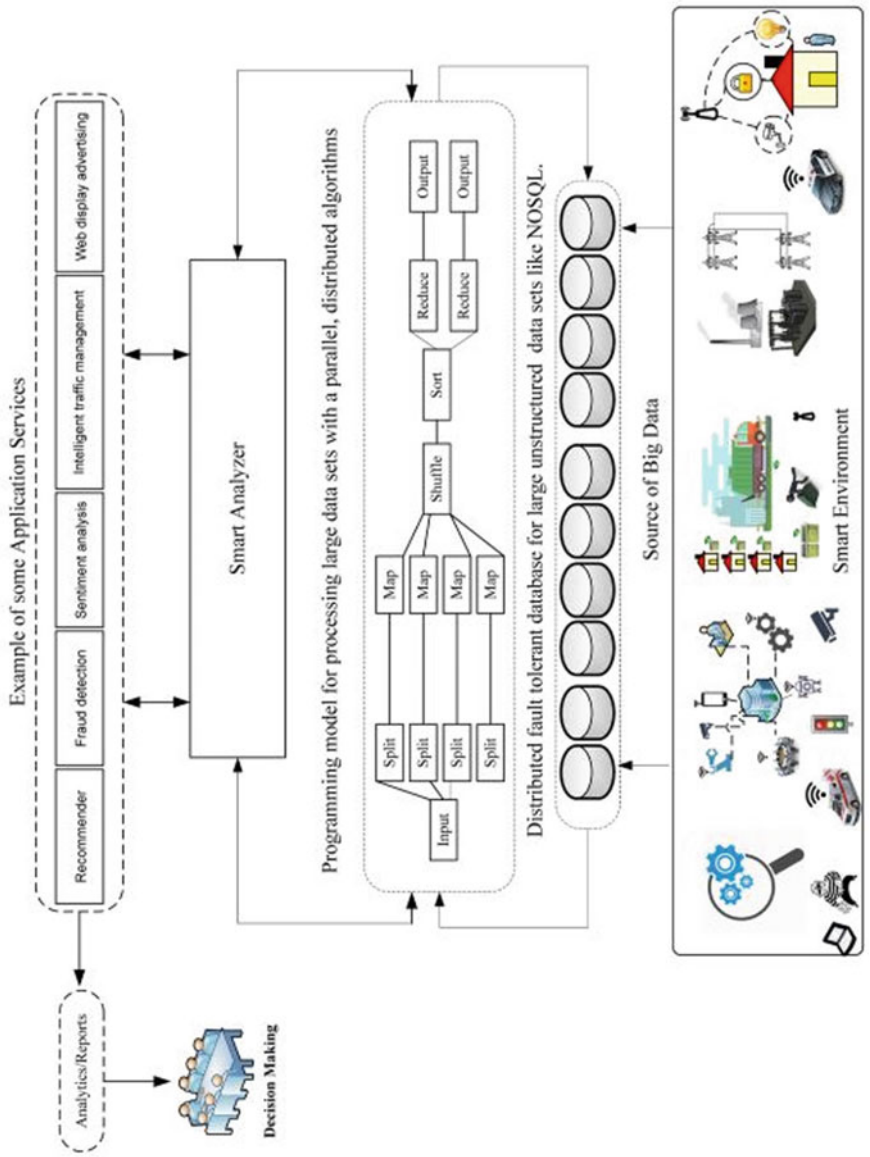

Fig. 3 Construction frame of big data technologies for smart city

layer, all the amassed unstructured data are checked in a common spread scold tolerant database found either in the city server ranch outfitted with all structure parts or by massive data confirming, for instance, “S3”, “Google cloud affiliations”, and “Azure from shippers”, for instance, “Amazon, Google, Microsoft, and Cloudera”. Accumulated huge data store structures can be used in these cases, for instance, “Cassandra, MangDB, CouchDB, Voldemort, DynamoDB, Hbase, and Redis”. Inside a close layer, the set away data are readied depending upon the pushing toward referencing using pack-based programming model, for instance, MapReduce framework or other supervising engines used for massive data. MapReduce gives a basic programming model to parallel and appropriated masterminding of gigantic data on social gatherings. In stream directing, data must be framed quickly so affiliations and individuals can react to changes reasonably in a wonderful city condition. Specific degrees of progress can reinforce structure and follow up on proceeding on spilling unstructured data sufficiently, for instance, Spark, Storm. The last layer is the application relationship, in which people and machines explicitly gather as one with each other to settle on sharp decisions. Such applications can be used for different purposes, for instance, proposal, press zone, estimation examination, sharp traffic the board, and web show examination.

7 Best Practices for Smart Governance

The office for E-data, E-counsel and E-support through internet-based life satisfies the essential criteria of savvy administration for a brilliant city. The intuitive observing procedure for arranging and arrangement usage builds the straightforwardness in the legislature.

In this way, the system proposes that the online networking improves government usefulness, arranging and reachability, and client interests for the urban areas advancement. Consequently, the web-based life assumes a pivotal job in the change of city administration into savvy administration.

8 Conclusions, Limitations and Future Research

The critical augmentation in related contraptions in urban zones has incited the quick advancement of data, which has evoked the thought of various authorities in different research spaces. This paper plans to offer a sweeping viewpoint at work of tremendous data in a sagacious city. In this exceptional situation, we discussed the enabling advances used in the sharp city. The future arrangement of activity and structure with the purpose of managing colossal data for sharp city were in like manner proposed, and the usages of the splendid urban networks in which immense data examination can accept an essential employment were discussed. Relevant examinations were similarly portrayed out. Finally, a couple of open research

challenges were revealed to give the examination course to the new investigators in the zone. Finally, we reason that immense data can accept a basic occupation to the extent expanding critical information and for fundamental authority purposes. In any case, colossal data investigate in a splendid city is in its most punctual stages and course of action of the discussed challenges can make it a sensible field.

References

1. Lim C, Kim K-J, Maglio PP (2018) Smart cities with big data: reference models, challenges, and considerations. Cities 82:86–99. https://doi.org/10.1016/j.cities.2018.04.011
2. Lim C, Maglio PP (2018) Data-driven understanding of smart service systems through text mining. Serv Sci. 10(2):154–180. https://doi.org/10.1287/serv.2018.0208
3. Caragliu A, Del Bo C, Nijkamp P (2011) Smart cities in Europe. J Urban Technol 18(2):65–82. https://doi.org/10.1080/10630732.2011.601117
4. Bakıcı T, Almirall E, Wareham J (2013) A smart city initiative: the case of Barcelona. J Knowl Econ 4(2):135–148. https://doi.org/10.1007/s13132-012-0084-9
5. Barrionuevo JM, Berrone P, Ricart JE (2012) Smart cities, sustainable progress. IESE Insight 14(14):50–57
6. Giffinger R, Pichler-Milanović N (2007) Smart cities: Ranking of European medium-sized cities. Centre of Regional Science, Vienna University of Technology
7. Komninos N (2015) Intelligent cities: variable geometries of spatial intelligence. In: From intelligent to smart cities. Routledge, pp 46–62
8. Kourtit K, Nijkamp P, Arribas D (2012) Smart cities in perspective–a comparative European study by means of self-organizing maps. Innov Eur J Soc Sci Res 25(2): 229–246. https://doi.org/10.1080/13511610.2012.660330
9. Lombardi P, Giordano S, Farouh H, Yousef W (2012) Modelling the smart city performance. Innov Eur J Soc Sci Res 25(2):137–149. https://doi.org/10.1080/13511610.2012.660325
10. Kumar H, Singh MK, Gupta MP (2016) Smart governance for smart cities: a conceptual framework from social media practices. In: Conference on e-Business, e-Services and e-Society, September 2016. Springer, Cham, pp 628–634. https://doi.org/10.1007/978-3-319-45234-0_56
11. Chakravaram V, Rao GVS, Srinivas J, Ratnakaram S (2019) The role of big data, data science and data analytics in financial engineering. In: Proceedings of the 2019 international conference on big data engineering pp. 44–50. ACM. https://doi.org/10.1145/3341620.3341630
12. Chakravaram V, Srinivas J, Ratnakaram S (2019) Use of ICTs in financial engineering applications in insurance business. ICT Analysis and Applications. Lecture Notes in Networks and Systems, vol 93. Springer Nature Singapore Pte Ltd. 2020 https://doi.org/10.1007/978-981-15-0630-7_27

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Booth Multiplier: The Systematic Study

B. Venkata Dharani, Sneha M. Joseph, Sanjeev Kumar, and Durgesh Nandan

Abstract Booth multiplier plays a major role in digital integrated circuits. Multipliers are used for arithmetic operations. There are several digital multipliers used in different applications in VLSI. This paper reviews different types of booth multipliers, comparison, Advantages, drawbacks and extensions, the basic architecture of the booth multiplier and its algorithm. The power consumption, delay time and area occupied by the chip, also better performance are taken into the consideration, we can justify the efficiency of multipliers and remodeling the modules in multipliers reduces partial product generation in booth encoder. Wallace booth multiplier uses modified encoder to overcome the drawback that occurred in 2009 paper and drawbacks in array multiplier are overcome by Wallace booth multiplier. We observed that modifying the modules in booth multiplier we can reduce power consumption and increase scalability.

Keywords Booth multiplier · Serial multiplier · Parallel multiplier · Wallace tree multiplier · Baugh wooley multiplier · Radix · Low power · SEC · Digital signal processing · Probabilistic estimation bias · Simplified sign extension

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_88

1 Introduction

In Digital electronics, the booth algorithm plays a key role. It is used to use for high scientific calculations the operations include addition, Subtraction, Division, and subtraction. But the multiplication process reduces the system speed and it takes much time to execute it [1]. Different types of booth multipliers are there which used in various applications especially in the electronics domain. We can construct a booth multiplier using adders includes full or half adders. Many techniques are put forth to advance these digital multipliers. It is a widespread element of signal processing (DSP) advancements. Based on radices used multipliers are designed and their working mechanism is varied here comes the delay, power consumption into the picture [2] and they are used to run complex high-speed calculations. The different kinds of multipliers are (1) serial multiplier (2) parallel multiplier (3) serial-parallel multiplier (4) Logarithmic Multiplier [3–5].

Various Multipliers are used in different applications to implement efficient microprocessor designs. For the multiplication process, a greater number of elements are required and it is somewhat complex operation so, operate at a slower speed. To introduce digital multipliers overcome several ideas proposed. They are: Array Multiplier here the multiplication of binary values is done by the addition process, this process should be continuous [6]. Observation of multipliers, Baugh Woolley multipliers, and Wallace tree multipliers. By the comparison of a few multipliers mentioned above, the factors of Wallace booth multiplier consume less energy compared to others. The factors like delay and power dissipation of the Wallace tree multiplier is less. It is used for signed data conversion in the multiplication domain. So, the selection of multipliers is very important to develop an efficient device. By considering performance the device application matters [3]. The purpose of the booth multiplier is to increase the performance of the multiplier. Generally, a multiplier consisting of a booth encoding phase where the binary data gave is multiplied. This is the reference technique used from far years back in designing a chip and it brings anonymous changes in the structure of the elaborative multiplication technique. In the traditional multiplier, the number of partials products can be added is determined by the radices used by the multiplier, for example, consider radix-2 it has two bits which are stored in n variable as (2^n). If the n value is more the number of partial products is also varied and the time is taken to execute the given task also increases. Most of the consumers or users require efficient and fastest multipliers to work and factors also matter so, to reduce the partials products which are continuously added during multiplication, systematic algorithms are discovered by researchers as shown in Booth Encoder Multiplication technique [6].

2 Literature Review on Booth Multiplier

The Booth multiplier algorithm is used for multiplication of both signed as well as unsigned binary values in 2's complement form. This algorithm is introduced by Andrew Donald Booth in the 1950s. A multiplier shows great efficiency in area, power consumption and scalability [17].

By considering the remodeling in the radix 4 booth algorithm structure makes the multiplier performance more efficient in the case of partial product generation units. Coming to the radix 8 based booth algorithm which is very low speed due to the multipliers and the cons of the radix-8 algorithm is overcome by various approximate structural designs in booth multiplier or algorithm. A 2-bit adder is introduced here, and it is used to calculate 1x and 2x binary value. It requires little area, less delay, and the lowest level of power consumption. By using a 2-bit adder, a worthless section. The section acts as a recoding adder to generate the three multiplicands and there with zero carry propagation delay as proposed. A 16 $\times$ 16 approximate the radix 8-bit booth algorithmic multiplier design using the recoding technique without the extent of more bits in a partial product. Therefore, due to approximation in multipliers, they are faster and give better performance than actual booth multipliers. Especially 15-bit multiplier gives the best performance than any other booth multipliers [10, 11] (Fig. 1).

The high accurate modified booth multipliers with fixed width are used to reduce the truncated error in different IC's and slight changes in partial product generation here an effective error compensation function is proposed. Due to the error distributed in the systematical and centralized manner, the error tends to zero and draws very little mean value and mean square value errors in a multiplier. The fixed

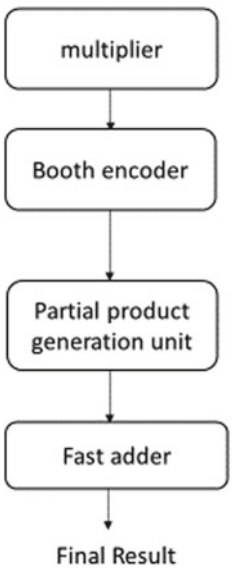

Fig. 1 Shows the general architecture of the booth multiplier

with the construction of the modified booth multiplier algorithm is used to improve the average signal to noise ratio [12]. By using the radix-2 modified booth multiplier the power used by the device is reduced [18].

The modified multiplication unit is based on radix 4 booth multiplier here Wen-Chang's redesigned booth encoding design (MBE) is modified so, it fastness increases and the speed of partial product generation is also increases and this is implemented by using simplified sign extension (SSE) and also the delay in 4:2 compressor is improved and the propagation delay reduced to 2% to 7% compared to other designs [7, 14]. A 16-bit booth multiplier is also designed by a 4:2 compressor to reduce the delay and increase system speed [19].

A 2's complement booth multiplier algorithm whose width is fixed proposed in the probabilistic estimation bias (PBE). This is derived from theoretical computation and doesn't change the original algorithm designs in compensation strategies. This multiplier provides less delay, lower truncation and small area [13].

According to the low power consumption booth multiplier, it reduces the power consumption of multipliers. Multiplier consists of a full adder the results are drawn by applying different inputs there by various outputs are obtained. Therefore, the booth multiplier is best among other multipliers. Especially a booth multiplier has an inbuilt recoding unit stage for lower-level power consumption [3].

In radix 4 booth multiplier different schemes are introduced to increase or improve the factors of a multiplier. Modified Booth Encoder and decoder is introduced to CMOS transistor level. This booth multiplier reduces the delay time and increases speed up to 66.3% [5, 13]. The radix-4 booth multiplier is remodified to optimize its model as shown in [20].

To avoid lossy ness in device a high accurate booth multiplier whose width is fixed introduced to avoid delay and power losses in the devices [12]. Similarly, a high fastest customizable re modified booth multiplier algorithm is introduced to overcome several drawbacks in previous unmodified booth multipliers [21] (Fig. 2).

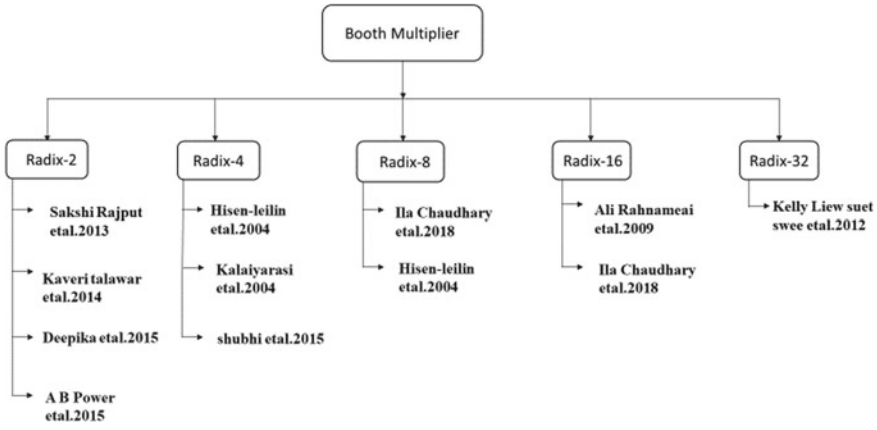

Fig. 2 Shows the different types of booth multipliers proposed by various authors

Radix-2: A booth multiplier consisting of different radices one of them is radix-2. It has two base values 0 & 1 i.e., 2^n where n = 0 & 1, 2^0 = 001, 2^1 = 010. The space occupied by the radix-2 booth multiplier is high but has less delay. For mathematical or arithmetic calculation purposes these are used in the Central processing unit-ALU (Arithmetic Logical Unit). To work on high scientific calculations booth multipliers are used. The limitations or cons of radix-2 is overcome by radix-4, Where partial product generation is quite complex in radix-2.

Radix-4: The limitations in radix-2 is overcome by radix-4. Where the space occupied by radix-4 is less compared to radix-2 but, the delay in radix-4 booth multiplier is more compared to radix-2. Here n = 0 to 3 i.e., 2^4 we get nearly 3 partial products in it. Similarly, this radix also used for high scientific calculations that are fabricated on IC's present in ALU's.

Radix-8: The cons of radix-4 is advanced by radix-8 booth multiplier. The space occupied by radix-8 is very less but the delay is more compared to the above radices. Where n = 8 for radix-8 i.e., 2^7 n tends to 0 −7 we get 7 partial products from it. Radix-8 replaces radix-2, as well as radix-4, depend on its advancements used in many applications.

Similarly Radix-16, Radix-32 whose n value varies from 0–15 & 0–31. If the size or radices increases the delay is also increases, but these are not replaced by other radices because for every radix it has it's own advancements in several applications. Based the radices the partial products are also increases and device accuracy will be improved.

3 Architecture of Booth Multiplier

The conventional booth multiplier mainly has three important elements they are booth selector, booth encoding stage and adder fast adder. The general working principle operation of the booth encoding stage is to obtain the original multiplier signal and the outcome of this stage is also utilized by the booth selection stage to obtain the partial products. The third component is the adder tree summation or fast adder and it will gather all partial products to generate results at the last stage. 2's complement error is corrected by using the adder tree summation [9]. The booth multiplier contains partial products. The Booth selector generates a partial product. This partial product is divided into different types for multiplication in 8-bit, 16-bit, 32-bit. To get an 8-bit multiplication result four partial products are required, similarly, to obtain a 16-bit multiplication result two partial products are required, and all these partial products are used in 32-bit multiplication. To achieve a normal partial product of 8-bit value and 16-bit value of multiplication a special regenerator is required to produce partial products.

(3) Fast adder: Due to the consumption of larger areas for an addition operation, the partial products are reused so, the area is reduced. The operation is done by

using four partial products and the next their sum is displayed as sum result0, sum result1, sum result2, sum result3. When the model of the bit changes, some symbol positions also change so, we require a 4:2 compressor, a 3:2 compressor, and a CLA, by using a 4:2 compressor the delay time is more. Due to the drawback of 4:2 compressor, we have chosen a 3:2 compressor and a Carry look head adder is required to calculate the results of partial products and CLA used to calculate signed values. Here the entire delay time is less compared to a former design that's why we chose this design [8, 9].

(4) Bit length commander: Usually they are designed by multiplexers and three more elements they are encoder stage, command stage, partial product regeneration unit and quick adder controlling unit. And they are like the model design of an array. The bit length controlling unit is used when bit design multiplication depends on the control signal this is used [9].

Both multiplier design is modeled in such a way that to reduce the delay time of partial products and effectively use the time of generation, by this design the power and area consumption is also less because the area of the chip is reduced. The booth multiplier contains the booth decoder in it the main purpose of the booth decoding unit is to convert applied input into its original booth form, generally, any booth form contains 0 data. The entire delay in tree-structured binary multiplexing kit obtained by the resultant of time taken in each step in which the partial product is obtained [3].

As coming to Wallace booth multiplier, it uses a modified booth encoder, here the reduction of partial products is done by this modified booth encoding unit. As same as booth multiplier It has various units like partial product generating unit, compression unit and final stage of product unit along with a propagation adder of a carrier and Wallace booth multiplier utilizes the approximate modules of modified booth encoder by this area occupied by the chip, delay time and power consumption is less using 4:2 compressor which is not possible in booth multiplier and possible with Wallace multiplier so, the performance is better than the exact multiplier [10]. And the drawback in 2009 paper is overcome by this paper.

Based on their base position of booth multiplier is classified into radix-2, radix-4, radix-8, radix-16, radix-32. Coming to radix-2 (2^1 = 0010) booth multiplier contains 3 bits. it has several advantages because booth multiplier works in reversible logic also so, the few applications of radix-2 booth multiplier are used in nanotechnology, Quantum computing by this the quantum costs and garbage outputs are optimized. And, the original radix2 multiplier for an N bit multiplier requirement are n shifts and N/2 additions and in some cases, the performance becomes worse [15, 16]. These drawbacks are overcome by radix 4. In radix-4 (2^2 = 0100) booth multiplier the partial product count is reduced so, there is an improvement in the speed of the device and the area occupied by the device is also reduced [7, 14, 16, 20]. To improve speed, area, delay time and partial product production, a radix-8 booth multiplier algorithm is introduced in last years and removing extra partial product rows in a array refer [22].

The performance of the radix-8 multiplier can be improved by introducing parallelism which is used to reduce calculation stages. Radix-8 can be expressed as:

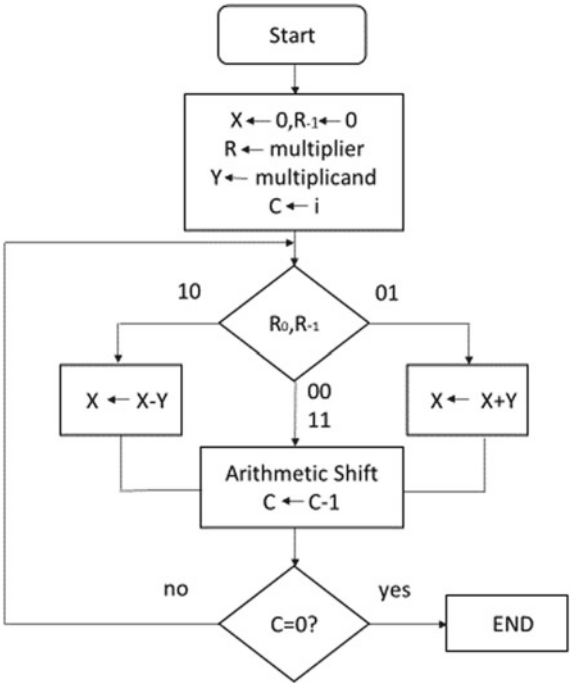

Fig. 3 Booth algorithm for multiplication

2^3 = 1000 here N = 3 bits. Compared to radix-4 multiplier radix-8 has increased bit size. Radix-4 multiplier uses 4-bits and it uses less area compared to radix4. The drawbacks in radix-4 are overcome by radix-16. Radix-16 uses 5 bits and it is expressed as (2^4 = 10000) here N = 4bits. The area occupied by radix-16 is less compared to radix-8 and the partial product generation also. The delay is more than radix 4, however, this cannot make much difference. Instead of radix-16 if radix-8 is used the area of the device increases and a larger number of groups are formed and multiplicands also. So, based on specifications and requirements booth algorithm is applied [16] (Fig. 3).

4 Result

In 2004, according to Hsin-lei lin et al. re-modified full adder compressor are used so, area and delay reduced to 22%−20% and also complexity in partial product generation refer [20, 22]. The power consumption of the device between 17%–24% by this device performance is better than the unmodified full adder circuit.

According to efficient modified booth multiplier architecture the delay of device reduced by redesigning 4:2 compressor based on Wen Chang BE. Here the delay is

reduced between 2%–7% To get reduced delay a Quartus architecture design is utilized.

In the structure of the modified lower-level power booth multiplier paper, different multipliers are compared by giving various inputs. This paper conveys that when 0's in multiplicands are high, high power reduction takes place.

Performance comparison review of radix-based multiplier design states that the different radices are compared and radix-4 is better than radix-32& radix-16& radix-8. When these radices are compared with radix-2 their delay decreases and when compared to radix-4 their delay increases for this ASIC design kit standard library and Verilog VHDL used.

According to radix-2 multiplier Vs radix-4 delay fewer multipliers radix-4 performance is better than radix-4 compared to all aspects nothing but the area, power consumption, delay So, the speed improved up to 19%. This improvement in speed due to modifications in partial product generation. According to Qian et al. convey that approximating encoders and partial products. So, area, delay, power consumption decreases, and device performance increases.

Tao et al. says that the time consumption during input and output communications is very less by this power saving up to 56% (approx.). To implement this SPICE tool is used.

In 2018, according to Illa Chaudhary et al. the delay of radix-16 is more compared to radix-8. But the area occupied by radix-16 is less compared to radix-8. If in the place of radix-16 radix-8 is used the area occupied by the device is more. Taking the delay as a point, radix-8 cannot replace radix-16 (Table 1).

5 Applications

Digital Electronics plays a major role nowadays without this there are no comfort facilities to mankind. In Digital electronics for higher scientific calculations booth multiplier is put forwarded. It is used in many applications i.e., Low power consumption less delay is most of the requirements for any system performance based on that booth multipliers are used in several applications. It has applications in digital signal processing and hugely used in Arithmetic Logical Units of the computer for calculation purposes of signed and unsigned binary data or information. The Booth multiplier is used in graphics applications. Nowadays mobiles are widely using they consist of processors which are implemented by booth algorithm to solve basic operations. When we are working with those devices if the power consumption exceeds the heat evaluated by the device is also more so, most of the companies are offering less power consumption elements. By this, the different booth algorithms are implemented to meet their requirements. The consumer seeking the best battery life of any device they purchase in the market, putting those words into mind researchers or designers implementing different kinds of models to overcome limitations or suggestions given by customers.

Table 1 Table that justify the practical values of different advancements in booth multiplier

Sl no	Year	Title	Area	Delay	Power consumption	Tools used	Conclusion
1	2004	Design of a novel radix-4 booth multiplier	Reduces 20% area	Reduces 20 ns	17%–24%	Re-modified full adder, Synopsys and Apollo library	In this paper the proposed modified booth multiplier and compressor are used to reduce delay, are and power consumption. So, automatically device speed increases
2	2008	An efficient modified booth multiplier architecture		Delay reduces to 2%–7%		Quartus II for architecture design	An efficient booth multiplier is designed based on Wen Chang BE and $:2 compressor is redesigned to fast up the device. The delay is reduced
3	2012	Design of modified low power booth multiplier			The average power consumed by (1) Booth multiplier: 0.4 (approx.) (2) Array multiplier: 0.7 (approx.) (3) column bypass multiplier: 0.7 (approx.)	Full adder	The power consumption is low in booth multiplier compared to array and column bypass multipliers and when the zeros in multiplicands are high, high power reduction takes place
4	2012	Performance comparison review of radix-based multiplier design	Less area is used by radix-4 than others			ASIC Design kit standard cell library in Leonardo Spectrum, Verilog HDL	The different radices are compared. Radix-4 is better than radix-32, radix-16, radix-8. When they are compared with radix-2 the delay is small, but when compared to radix-4 their delay increases

(continued)

Table 1 (continued)

Sl no	Year	Title	Area	Delay	Power consumption	Tools used	Conclusion
5	2015	Radix-2 Vs Radix-4 high speed multiplier	The area occupied by radix-2 is greater than radix-4	The combinational path delay (ns) for (1) radix2: 8 (approx.) (2) radix4: 6 (approx.)	43% power consumption in radix2	VHDL, Xilinx ISE 13.1 design suite	In radix-4 speed improvement is 19%. The partial product generation is reduced in radix4. If the speed increases the device performance is better. Further improvement in the device speed can be achieved by CLA connecting at last stages
6	2016	Design & evaluation of approximate Wallace booth multiplier	AWBM-I: 8920 μm^2 AWBM-II: 677 μm^2	AWBM-I: 2 (approx.) AWBM-II: 2 (approx.)	AWBM-I:2208 AWBM-II:1684	Approximate Booth encoders, Verilog HDL	Here the area, speed, delay and power consumption are decreased so, these features increase the device performance
7	2016	A racetrack memory based in memory booth multiplier for cryptography application.	Low area	Low delay	Low power	SPICE	In this paper the time consumption is less during I/o communications and it saves 56.3% of power
8	2018	Design and comparison of high-speed radix-8 and radix-16 booth multipliers	Area occupied by (1) radix8: 773/21504. (2) radix-16: 1188/21504	(1) Radix-8: 25 ns (approx.). (2) Radix-16: 25 ns (approx.)	Low power consumed by radix-16	VHDL, Xilinx ISE 14.1 design suite	The delay in radix-16 is more compared to radix-8. But area occupied by radix-16 is less. Anyway Radix-8 cannot replace it

6 Conclusion

In this paper, the basic architecture of the booth multiplier and its types are proposed. The comparison between different booth multipliers gives their pros and cons. Based on modifications or advancements in modules of Encoder, Partial product generator, Booth Algorithm reduces the space occupied by the device and increase the performance and efficiency. Reducing delay time and equipment makes the device smarter. Booth multiplier works also in negative logic, based on these many applications are depended. Coming to booth multiplier radices radix 16 has more delay than radix-8 but radix-8 cannot replace radix-16. Instead radix-16, radix-8 is used it occupies a large area, more groups and the multiplicands are also more. Comparing advancements in booth multiplier 15-bit multiplier gives the best performance than any other.

References

1. Govekar D, Amonkar A (2017) Design and implementation of high speed modified booth multiplier using hybrid adder. In: International conference on computing methodologies and communication (ICCMC), 18–19 July 2017, pp 138–143
2. Chen Y-H, Chang T-Y, Jou R-Y (2010) A statistical error-compensated booth multipliers and its DCT applications. In: TENCON 2010 - 2010 IEEE region 10 conference, 21–24 November 2010, pp 1146–1149
3. Prabhu AS, Elakya V (2012) Design of modified low power booth multiplier. In: 2012 international conference on computing, communication and applications, 22–24 February 2012, pp 1–6
4. Nandan D, Kanungo J, Mahajan A (2017) An efficient VLSI architecture design for logarithmic multiplication by using the improved operand decomposition. Integration 58:134–141. https://doi.org/10.1016/j.vlsi.2017.02.003
5. Nandan D, Kanungo J, Mahajan A (2018) An errorless Gaussian filter for image processing by using expanded operand decomposition logarithm multiplication. J Ambient Intell Humaniz Comput. https://doi.org/10.1007/s12652018-0933-x
6. Swee KLS, Hung LH (2012) Performance comparison review of radix-based multiplier designs. In: 4th international conference on intelligent and advanced systems (ICIAS 2012), 12–14 June 2012, pp 854–859
7. Kalaiyarasi D, Saraswathi M (2018) Design of an efficient high-speed radix-4 booth multiplier for both signed and unsigned numbers. In: Fourth international conference on advances in electrical, electronics, information, communication, and bio-informatics (AEEICB), 27–28 February 2018, pp 1–6
8. Li Z, Chen H, Yang X (2018) Research on the disposal of negative partial product for booth algorithm. In: IEEE international conference on information theory and information security, 27–28 February 2018, pp 1115–1117
9. Yi Q, Han J (2009) An improved design method for multi-bits reused booth multiplier. In: 4th international conference on computer science & education, 25–28 July 2009, pp 1914–1916
10. Qian L, Wang C, Liu W, Lombardi F, Han J (2016) Design and evaluation of an approximate Wallace-Booth multiplier. In: 2016 IEEE international symposium on circuits and systems (ISCAS), 22–25 May 2016, pp 1974–1977

11. Luo T, Zhang W, He B, Maskell D (2016) A racetrack memory based in-memory booth multiplier for cryptography application. In: 21st Asia and South Pacific design automation conference (ASP-DAC), 25–28 January 2016, pp 1–6
12. Wang J-P, Kuang S-R, Liang S-C (2011) High-accuracy fixed-width modified booth multipliers for lossy applications. IEEE Trans Very Large Scale Integr (VLSI) Syst 19(1):52–60
13. Li C-Y, Chen Y-H, Chang T-Y, Chen J-N (2011) A probabilistic estimation bias circuit for fixed-width booth multiplier and its DCT applications. IEEE Trans Circuits Syst II Express Briefs 58(4):215–219
14. Lin H-L, Chang RC, Chan M-T (2004) Design of a novel radix-4 booth multiplier. In: IEEE Asia-Pacific conference on circuits and systems, proceedings, 6–9 December 2004, pp 837–840
15. Talwar K, Hosamani P (2014) Ultra area-efficient reversible Quantum Radix-2 booth's recoding multiplier for low power applications. In: IEEE international conference on computational intelligence and computing research, 18–20 December 2014
16. Pawar AB (2015) Radix-2 vs radix-4 high-speed multiplier. In: Special issue on 2nd international conference on electronics & computing technologies-2015, pp 329–333
17. Sakthivel B, Maheshwari K, Manoj Prabakar J, Nandhini S, Saravanapriya A (2017) Implementation of booth multiplier and modified booth multiplier. Int J Recent Trends Eng Res (IJRTER). Conference on electronics, information and communication systems (CELICS 2017). Special Issue; March 2017, pp 45–51. ISSN 2455-1457
18. Rajput S, Sharma P, Gitanjali, Garima (2013) High speed and reduced power – radix-2 booth multiplier. IJCEM Int J Comput Eng Manag 16(2):25–30
19. Rahnamaei A, Fatin GZ (2009) High speed 16 × 16 bit booth multiplier based on novel 4-2 compressor structure. IEEE Trans Circuits Syst II Express Briefs 56(5):404–408
20. Shubhi S, Gulhane P (2014) Optimized model of radix-4 booth multiplier in VHDL. Int J Emerg Technol Adv Eng 4(9):275–279
21. Sri Sakthi S, Kayalvizhi N (2011) Power-aware and high-speed reconfigurable modified booth multiplier. In: IEEE recent advances in intelligent computational systems, 22–24 September 2011, pp 352–356
22. Mohanty BK, Choubey A (2017) Efficient design for radix-8 booth multiplier and its application in lifting 2-D DWT. Circ Syst Signal Process 36(3):1129–1149

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Systematic Observation on Non-orthogonal Multiple Access for 5th Generation Communication Technology

Muppana Sonika, S. B. G. Tilak Babu, and Durgesh Nandan

Abstract Non-Orthogonal Multiple Access (NOMA) has become popular optimizing automation that offers huge power, less dormancy and has a high connection to meet vivid opportunities in the fifth—stage of the cable fewer networks. It is a multiple access scheme. Since the rearmost is regarded to be Heterogeneous Networks (Het Nets), the accomplishment of NOMAon5GHet Nets is greatly considered. In this paper, temporarily reveal that the NOMA strategies have grown step by step starting Single-Carrier NOMA (SC-NOMA) into Multi-Carrie NOMA (MC-NOMA). At that point we enquired concerning essentials, authorizing formats and advancements of the two mainly encouraging MC-NOMA strategies, in particular, Pattern Division Multiple Access (PDMA) and Sparse Code Multiple Access (SCMA). Visible light communication (VLC) constructs over the dynamic purpose of the present-day glittering platform for wireless communication. VLC is most competent, assured and is a high yield wireless access technology. Target on the multi-user VLC systems is an attempt to transfigure VLC into a measurable and completely fret worked wireless technology.

Keywords NOMA · 5G · VLC · SCMA · PDMA · Het-Nets

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_89

1 Introduction

SC-NOMA has been an emerging field of research and there is a huge amount of research is going on [1, 2]. Observing that the NOMA is a multiple access method we study the further concepts of NOMA. The assessments of the blackout likelihood and EE of MC-NOMA must be considered as the still ideas to be inquired about. Likewise, we have additionally profoundly enquired about the quality of MC-NOMA. We found that the execution of MC-NOMA may be invigorated and produced by the deliberately investigated SC-NOMA purposes gathered utilizing striking strategies and situations [3]. Besides, we can also analyze the association of MC-NOMA with different 5Gtechnologies that have great assets along with some objections [4]. The fourth generation in mobile networks is brought into effective action worldwide and investigate to describe the upcoming age group mobile network is now achieving noticeable recognition [5]. Particularly, because of colossal phantom effectiveness non-symmetrical different access (NOMA) has been perceived as guaranteeing numerous entrance strategies of 5G systems [6]. OFDMA will be established in 5G wireless systems [7–17]. Hence, MC-NOMA technology combining NOMA and OFDMA is being often mentioned as a challenging area [18]. Considering the technical hierarchical level, Orthogonal Frequency Division Multiple Access (OFDMA) will be the probable set up in 5G remote frameworks. Thus, the MC-NOMA innovation, which relates the attributes of both NOMA just as OFDMA has been frequently perceived as anxious wannabe. The utilization of MC-NOMA with the rest of the innovations, particularly other 5G key advancements, is still in its newborn child arrange. Downlink helpful MC-NOMA, MIMO widened MC-NOMA [12], mm-Wave based MC-NOMA and the foundation of MC-NOMA in UDN investigated advance and accomplish major rehearsing potential outcomes in 5G periods.

This raised origination flexible reference of the blending strategy that can be utilized depending dependent on arranging load for NOMA. Consequently, this balanced out the system limit gain and the multifaceted nature of the matching strategy is acquired [19–21]. On the dissimilar, LB-NOMA is utilized, a simple coupling technique shall provide the record level benefits (nearly 29.1%). This occurs due to the incapability while selecting the most desirable pairs that can be counteracted with the load balancing techniques [22]. According to our ranging products mixture, MA with LB-NOMA + OMA along with fortuitous pairing involves a significant handful of cells established to provide a similar proportion to that of the other selections chosen. These conclusions allow us to deliberate over a flexible choice of pairing method for NOMA subjecting on the load environment of the web [23]. Under the contents in which, every compartment uniformly packed. Due to this reason, load balancing procedures are in effective, the option of a convoluted pairing practice is favoured. In conditions wherein closures are loaded disproportionately, the selection of easier and swiftly coupling approaches added with stack balancing techniques could lend a better performance for the network, in the expression of capacity and pairing complexity in NOMA. Heterogeneous

Networks are the most powerful tools to deal with the rapidly increasing demand for mobile broadband bandwidth. These are said to be the key roles of the shift in the way networks are designed and established. Heterogeneous Networks (Het Nets) contains small, tiny cells embedded in a macro-cellular latency and activate flexibility and scalability capacity enhancements (Fig. 1).

2 Literature Review

The reins a huge development of 5G technology in recent years, various private organizations, professional entities, and research centers are performing research in vivid technologies in 5G. Specific radio access technology is not the basis of 5G networks. The major area of interest which is under multiple access schemes is assumed to lodge a gigantic number of utilizes with distinguishing expedition of information dispatch. At that point, vogue movements concerning SCMA and NOMA have been done to perceive the most recent upgrades and their outcomes are talked about in this paper. This investigation included lower intricacy levels, low BER, successful and proficient vitality use. The latest developments have found attributes such as spectral efficiency, spatial productivity, low BER, and inactivity, alongside asset assignment and different access. NOMA is a radio access technology design for enabling. It is a key component of the networked society. One of the crucial criterions are relevant to NOMA is the provision of conspired benefits and assignment of resources to them. Using some power and spatial proficiency, we conclude that statistically unrelated mechanisms systems are never the procuring courses of action. The basic point that attracts are searcher non—orthogonal transmission for 5G mobile communication is the rapid day-to-day development of mobile communications. By evaluating and differentiating characteristics of these technologies, and investing path of enrooting the upcoming 5G several gateway and plots are provided in the above figure of 5G scenarios. Non-orthogonal thought has been applied greatly to 5G multiple access latest trends technology and the

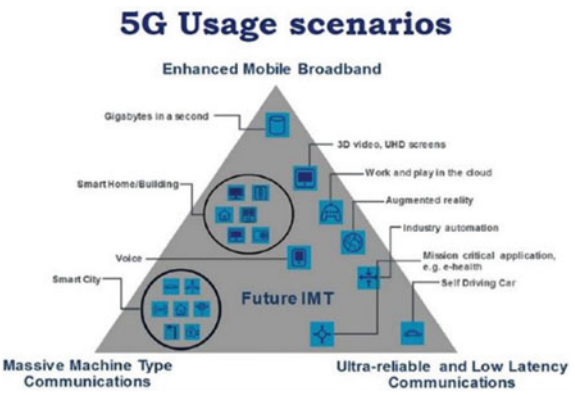

Fig. 1 Applications of 5G

waveform modulation techniques. With deep study, the waveform of 5G technologies of multiple accesses will become clear and standard. NOMA has been recognized as a promising solution for 5G networks to improvement work capability. Two of them aim solutions for capacity boosting of 5G technology is NOMA and mountainous deploy men to find division. Using the unification of NOMA, we can increase the spectral efficiency producing sleeper capacity than orthogonal multiple access. This is achieved by manipulating and because of coupling without changing either time or frequency resources. Anyway, in critical situations where we find significant degradation of network performance, we need extra solutions to deal with the high traffic volume. In such cases, the possible method is cell densification here we bring to effective my justification of compact cell sand integrate them firmly with previously mystified bulky slots, the pile of the network might be escalated and the standard of utility may be handed.

These solution sleds to the Heterogeneous Networks (Het-Nets) along the hybrid Multiple Access (MA).

Main Advantages of Noma

- **High Bandwidth Efficiency:** NOMA constitutes high bandwidth. It enhances the amount of material or items passing through a system.
- **Fairness:** It distributes more power to vulnerable users. It is able to assure an attractive trade-off between users in terms of their production.
- **Ultra-high connectivity:** There was a strong demand for connecting smart devices using IoT (Internet of Things) to future 5G systems.
- **Compatibility:** This can be considered as an "add-on" technique to any existing OMA (orthogonal multiple access) technologies.
- **Flexibility:** Multi-user shared access (MUSA), PDMA, SCMA, such as various NOMA techniques are of low complexity design.
- **The spectral efficiency:** It is improved by using various user scheduling techniques and feedback mechanisms to manage 5G traffic demands.

3 Results

Results are shown in Table 1 based on the performance of 5G parameters like latency, data rate by cell edge, the data rate on peak and capacity of the network.

Table 1 Expected performance of 5G parameters

Parameter	Performance
Capacity of network	10,000 times more of existing network
Data rate (peak)	10 Gbps
Data rate (cell edge)	100 Mbps
Latency	<1 ms

4 Applications

- In increasing the power domain of multiple access
- Device to device communication
- In improving spectral efficiency
- Flexible spectrum usage
- In MIMO and co-operative communication scenarios
- Flexible duplex
- Energy efficient
- Multi—antenna transmission

5 Conclusion

This is a layout of the examination accomplishment of NOMA from the stances of single-transporter and multi-bearer, with a huge extent of the MC-NOMA progress and application. Gathered with the presentation of ordinary OMA plans, SC-NOMA and MC-NOMA can confer driving SE and feasible trip. We have likewise investigated from filigree scale objectivity the requirement of a Het Net with compound MA. The radiation of VLC frameworks as high information-rate, resistant, and vitality high minded downlink transmission innovation has fuelled look into on the blaming correspondence recommendations for these frameworks. In perspective on this plan, we featured a portion of the advanced bearings on physical-layer based on multi-client plans for VLC frameworks.

References

1. Dai L, Wang B, Yuan Y, Han S, Chih-Lin I, Wang Z (2015) Non-orthogonal multiple access for 5G: solutions, challenges, opportunities, and future research trends. IEEE Commun Mag 53(9):74–81
2. Nikopour H, Baligh H (2013) Sparse code multiple access. In: 2013 IEEE 24th annual international symposium on personal, indoor, and mobile radio communications (PIMRC), pp 332–336
3. Huang J, Peng K, Pan C, Yang F, Jin H (2014) Scalable video broadcasting using bit division multiplexing. IEEE Trans Broadcast 60(4):701–706
4. Tse D, Viswanath P (2005) Fundamentals of wireless communication. Cambridge University Press, Cambridge
5. Li QC, Niu H, Papathanassiou AT, Wu G (2014) 5G network capacity: key elements and technologies. IEEE Veh Technol Mag 9(1):71–78

6. Saito Y, Benjebbour A, Kishiyama Y, Nakamura T (2013) System-level performance evaluation of downlink non-orthogonal multiple access (NOMA). In: 2013 IEEE 24th annual international symposium on personal, indoor, and mobile radio communications (PIMRC), pp 611–615
7. Benjebbour A, Saito Y, Kishiyama Y, Li A, Harada A, Nakamura T (2013) Concept and practical considerations of non-orthogonal multiple access (NOMA) for future radio access. In: 2013 international symposium on intelligent signal processing and communication systems. IEEE, pp 770–774
8. Razavi R, Dianati M, Imran MA (2017) Non-orthogonal multiple access (NOMA) for future radio access. In: 5G mobile communications. Springer, Cham, pp 135–163
9. Higuchi K, Kishiyama Y (2013) Non-orthogonal access with random beamforming and intra-beam SIC for cellular MIMO downlink. In: 2013 IEEE 78th vehicular technology conference (VTC fall). IEEE, pp 1–5
10. Nonaka N, Kishiyama Y, Higuchi K (2015) Non-orthogonal multiple access using intra-beam superposition coding and SIC in base station cooperative MIMO cellular downlink. IEICE Trans Commun 98(8):1651–1659
11. Zeng M, Yadav A, Dobre OA, Tsiropoulos GI, Poor HV (2017) Capacity comparison between MIMO-NOMA and MIMO-OMA with multiple users in a cluster. IEEE J Sel Areas Commun 35(10):2413–2424
12. Zeng M, Yadav A, Dobre OA, Tsiropoulos GI, Poor HV (2017) On the sum rate of MIMO-NOMA and MIMO-OMA systems. IEEE Wirel Commun Lett 6(4):534–537
13. Benjebbour A, Saito K, Li A, Kishiyama Y, Nakamura T (2015) Non-orthogonal multiple access (NOMA): concept, performance evaluation and experimental trials. In: 2015 international conference on wireless networks and mobile communications (WINCOM), October 2015, pp 1–6
14. Benjebbour A, Li A, Saito K, Saito Y, Kishiyama Y, Nakamura T (2015) NOMA: from concept to standardization. In: 2015 IEEE conference on standards for communications and networking (CSCN), October 2015. IEEE, pp 18–23
15. Kim B, Chung W, Lim S, Suh S, Kwun J, Choi S, Hong D (2015) Uplink NOMA with multi-antenna. In: 2015 IEEE 81st vehicular technology conference (VTC spring), May 2015. IEEE, pp 1–5
16. Ding Z, Adachi F, Poor HV (2015) The application of MIMO to non-orthogonal multiple access. IEEE Trans Wireless Commun 15(1):537–552
17. Ding Z, Dai L, Poor HV (2016) MIMO-NOMA design for small packet transmission in the internet of things. IEEE Access 4:1393–1405
18. Lan Y, Benjebboiu A, Chen X, Li A, Jiang H (2015) Considerations on downlink non-orthogonal multiple access (NOMA) combined with closed-loop SU-MIMO. In: 2014 8th international conference on signal processing and communication systems (ICSPCS), December 2015. IEEE, pp 1–5
19. Dai X, Chen S, Sun S, Kang S, Wang Y, Shen Z, Xu J (2014) Successive interference cancelation amenable multiple access (SAMA) for future wireless communications. In: 2014 IEEE international conference on communication systems, November 2014. IEEE, pp 222–226
20. Al-Imari M, Xiao P, Imran MA, Tafazolli R (2014) Uplink non-orthogonal multiple access for 5G wireless networks. In: 2014 11th international symposium on wireless communications systems (ISWCS), August 2014. IEEE, pp 781–785
21. Boccardi F, Heath RW, Lozano A, Marzetta TL, Popovski P (2014) Five disruptive technology directions for 5G. IEEE Commun Mag 52(2):74–80

22. Marcano AS, Christiansen HL (2018) Impact of NOMA on network capacity dimensioning for 5G HetNets. IEEE Access 6:13587–13603
23. Yuan Z, Yu G, Li W (2015) Multi-user shared access for 5G. Telecommun Netw Technol 5 (5):28–30

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Interactive Security of Ransomware with Heuristic Random Bit Generator

Rahul Rastogi, Gaurav Agarwal, and R. K. Shukla

Abstract Nowadays internet is an important part of our life but we should use it carefully because so many cyber threats are there in web. One of crucial attack is ransomware attack. In 1995, the basic concept of ransomware was introduced as a cryptovirus. Nevertheless, since then, it has been considered for more than a decade merely a philosophic topic. Throughout 2017, Ransomware came to life, with many popular ransomware incidents targeting critical computer systems around the world. For starters, the damage caused by CryptoLocker and WannaCry is massive and worldwide. We encrypt the data of criminals which need an enormous amount of money in order to decrypt them. The key to recover cannot be found on the victim's system ransomware footprint as they use public key encryption.

Consequently, after being damaged, the system cannot be replaced without recovery costs. Antivirus researchers and network security experts have developed various methods to counter this risk. Nevertheless, cryptographic security is assumed to be infeasible because it is computationally as difficult to recover the files of a victim as breaking a public key cryptosystem. Recently, various techniques have been suggested to protect an OS' crypto-API from malicious codes. Almost all ransomware uses the random number generation services offered by the victim's operating system to develop encryption keys. Therefore, if a user can monitor all the random numbers created by the program, he/she will be able to recover the random numbers used during encryption key by the ransomware. We suggest a flexible ransomware security approach in this paper which substitutes the OS' random number generator with a user-defined random number generator. Given that the proposed method causes the virus program to generate keys based on the

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_90

user-defined generator output, an infected file system can be recovered by reproducing the attacker's keys used to perform the encryption.

Keywords Cryptovirus · Heuristic random bit generator · Ransomware · Protection

1 Introduction

Ransomware is just a malicious code that codes the data on the device of the user and demands payment before it is recovered. NO MORE RANSOM [1] is a campaign designed to combat threats to malware, involving Europol, Kaspersky and McAfee Labs, the Netherlands National Police. Free tools for rehabilitation are provided by NO MORE RANSOM. One can download these tools from its website. So far, 28,000 infected devices have been recovered from the tools provided, but WarnerCry, a form of cryptovirus, is irrecoverable. The latest cryptoviruses such as the WannaCry and Petya cryptographic algorithms penetrate computer systems and encrypt user data that include bitcoin payments. When contaminated, restoring infected files is unfeasible because they are encrypted using powerful algorithms of cryptography. Young and Yung [2] brought the fundamental idea of crypto virology as a deceptive use of technique of cryptography in the 1990s. Their research demonstrates that if a malicious code uses public key cryptography, it is impossible to recover the damage without the attacker's help. It was not considered practical when their work was discussed for two main causes: (1) Public key encryption within a small virus could not be enforced and (2) By revealing his/her identity, the attacker had very little way to extract ransom money. Nevertheless, the recent elimination of these barriers has made crypto virus attacks a reality. The systems also have APIs to use popular cryptographic algorithms to use shared software lines such as the RSA [3]. In this respect, some lines of code have to be included. Second, cryptocurrency allows anonymous collection of money by hackers, with Bitcoin being the most common malware user. Malware is therefore capable of bugging the police and is very dangerous.

The malware of WannaCry has compromised many large organizations around the world, such as the National Health Service of the UK. For medical staff in the UK, this spread quickly. Computers are reported to be contaminated in random order. NHS staff posted WannaCry screen catches requesting bitcoin portions to open the records for every PC. Via malicious email attachments or remote sharing of resources, any devices on a network can be compromised. The users are therefore very worried about the contamination of their machines, with certain users also taking into account the removal of their LAN cables as precaution and increasing computer flow.

Antivirus research in response to the rise in ransomware attacks is currently underway. For example, reverse technology is used to check output code by static and dynamic analysis to find clues to recover data from ransomware that have been

compromised. Sensitive API calls and complex analyzes of unusual trends in performance are also used to stop malware from monitoring cryptographic APIs. This is because user data cannot be restored completely after encryption.

Barker and Kelsey [4] suggested approach for using cryptographic techniques to proactively defend against ransomware in year 2017. The methods used rely on the insecurity of the working block chip modes and the efficient blocking of encrypted API ransomware calls. Nonetheless, the consumer can't defend against the ransomware if their suggested solutions do not use a particular operating mode. Therefore, it is believed that only when avoidance is performed in advance will the approach have an impact of about 50%. Kolodenkerz et al. [5] discussed a version of the PAYBREAK key escrow method. PAYBREAK preserves in a comprehensive log file all random number created from the program, so that users can search the log file for an in-depth encryption key. PAYBREAK targets crypt APIs, especially the CryptGenRandom() random number generation API. PAYBREAK is very powerful when ransomware collects information and creates encryption keys with CryptGenRandom().

In this article, we suggest a complex method of defense against ransomware that recovers the encryption key after infection. The proposed method is useful for CryptGenRandom() dependent ransomware, as explained in Sect. 2, and provides a more effective defense framework than PAYBREAK. The system suggested calls for pre-infection implementation. Upon infection, users can then search and retrieve their files successfully using the encryption key used by ransomwares.

2 Crypto API Ransomware

Older types have included their own authentication algorithms for ransomware programs. Yet recent rankings have a very limited code size since they use cryptographic API encryption algorithms. Actually, as part of the operating system Microsoft Windows provides a cryptographic library.

It allows the authentication of user data through ransomware. Microsoft's Crypto API [3] is a multi-service provider that supports the public key and symmetric key encryption. Nevertheless, the Crypto API does not separate viruses from legitimate client applications that demand cryptographic services. So, ransomware can decrypt cryptographic API functions for encrypting user files.

We mainly focus on ransomware using the MS Crypto API, especially the ones based in the latest ransomware CryptGenRandom(), including CryptoLocker and WannaCry. These attacks by ransomware use a symmetrical cryptographic key algorithm AES for encrypting files in the crypto API. The algorithm symetrical key encryption includes "Enc" encryption and "Dec" decryption. The same key K_{file} for encryption or decryption as in (1) is shown for text or files to be encrypted with "M". Encrypt feature "E"'s result value is the cipher text marked "C". It is known that the AES symmetrical key algorithm is secure, making it difficult to decode

without the encryption key. Therefore, you need to find a key kfile to restore files using the ransomware for encryption.

$$E_{K_{File}}(M) = C, \quad D_{K_{File}}(C) = M \tag{1}$$

But ransomware encrypts the K_{file} key with the asymmetrical key encryption. The encryption function is "E'" in a RSA asymmetric key encryption algorithm, and the decryption is "D". The K_{pu} encryption key (public) and the K_{pr} decryption key (private), as shown in (2), is different.

$$E'_{K_{pu}}(K_{file}) = C', \; Dec'_{K_{pr}}(C') = K_{file} \tag{2}$$

To avoid K_{file} visibility, Ransomware employs its own public key K_{pu}. Thus the K_{file} encrypted key cannot be decrypted, even if the K_{pu} encoding key has been exposed. By decrypting with private K_{pr} keys, K_{file} must be retrieved from its encrypted $E'_{K_{pu}}$ (K_{file}). K_{pr}, in most instances, is stored only on the computer of the attacker. Any attempt to decipher contaminated files using the victim's software data is therefore desperate without K_{pr}. Here, when Ransomware encrypts files by means of public key encryption, the password K_{file} can be encrypted without any effort. Though, it's because the method for public key coding is too sluggish to use a symmetric key algorithm.

We emphasis on the process of using the file encryption key K_{file}, which ransomware creates randomly by using the Windows API CryptoRandomGen (), a crypto-safe number generator. CryptoRandomGen ()'s output is unpredictable, as it generates random numbers with a high cryptographic algorithm, which is initiated by a seed with multiple operating noise sources. The ransomware encrypts the K_{file} key with a public RSA key K_{pu} after file encryption so that only the attacker can subsequently get the K_{file}. Figure 1 shows the system for ransomware attacks on user files.

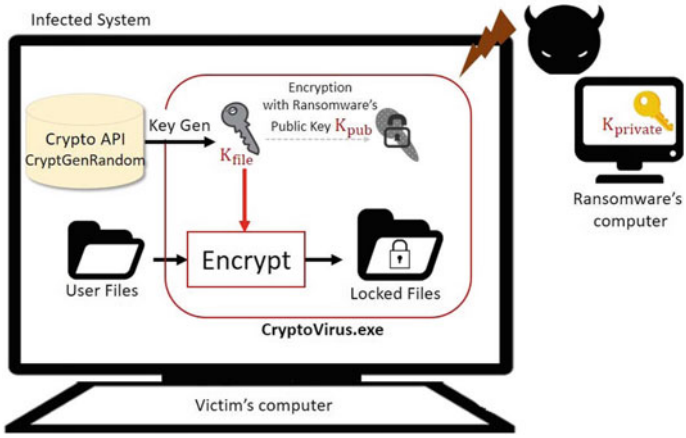

Fig. 1 Cryptovirus attack scheme

In short, the ransomware targets the machine of the victim as follows:

Stage 1. The ransomware persists via the network on the victim's system.
Stage 2. The ranking system produces K_{file} from CryptRandomGen() generator of pseudorandom number, given by Windows.
Stage 3. Ransomware encodes data using a symmetric encryption algorithm with the K_{file} encoding method.
Stage 4. The K_{file} encrypts with a public K_{pu} to avoid the secret K_{file} being displayed using an asymmetric key algorithm.
Stage 5. After encryption of data, the ransom ware asks for money.

3 Suggested Prevention System Against Ransomware

We suggest a method that restores user files to find out the main K_{file} with minimal effort. With the target ransomware, there is no efficient way to retrieve the encrypted file except with a key exhaustive search. All random bits created by CryptRandomGen() are saved in PAYBREAK [5] to determine the ransomware's K_{file}. Yet CryptRandomGen() is highly inefficient as it uses not only ransomware but other tools to create a protected pseudio allocation number for itself. It is also impossible to foresee if a ransomware enters the system that requires the continuous saving of all values.

We therefore suggest the replacement of CryptRandomGen () with the DRBG (deterministic random bit generator). The K_{file} can be obtained more productively using this method. DRBG generates the same value from the same seed price.

3.1 The DRBG

A DRBG is a device or algorithm which produces a sequence of binary bits which appears statistically autonomous and impartial [6]. It makes it possible to create a long random series of a hidden seed with a limited length:

$$\mathbf{DRBG}(\mathbf{seed}) = \mathbf{pseudorandom\ bits} \tag{3}$$

The safety of DRBG is connected with seed entropy. In the current version of DRBG, an additional input is used to improve its security. SP 800-90B is the safety evaluation criteria for entropy entry. The second draft model [7, 8, 10] has now been updated. The DRBG uses a seed value and adjusts the internal condition in order to produce consistent random bits. There are v and reseed counters for the internal state of the DRBG. The v value is the generation feature input value that

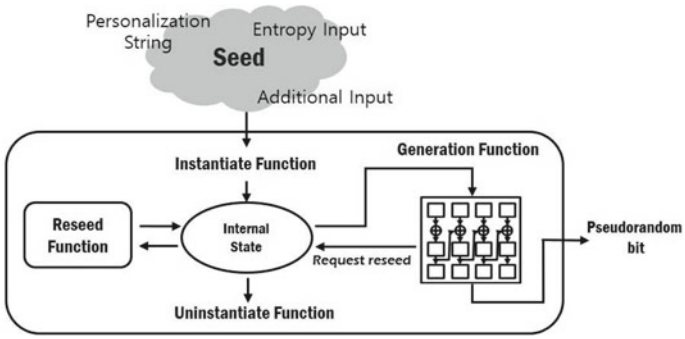

Fig. 2 Deterministic random bit generation method

produces pseudorandom bits for the DRBG. *Generate_Function* deletes random bits from v and calls *Reseed_Function* when a new seed restart is needed.If the *Reseed_Function* is named, it raises the *Reseed_Counter* and produces a new internal rank, v from the old v to the *Reseed_Function*. *Generate_Function* is used for generating random bits with the modified internal v condition. Update the inner state when a reseed is required by the same system. Figure 2 indicates the technique used by DRBG.

3.2 Method of Protection

By saving the seed, the user can restore the random sequence number, which is the DRBG output value. Thus the Kfile can be retrieved from the kernel, although the ransomware receive the DRBG Kfile from the recipient. Users can therefore protect themselves from ransomware using this approach more effectively than before. The defense proceedings are as follows:

The user sets the seed value first, the initial DRBG status. Because this value of seed must be kept safe, it is recommended that it should be encrypted or backed up using a public key to protect the seed of users on an external device, for example a mobile phone. The system instead downloads the software DRBG for CryptRandomGen() substitution. The crypto API must be hooked up at this point. Hooking is used to overload original features with arbitrary new features to change apps behaviour. API hooks are used without intervention in their source code to modify applications [9]. Various hooking styles are available [5]. Suppose CryptRandomGen() is removed, the method for ransomware operating on the entire system with DRBG of the user, rather than with CryptRandomGen().

If a ransomware is heavily infected far beyond its location, all random bits that have been used can be difficult to recover. We show users a way to save their internal status in the log file to quickly retrieve the secret key *Reseed_counter* and the inner v state are stored by time, since random numbers can be recovered faster

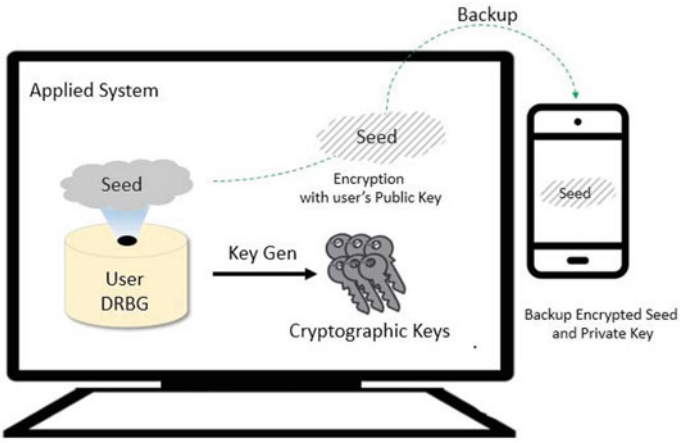

Fig. 3 Proposed Model: Substitutes "CryptRandomGen ()" with a random seed generating DRBG client. The seed must be placed on an outside computer (Like smartphone)

than random numbers derived from the first used seed. Thus, we propose a way to save internal v and *reseed_counter* in a log file and e-mail the log file to avoid ransomware encryption. Figure 3 shows our scheme, consisting of the CryptRandomGen substitution.

3.3 Method of Recovery

Ransomware is intended to use CryptRandomGen() Randomness to extract the authentication K_{file} on penetration of a device. Based on *CryptRandomGen()* substituted with user DRBG, the user DRBG produces random bits using the K_{file}. So the operator will recover all random bits after the seed is placed on an external hard drive. Since the ransomware doesn't know if K_{file} is a user DRBG-generated key, it uses a K_{file} to encrypt user files. After this method, the user will retrieve random bits from the seed, internal state and *reseed_counter*. DRBG is used for a large number of applications, including ransomware, so that the user searches the right Kfile thoroughly. The client then recovers all encrypted files successfully with Kfile. Figure 4 shows the secret key for the recovery of Kfile and the decryption system.

In summary, the process used by the dynamic DRBG protection method is:

(1) ***Enable mode of defense***

- Set the original DRBG seed and status
- Store the seed in an external unit
- Link with client DRBG to Crypt API CryptRandGen ()
- Enter *reseed_counter* by date and the internal v State

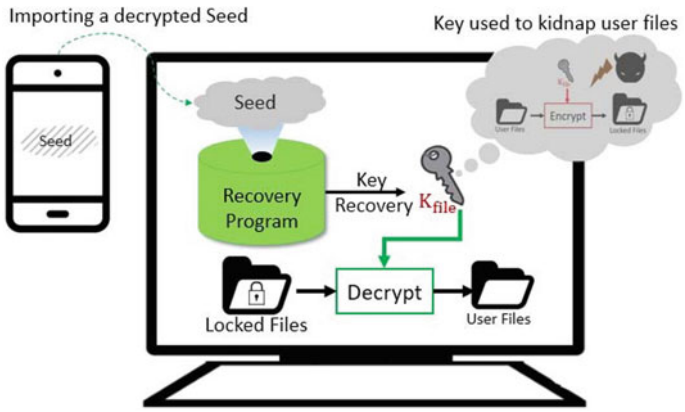

Fig. 4 Suggested scheme to recover secret keys and decryption

(2) ***File encryption and ransomware infection***

- Ransomware generates K_{file} randomly from the RDBG of the client
- Ransomware encodes files with symmetric K_{file} key algorithm
- K_{file} encryption with public key encryption

(3) ***Scheme for Recovery***

- Rebuild K_{file} with the help of seed of DRBG
- Regain the converted data with the help of Kfile

3.4 Safety of the System Proposed

When DRBG replaces CryptRandomGen(), there are certain safety considerations. The seed should be produced first with high entropy to be formulaicTraditional cryptography assumes that when the length of the seed is at least 256 bits, the DRBG produces free random bits. In order to improve safety, users should increase the seed length or use an additional input. Customers will set the required level of DRBG protection. Second, if the seed is found, all applications that need protected random numbers cryptographically become vulnerable. Nevertheless, this will not arise when the seed is mounted only on external devices. We also suggest encrypting the seed with a public key in order to maintain the seed secure.

4 Future Scope and Conclusion

We also introduced a security ransomware strategy in this paper that can restore the core value by removing the crypto-API. This approach can be used to mitigate infections issues for network and web users. The method implemented shields the user files against ransomware. For future studies for the theoretical implementation of the new protection program, we suggested the application DRBG as an Alternative to the Crypto API.

References

1. NO MORE RANSOM (2016). http://www.nomoreransom.org/
2. Young A, Yung M (1996) Cryptovirology: extortion-based security threats and countermeasures. In: IEEE Symposium on security & privacy, 6–8 May 1996, pp 129–141
3. Barker E, Kelsey J (2012) Recommendation for the entropy sources used for random bit generation. NIST DRAFT Special Publication 800-90B
4. Barker E, Kelsey J (2012) Recommendation for random number generation using deterministic random bit generators. NIST special publication 800-90A
5. Kharraz A, Kirda E (2017) Redemption: real-time protection against ransomware at end-hosts. In: The 20th International symposium on research in attacks, intrusions and defenses (RAID 2017)
6. Young A (2006) Cryptoviral extortion using microsoft's crypto API. Int J Inf Secur 5(2):67–76
7. Palisse A, Le Bouder H, Lanet JL, Le Guernic C, Legay A (2016) Ransomware and the legacy crypto API. In: International conference on risks and security of internet and systems, September. Springer, Cham, pp 11–28
8. Kolodenker E, et al. (2017) PayBreak: defense against cryptographic ransomware. In: Proceedings of the 2017 ACM on Asia conference on computer and communications security. ACM
9. Berdajs J, Bosnis Z (2010) Extending applications using an advanced approach to DLL injection and API hooking. Softw Pract Exp 40(7):567–584
10. Turan MS, Barker E, Kelsey J, McKay KA, Baish ML, Boyle M (2016) Recommendation for the entropy sources used for random bit generation, (Second DRAFT) NIST SP 800-90B

Comparative Study of RSA with Optimized RSA to Enhance Security

Amit Taneja and R. K. Shukla

Abstract Asymmetric crypto algorithms are a robust technology used in the communication of texts on the channel to reduce security risks. Mathematical approaches are one of the drawbacks and it's because they involve a larger amount of calculation which contributes to the need for enhanced use of computing power. This paper aims to refine the algorithm for RSA encoding and therefore enhance information security, reliability and availability. The results show the information security efficiency and usability of the RSA algorithm. We can also see that when performing encoding and decoding, time, space, processor and network output are lower than other RSA solutions since computing is performed on the client and server.

Keywords RSA · Efficiency

1 Introduction

Integrity and confidentiality of data can be maintained through encrypting and decrypting the information. Moreover, As new technologies are being evolved so vulnerabilities and threats are also increasing which is a big challenge. [5] Nowadays, several algorithms have been endorsed to provide security but often consume high computational resources and generate a higher cost. RSA asymmetric encryption is one of those (Fig. 1).

The RSA algorithm is the widely used universally, providing security by encryption of web passing data and maintaining the integrity and confidentiality of information. [1] The algorithm became popular due to simple calculation and is known as public key algorithm. Nevertheless, the RSA algorithm security relies on

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_91

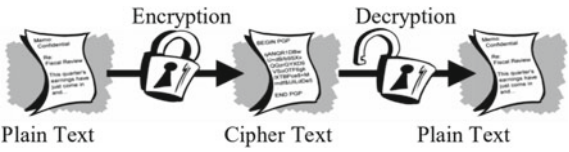

Fig. 1 Encryption and decryption

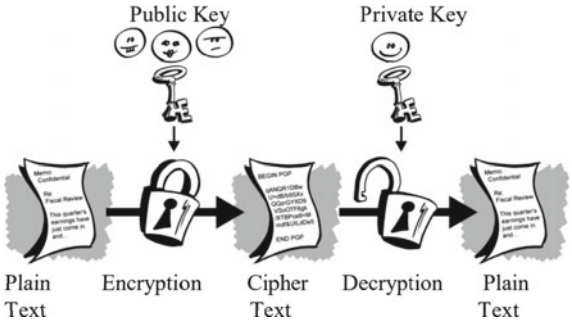

Fig. 2 Public key encryption

the capacity of the prime numbers used in factoring [1]. It is influenced by the rise in prime factorization-related computational costs, [6, 7] which means higher key lengths to ensure safety. To develop this research, modeling techniques need to be studied which determines the capability of representing the data model. Such approaches include modeling languages like UML; frameworks like Model Driven Architecture; and, for example, network management, RSA model. The current approaches to modeling encryption schemes were subsequently studied. With these tests, we established a framework for RSA-based data encryption and decryption. Eventually, in the implementation of the API (Application Programming Interface), an authentication library is developed that permits us to encode text on client side and submit it over the network with public keys [1].

On the server side the data is obtained and by loading the database (decryption process) private keys are accessed. Private keys are regularly updated to optimize template security through a mixing process [3] (Fig. 2).

2 Related Work

There are various works in the literature ensuring information security and increasing performance efficiency, reducing resource consumption. For example, the work proposed in [8] by Gupta and Sharma developed a hybrid encryption algorithm based on the RSA algorithm and the key exchange algorithm by Diffie-Hellman to increase security regardless of computational speed. Nagar in [2] presents a new method for exchanging indexes comprising both the keys stored in a database. Surbhi explains security threats in the transmission of e-mail over the Internet in a comparative analysis. [9] This research involves a comparative study

of various authentication algorithms and concludes selecting the best technique to tackle the computational cost and security problem. In [10], Mahajan develops a new solution using CUDA frameworks, which proposes a new method that calculates the module value, processes small and large prime numbers. Shahzadi et al. [1] presents the analysis of asymmetric encryption algorithms: RSA, ElGamal & Pallier, which compares these algorithms in terms of encoding and decoding time, storage use and efficiency. A comparative evaluation is conducted in [11] and [3] for various commonly used symmetric key algorithms such as DES, AES and RSA, taking into account several criteria such as computation time and memory utilization. A method for encrypting information using images is proposed in [10], creating a new encoded file each time the same message is encoded. A third prime number is used in [1] to make it hard to decompose a module n. To obtain the keys to solve the propagation problem, the modified Euclidean theory is applied. While previous work concerns the RSA performance issue, neither of them examines how to improve the level of protection. Not really a generic remedy has been accomplished as these methods prefer high resource and software cost consumption without setting up a process for software engineering. We have established an optimized RSA design, which incorporates modular and probabilistic computation for encoding and decoding, by contrasting these studies with our research.

Problem Statement

In this study, another model was designed and implemented to calculate the efficiency level of the proposed model, the Baseline RSA Model, which works with 300 digit prime numbers factorization. [1] The main interest of this research is the design of an integrated architecture for mathematics and technology that provides the above-mentioned improvements:

(1) Using a mathematical model of modular and probabilistic calculations
(2) The matrix that can produce encrypted messages of the same data quality but with multiple meanings.
(3) A system for combining private key updates
(4) Message processing through an RPC
(5) Converting a deterministic model into a probabilistic project by generating random values.
(6) Function with less complex structures that reduce time and resources use.

In the following way, the majority of this work has been arranged. Section 2 defines the anomalies in RSA. Section 3 defines the scope. Section 4 contrasts the Optimized RSA model with the RSA model baseline. Section 5 provides the performance analysis. A safety comparison between optimized and baseline RSA methodology is performed in Sect. 6. Finally, Sect. 7 onwards ends the report with observations and possible lines of research.

2.1 Anomalies in RSA

When researching the RSA algorithm, I found the following problems:

[1] Cryptographic computational solutions require a significant quantity of computing which means higher computing resources usage, requiring higher bandwidth.

[2] Security needs to be proofed. RSA security focuses on the complexity of factoring large numbers, but is similar to factoring has not been technically proved; as there is no proof that broken RSA would need factorization. If there is an algorithm, a large number can easily decompose, thereby compromising the security of the RSA algorithm.

3 Scope

In the development of emerging network security technologies, cryptographic techniques and methods play an important role. It is evident from the fact that the most industrialized countries in the world, such as the United States, accept cryptographic technology as the mainstream technology, taking into account the security aspect of the world's fast-growing trade, banking, military activities, and the need for the day to standardize it so that the entire world can benefit from it. Cryptographic Key Management (CKM) is a vital cryptographic feature and is considered as one of the key aspects of its use. The scalability and usability of the methods used for distributing the keys are of particular interest. That's why National Institute of Standards and Technology (NIST) has made an effort to improve the overall key management approaches used by both the public and private sectors to improve the functionality of cryptographic technology and to promote a global cryptographic key management network (Figs. 3 and 4).

The primary limitation of the RSA design is that while modifying the executable. jar (java archive) anyone can get to private keys as shown in Fig. 5. It doesn't occur in the optimized RSA template since keys are protected.

Although the RSA template is completely asymmetric encrypted data, the optimized RSA architecture is semi-asymmetric as it generates 2-byte encrypted data from which 1 byte originates from the origin text and vice versa [3].

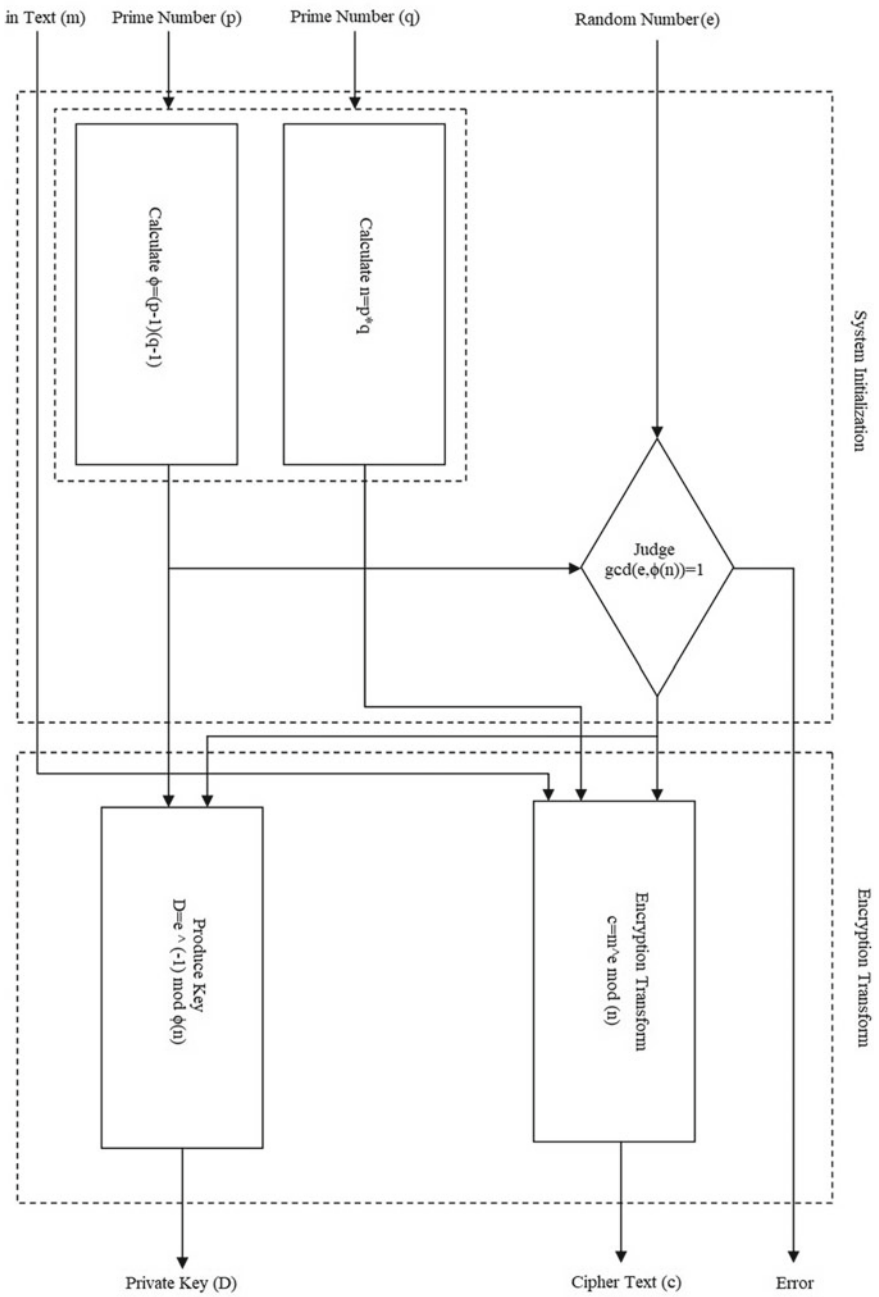

Fig. 3 Block diagram of RSA algorithm

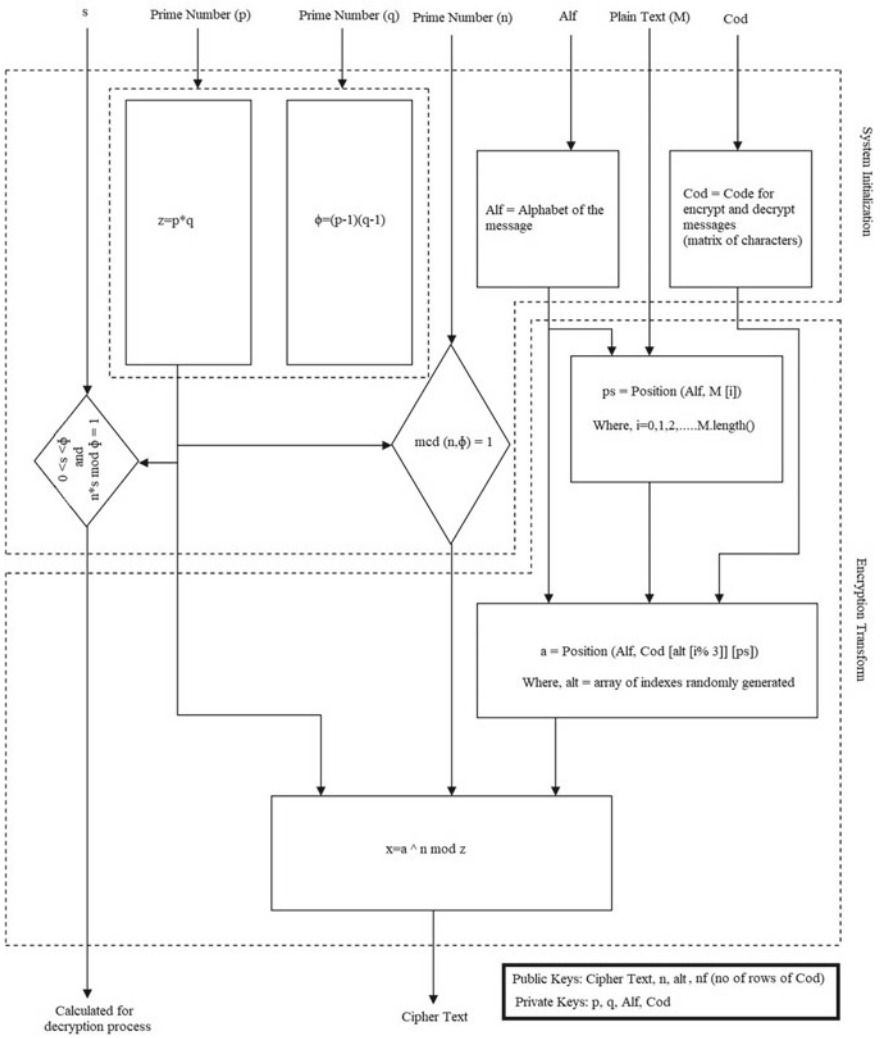

Fig. 4 Block diagram of optimized RSA (Encryption of plain text)

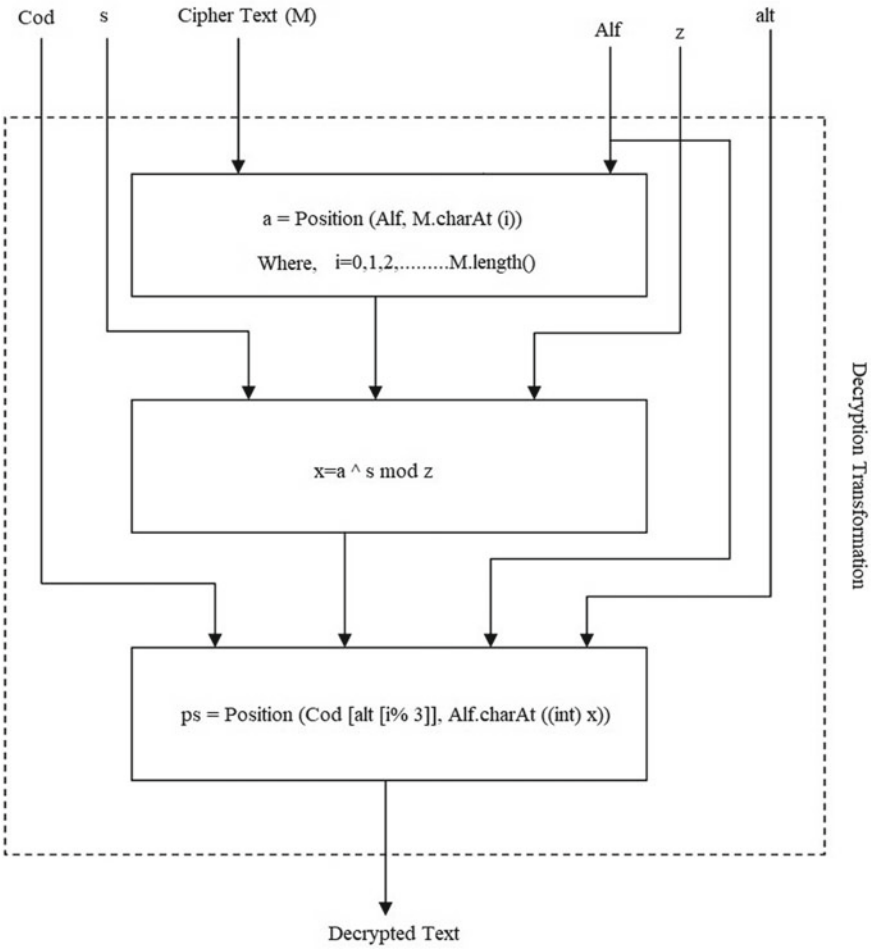

Fig. 5 Cont. block diagram of optimized RSA (Decryption of cipher text)

4 Block Diagram of RSA V/S Optimized RSA

See Figures 6, 7, 8, 9 and 10

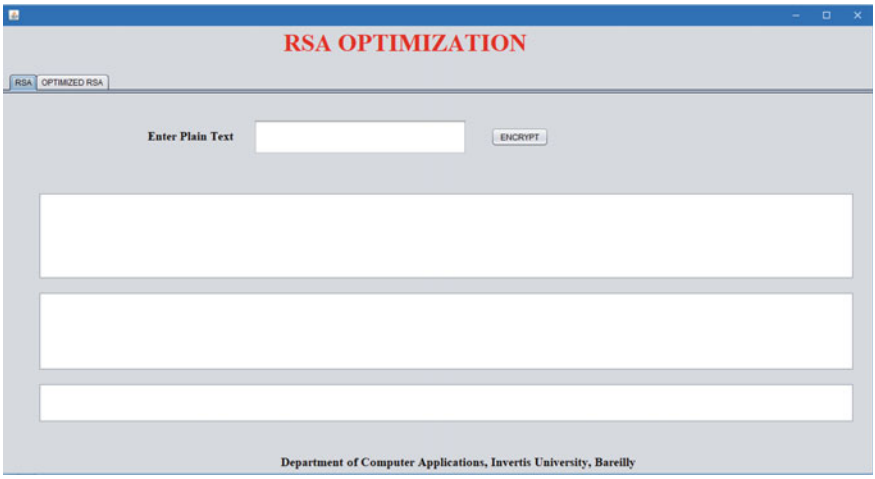

Fig. 6 Home screen of application

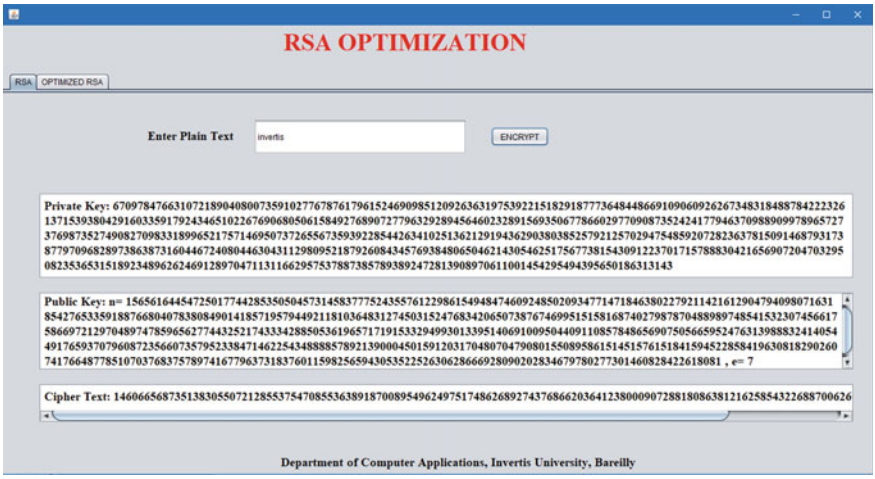

Fig. 7 Encryption of plain text by using RSA algorithm

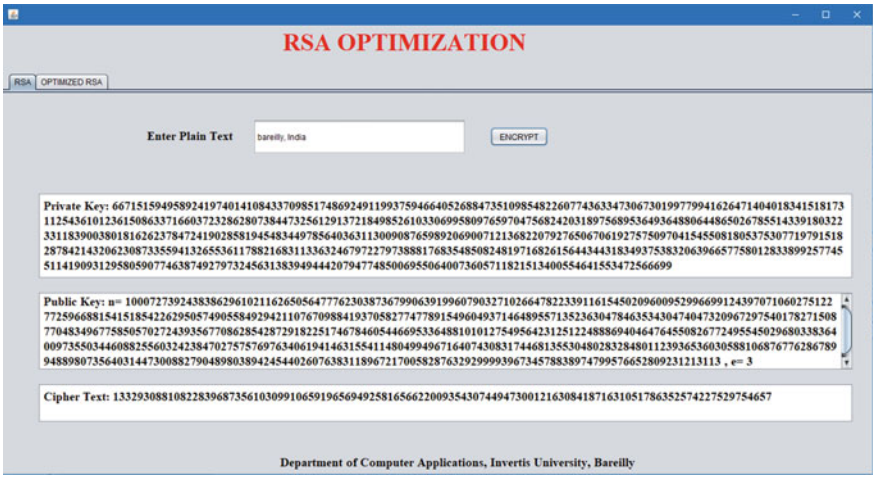

Fig. 8 Encryption of plain text by using RSA algorithm

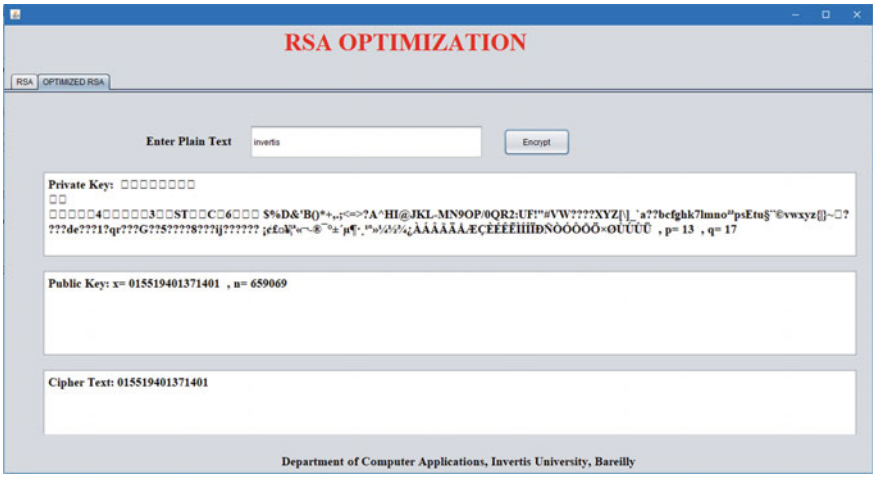

Fig. 9 Encryption of plain text by using RSA optimized algorithm

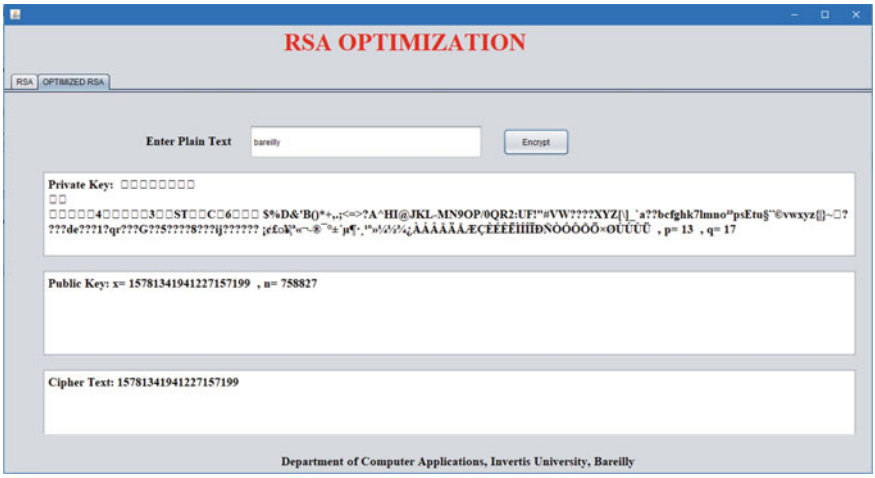

Fig. 10 Encryption of plain text by using RSA Optimized Algorithm

5 Implementation Screens

5.1 CASES

Test 1: RSA Algorithm

We're going to perform the Hello message encryption and decryption operation by using the above algorithm. The relevant values are taken into consideration:

p = 11751156676056622846032154927584566441912607016847588327837746081630132921051256991950217302953097795562137569194452506592113705910203219978977473343827871649373715371124133309558218368959228048967672102831943704619344430744137425078325937863040056689935658464052612062386470111958451096144746666926893358127 3

q = 11653579582399785984908384334648953482597717604630353271836573180454133098374601988207678448607018227317117381931643112300658568961163796123566711682609145221225339945385523690743099100398800248674949216553366759580040690085286700729695386473176277803537145282786288370255675833732296822446609152208138814446 9

n = 13694303950967439601994508322231334075892045903973898605618067573358515737623479488417378894797171901924313371625141716822600461515593478380914073072468488696565893150495702656610538676006665868504792082907235629053434889813859578365308254621829634246543960307844239945063613115589654861746688451332044142107492030277978187963199185248255938324258218907053783505724345266073518141936340368720702341911186411056965247888097143548544871981655730163970455559 4

13757714188142890115198195117893776368807965720919927804899689571632373998219966176026423014603760985633515334149754784068975966427528855996965476432212476929037

phi = 13694303950967439601994508322231334075892045903973898605618067573358515737623479488417378894797171901924313371625141716822600461515593478380914073072468488696565893150495702656610538676006665868504792082907235629053434889813859578365308254621829634246543960307844239945063613115589654861746688451332044142107257982915393623874889779855633603125013115660839004089727602073452675481742081778919123384395585250828172698376836187359617149232942060002945013709149387545482152336950101625114880601675227682744493714611046584929638522789925724917946209771241597640698787296681365779742554506970621376811051918240862155203296

e = 3

Private_Key = 91295359673116264013296722148208893839280306026492657370787117155723438250823196589449192631981146012828755810834278112150669743437289855872760487149789924643772621003304684377403591173377772456698613886048237527022899265425730522435388364145530894976959735385628266300424087437264365744977923008880294280715053219435957492499265199037557354166754104405593360598184013823017836544947211859460822562637235005521151322512241249064114328219613733352966758060995916969881015579667344167432537344501517884963291430740310566197590151932838166119641398474943984271325248644542438531617030046470809178740346121605747701355 31

Plain Text = invertis university

Cipher_Text = 12997780838641179177640456075462056830970196719415751323245358546184304696324160095570778875988780575118726666582736579739085993099437097

Test 2: RSA Algorithm

p = 15537122110565872517919990812339518915868178527559665207605076032661107107641535251891307382239096278618556014333894730132849983300214905116014127082446961814153217174426974728969258730726740281166641055682720491297829732776773804829008033536943986588447149683631112241596148429318176942190317341208819599497 3

q = 15010527146289063988902108262095484546269803764376224619256176050232480964930867191051550788119424702208336222936290817067218593723897467724792663088566603458870620906567672405111243553112779023091781930859902243382907961926773735090795221446162453530986296559258826337307354341210317346659049494904353032819 3

n = 233220393215857065344752707816550400613078289833577739076713
791891387508661260247455343703700194640852303963563656163127120928
296050804274291430486773242415220009397589203723350219188381498018
221611380750399855785834630215708684841959549491736386194416430179
684157694900552803206256091509436076255124569696546081928395461766
680362901357831972707148464674412432463393911292384332268518475432
624313737358650169570182237145142746662198688681623820601052104989
444171026307919722500025002964262909630148763391980424865576937200
262064367943447723142617683545776607704931560167951750943256684137
552852679766964994828681737 89

phi = 233220393215857065344752707816550400613078289833577739076713
791891387508661260247455343703700194640852303963563656163127120928
296050804274291430486773242415220009397589203723350219188381498018
221611380750399855785834630215708684841959549491736386194416430179
684157694900552803206256091509436076255124569696543027163469776273
029680691450388472360934666445218843480707786084094973461261235183
330027920322798071487493013418124191942191830979212583316971425972
342814499005535914400560289556212681246196832966138126211314663732
188294897588693731162292185235132595761586935878957893052906407084
703423794830281383511418506 24

e = 5

Private_key:466440786431714130689505415633100801226156579667155478
153427583782775017322520494910687407400389281704607927127312326254
241856592101608548582860973546484830440018795178407446700438376762
996036443222761500799711571669260431417369683919098983472772388832
860359368315389801105606412512183018872152510249139393086054326939
552546059361382900776944721869332890437686961415572168189946922522
470376660055840645596142974986026836248383884383661958425166633942
851944685628998011071828801120579112425362492393665932276252422629
327464376589795177387462324584370470265191523173871757915786105812
814169406847589660562767022837012 5

Plain Text = bareilly

Cipher_Text = 179038843400401160126327134003544298850047269436746
829508572534409405660779776580670304809320 57

Test 3: RSA Optimized Algorithm

Alf: ┐ └ ┘ │ – ● ◘

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u§¨©vwxyz{|}~ ????de???1?qr???G??5????8???ij?????? ¡¢£
¤¥¦ª«¬-®¯°±´µ¶·¸¹º»¼½¾¿ÀÁÂÃÄÅÆÇÈÉÊËÌÍÎÏÐÑÒÓÔÕ
Ö×ØÙÚÛÜ

nf = 5

cod:

ROW: 1

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tÑ,# y•d_8¸%ÛÏ=:bØDk×RÜ²—°É”}¤ËÍŒ¨× ¾¯kÏ·Š
− ┬ ¦“–×’”ÛE¿rB6┐ ÎÄ †ÕF

ROW: 2

┼ 3ªV│ A±dÖ1Mœl¥¥0sÓ†R¹-
j}s↑ «*f*©“a{ÀDKÅRµÜ Æ8p)ÖM← !¥Ã Õ b+6U
← Ia◄ ÁQÕ[q†hn¹Ó→ ¶Ù▪ − Æ²← ©J)ÑÔ Q³↑ ÓA¹¢{-
¸7,½9 6‹´u↑ ²U!_● ┤ dÑÂp],ÉxÈ~ŒÄ*f*Ÿ©–uF3
ÙH¶┴ Å┘ ¥,i-Ÿ°¥ u● .pm o8┤ s]‘ ÁBÏ<⁄,rU/¶Ê:
½┤ °¤Æ

ROW: 3

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└ H│ f« ¯86o¦º•‰lÉ↑ ↑ OÙÓ™,–ª µ„ A!§f
Öd ┬ ™d● È¬^;-
ÏK7j §,Ä<91·8– ^»├ ¹Æš‡W¡~WÛ±´É%ª┐ ÀBZ ¶ -
–Ú%±Rl ,1 aÔeÊ¶▪ ┘ -
´ÅVÅ,z☼ ¢¦ÆCÓ˜71Ozh±~@³K@Ë< ▪ − ÃÙ¼?← Å\
S│ 3>

ROW: 4

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*EÂ +ŒÛ↑ r;P5 'q?DÇÕ§P!_ŠŠ±ÄV~TK↕ Ê™
BuÏ;3 ŠpÄ=œÃŸ‰D− È8Öª+-
ZÎŠ^/W ~Ä”]Ô}©˜½├ A–'‰½┬ U◄ Pa „]#

ROW: 5

↑ S└ ← -
$9-}<]→ W┐ ZÓ§← 0>^\q'À>˜¡OÊÃ‼ • ˜eAYbŒ┐ [¾ ↑]² x±g↑ ¶ ¹ 5º"MÇÒ¥ • £¢¼L¾¡…°
Ãohh²^…‘£CH¿3-Ho ½s=fɤYUÂ×sÕ:+hN³ŠP X M¼?7!› ª-/┬ B’}¯ÔRJ0š▪ ┼i├ R├h
#(’ $¨o‰.¾.ÇUYX-OÒO„Œ>| `52w™®È03 Õ« ¸L¼ÎO?’|Šf ?K]–#t V• Ù3Y◀H $1

p=11 , q=19

Public Key: x= 81221797600856 , n= 765659

Plain Text: invertis

Cipher Text: 81221797600856

Test 4: RSA Optimized Algorithm

Alf: ┐ └ ┘ │ – • ◘
☼┼◀↕4‼ ¶┴┬┤3↑ ├ST→←C 6 -
$%D&'B()*+,.;<=>?A^HI@JKL-
MN9OP/0QR2:UF!"#VW????XYZ[\]_`a??bcfghk7lmno²³psEt u§¨©vwxyz{|}~ ????de???1?qr???G??5????8???ij?????? ¡¢£ ¤¥¦ª«¬-®¯°±´µ¶·¸¹º»¼½¾¿ÀÁÂÃÄÅÆÇÈÉÊËÌÍÎÏÐÑÒÓÔÕ Ö×ØÙÚÛÜ

nf = 4

cod:

ROW: 1

ÚJÉ
Åo ¦^³‡«NÄª☼ ÙkµÑ°œk 7ÎŠ- {aÁ¦„¹Ö«J†Z¸´°4 dA…“S zÌŒX™ÖÊkÍ%Š☼ f┬ Ne9ÑœF
@Å↕ w«│ RH¢V°M§`GÙ-i†Ø6ª‰[l/8^VÕÍm– Ôfx6o£ ‹™–ºx <'¼0;g"b±|i┴ QÐ8ÀX)!’┘

ROW: 2

O P^%•ÔN×¸F~¤<M‡´Ç
µjWz^↕ H;ÔÒ¶ ¿µ¥ ®¶ ”‹3 M¸7│ ÏÓ Äz„„-┼ |)Â >├

ROW: 3

d³s» ‰"┴ ¿ÁB'
}&← b← ÛÇjÉC µ-┬ -ÀÌ$ÈÏª‼ i¶ £Nh˜– ©Y39-Ñ«*f* Å2i´Ð_h8šË↕ “=^Q07TÛfↄ↕ {Û^¼% •
ÅÀ›ÑR↕ =ÂšH, Ð9,˜³Úx¶ªØ, ke[œ‹¼Ñ‰uµ(k,†¢ UÏ,ÙÃ× ’┤

ROW: 4

¥Ñi¡Ã├ c× ŸFÄYz● -¤b→ ¥¸¡À•h┬ VFÀ4®┤ 9
%┤ Œb-¿I«v°©KÅ-À°{·=¤Û┘ ÓfÜQ¦‡??┬
,o°)t „kÖ>┘ Ð Ï_'bš&“ @ %KÈZ ´
<j©[†Å 5Én◀ ‡
vÅ‼ T*B0Ú°9o°├ Ö¾Éf← ™?´Œº¬ƒ3ÛH5v´Í ?ÏK
*\j XdvŠ$1 ¹Œ.Å«FŒÁ'├ `6?S´ I)┼ ”!·q–
┐ ¾ ┼♊k:Ñ»µ)J0˜s'?"…-¬2ƒXÛ¸ ÏV[

p= 7, q=17

Public Key: x= 56001171129595149 , n= 988579

Plain Text: bareilly

Cipher Text: 56001171129595149

Public Key: x = 56001171129595149, n = 988579
Plain Text: bareilly
Cipher Text: 56001171129595149

6 Implementation

A. Optimized RSA Algorithm

Optimized RSA Algorithm can be Implemented by Introducing Following Versions in Basic RSA Algorithm

(i) RSA value is assigned to each character of the message.
(ii) n is working like a nonce which is generated as randomly.
(iii) A matrix (Cod) is used to combine the message characters and randomly generate the indexes of the matrix rows. Example: Assume that we want to encode the message Hello; the table below gives Alf and Cod, In order 3 1 and 2 row indexes are also generated; The encrypted message will then be produced as an ooole (Fig. 11).

Fig. 11 Table of encryption

		1	2	3	4	5
Alf:		H	e	h	l	o
Cod:	1	l	o	H	h	e
	2	e	h	l	o	H
	3	o	H	h	l	e

The above example is pretty easy. For reality, the set has 221 columns of m rows, m(integer) value can be consider from 1 to 221, consider as a factorial value. All rows are randomly mixed chains. Consequently, the Encryption table generation method has a different degree of complexity.

(a) ***Generation of keys:***

STEP 1	p and q are selected as two prime numbers ∃ the number of printable ASCII characters would not surpass their multiplication.
STEP 2	Calculate z = p × q, where z is the private key. The outcome is considered the key length.
STEP 3	Use the Cod matrix to create the message combination. The security of this system is based on this key and Alf, as they are updated regularly and arbitrary row indexes are generated.
STEP 4	Calculate $\phi=(p-1)\times(q-1)$, here $\phi \rightarrow$ Euler Totient function.
STEP 5	Consider e as an integer$\lvert(e,\phi)\rvert = 1$, where n is the prime number and public key.
STEP 6	Finally evaluate s, where $0 < s < \phi$ and $n \times s \lvert\phi\rvert = 1$, while decrypting.
STEP 7	Continue from step 3 while characters are obtainable.

(b) ***Encryption process:***

STEP 1	Capture the message (mesj).
STEP 2	A random prime number is generated between four and nine digits (n).
STEP 3	The number of matrix Cod rows are generated at random (nf between 0 and k − 1). Create the code (alt) index set of nf elements randomly. Retrieve, Alf, p, q, k and Cod from database.
STEP 4	Perform every message character (mesj): Evaluate the alphabet character position (ps), formula (1). To evaluate the basis of formula (3) (a) formula (2) is applied. To get (x) formula (3) is applied. Get the character in position x which can be obtained from alphabet's encoded message.
STEP 5	Message next character (mesj).
STEP 6	The encoded message from the original message as a output. (mesj) to (msjc).
STEP 7	msjc, nf, n and alt is sent to the recipient

(c) ***Decryption Process:***

STEP 1	Obtain the random number (n), the number of Cod rows (nf), the code (alt) index array, and the encrypted message (msjc).
STEP 2	Using formula (4) the key (s) is evaluated Access from the database p, q, k, Alf and Cod.
STEP 3	For every encoded message character (msjc): Evaluate the character's position in alphabet (a), formula (5). To get (x) formula (6) is applied To evaluate the position (ps) formula (7) is applied. Obtain from the alphabet, the character found at position ps which is part of the decoded message (original message).
STEP 4	Next character of the encoded message (msjc).
STEP 5	Finally, we have the original message from the encoded message. (msjc) to (mesj).
STEP 6	The encoded message can be viewed. (mesj).

7 Results and Conclusion

All tests were conducted in one host HP Pavilion g4 Notebook PC, AMD A4 3330MX APU @ 2.2 GHz, 4 GB RAM, Windows 10, Java Development JDK, NetBeans IDE 8.2. In order to evaluate the software quality, 10 tests are carried out The evaluated variables were processor, memory, time for encryption and decryption, and system security level. NetBeans IDE 8.2 was used to measure the CPU performance,. These tests were taken in during the process of encoding and decoding of the message. A program was created in Java to evaluate encoding and decoding time. For this analysis, the basic RSA results and the optimized RSA are matched.

8 Results

8.1 Chart of CPU Usage

See Figures 12, 13, 14, 15, 16 and 17.

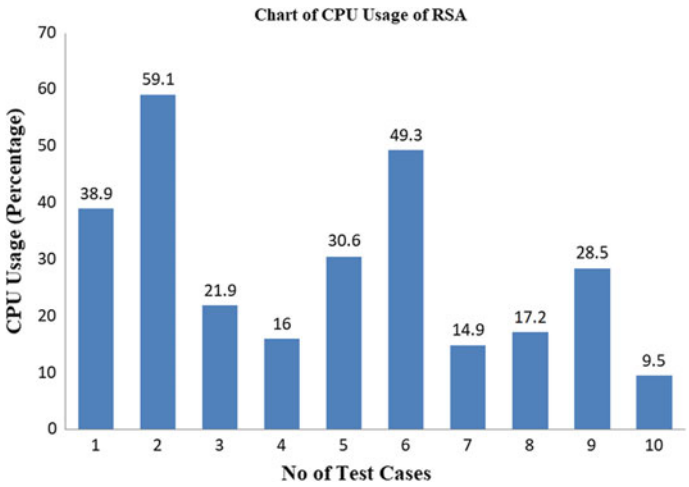

Fig. 12 CPU usage of RSA algorithm

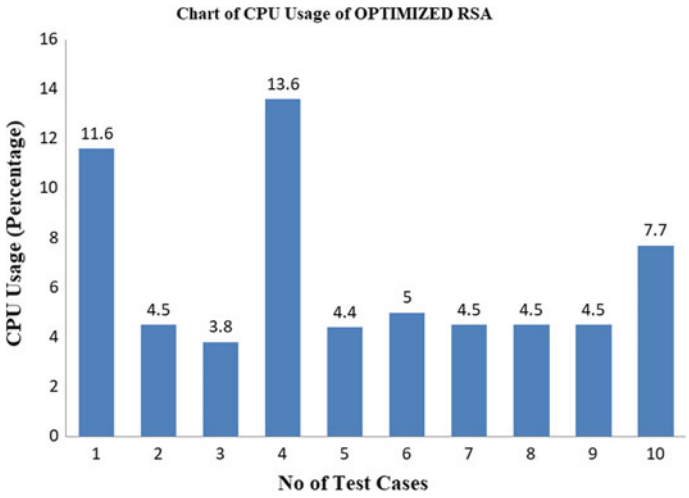

Fig. 13 CPU usage of OPTIMIZED RSA algorithm

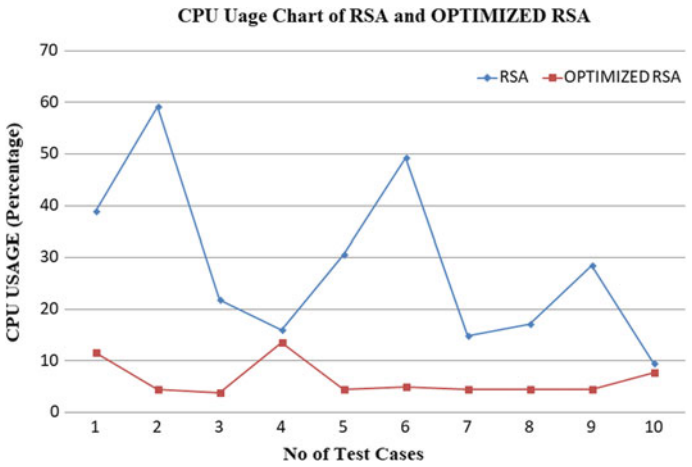

Fig. 14 CPU usage of RSA and OPTIMIZED RSA algorithm

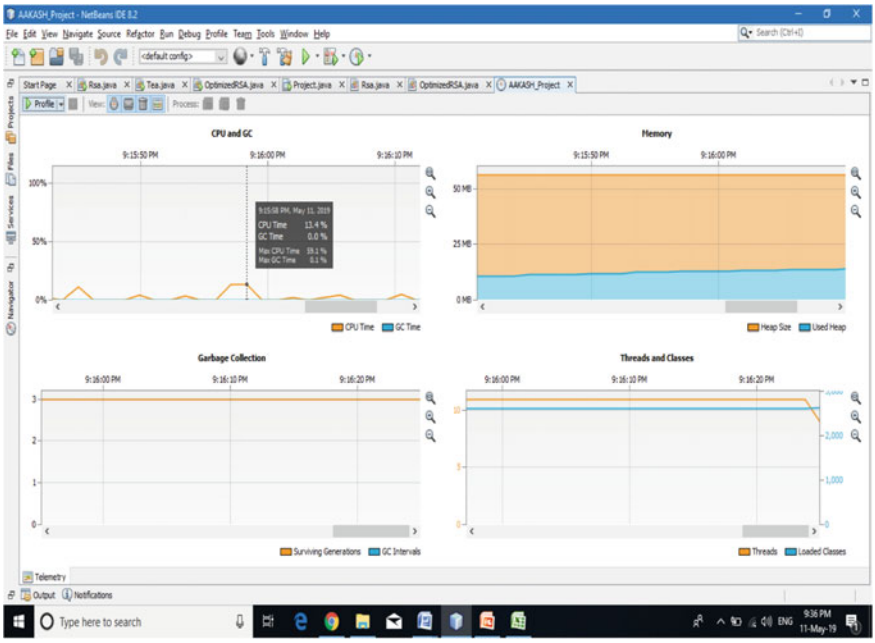

Fig. 15 Screenshot of test cases performed on NetBeans IDE 8.2 for CPU usage

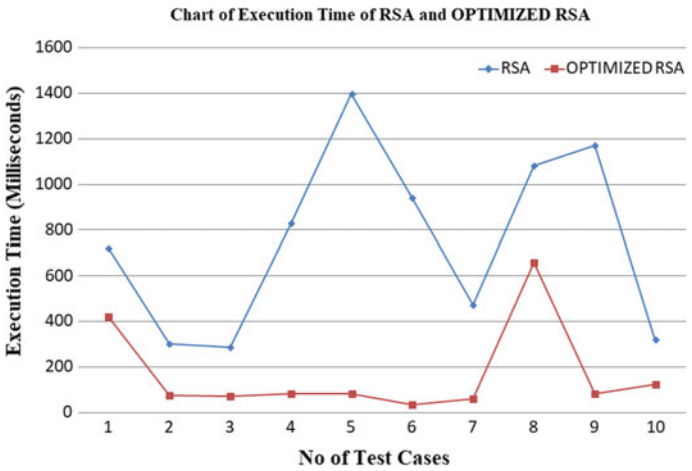

Fig. 16 Execution time of RSA and OPTIMIZED RSA algorithm

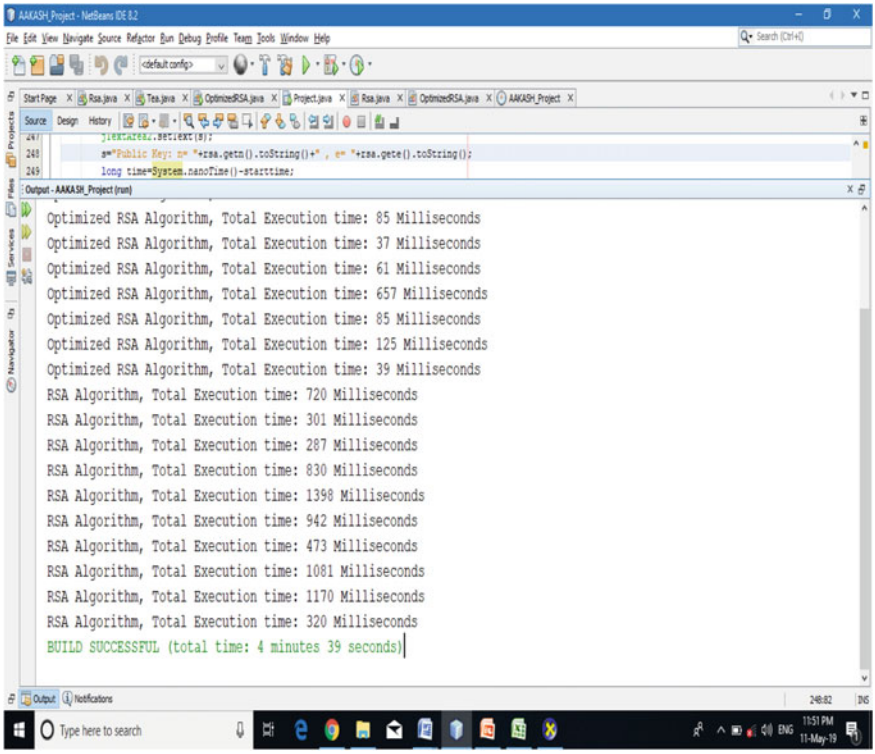

Fig. 17 Screenshot of test performed on NetBeans IDE 8.2 to calculate execution time

8.2 Chart of Execution Time

The present study confirms that the RSA encryption algorithm is optimized by a standard design, capable of encrypting and decrypting data that has improved the effectiveness and safety of messages sent through network. We noticed inconsistencies in the simulation, the design tools and the techniques used to compare results with the optimized version. The base plan has basic functions such as using big prime numbers p and q, which in this case can be found on the Internet. On either end, these numbers limit the message because its length relies on the numbers p and q. However, the proposed project has been fundamentally simplified as it supports encoded and decoded messages whose length is limited to the width of the channel and the processor to be sent, which means that the restriction is not due to the algorithm but to the network. Eventually, it is known that the RSA template configured supports three technical and legal measures that demonstrate the level of security: confidentiality, accessibility and honesty. Privacy was retained because the conditions required for encryption and decryption were not revealed. Integrity has been achieved by creating the DLL (Dynamic Link Library) that can only be managed and updated by the developer of the new RSA encryption system. Compatibility refers to the user's accessibility to send messages to the destination that require a higher level of security.

9 Conclusion

The focus of this work was on optimizing the algorithm for RSA encryption. We have established a standard solution that can encrypt and decrypt data, improving the efficiency and security of network-based messages. This approach included system analysis, optimization of the model of mathematical speech, which enhanced the process of authentication, and implementation of algorithms to secure network message transmission. NetBeans IDE 8.2 is used which is a free software which allowed a new Java API to be created. Within this API, the new RSA algorithm method is evolved. The findings show our analyses' efficiency, security and usability, but suggest that the algorithm has been quantitatively optimized.

References

1. Patidar R, Bhartiya R (2013) Modified RSA cryptosystem based on offline storage and prime number. In: IEEE international conference on computational intelligence and computing research (ICCIC), pp 1–6
2. ISCI (2012) Enhancing security features in RSA cryptosystem. In: 2012 IEEE Symposium on Computers Informatics (ISCI), pp 214–217

3. Wang HJ (2012) Key generation research of RSA public cryptosystem and matlab implement. In: IEEE international conference on sensor network security technology and privacy communication system (SNS & PCS), pp 639–642
4. Cohen AE, Parhi K (2012) Architecture optimizations for the RSA public key cryptosystem, a tutorial. IEEE Circuits Syst Mag 11(4):24–34
5. Zhou X, Tang X (2011) Research and implementation of RSA algorithm for encryption and decryption. In: 6th international forum on strategic technology (IFOST), pp 1118–1121
6. Yadav PS, Sharma P, Yadav DK (2012) Implementation of RSA algorithm using elliptic curve algorithm for security and performance enhancement. Int J Sci Technol Res 1(4):102–105
7. Singh G, Supriya A (2013) A study of encryption algorithms (RSA, DES, 3DES and AES) for information security. Int J Comput Appl 67(19):33–38
8. Liu Q, Li Y, Li T, Hao L (2011) The research of the batch RSA decryption performance. J Comput Inform Syst 7(3):948–955
9. Dongjiang L, Yandan W (2012) An optimization algorithm of RSA key generation in embedded system. J Theor Appl Inform Technol 7(3):948–955
10. Mahajan S, Singh M (2014) Analysis of RSA algorithm using GPU programming. CoRR abs/1407.1465
11. Gadelha M, Costa Filho C, Costa M (2012) Proposal of a cryptography method using gray scale digital images. In: International conference for internet technology and secured transactions, pp 331–335

A Generalized Framework for Technical Education and Implementation of Machine Learning Techniques

Dipti Verma Nashine and K. Nirmala

Abstract A framework is described in this paper. To enhance teaching learning procedure in education it is important to find critical factors and the way they are affecting this process. In this paper a framework is designed for achieving the highly specified and target oriented objective in education. This paper describes study in two sections, first focusing on framework and second related to Machine Learning in education along with critical factors affecting Teaching Learning.

Keywords Machine learning · Framework for enhancing teaching learning · Outcome Based Education (OBE) · Key Performance Indicator (KPI)

1 Introduction

In this era Quality Education is given more importance rather than just Education. As we know this era full of data just require is to use it in best possible manner. Demand of using technology is increased and when it comes to MCA course it at its peak in the form of ICT, use of science, technology, engineering and mathematics (STEM) education.

To achieve actual transformation from Information to Knowledge, Information and Communication Technologies (ICT) played a principal role in KM i.e.; knowledge management and education processes. The gap is getting bridged up between technology and teaching methods by using ICT based methods. Some of the most popular tools include Gnomio, google classroom, kahoot, Socrative, Quizlet, Explain Everything and so on. These are growing rapidly and overcoming old and traditional teaching methods.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_92

In the search of ways to reconcile consolidated and latest technologies with educational methods to enhance educational processes, a technical atmosphere is created to promote learning services: the learning ecosystem. Francisco José García-Peñalvo in their research paper they said that "Knowledge based framework in education for enhancing Teaching Learning Procedure need to merge traditional and technological methods based on critical factors".

STEM education is one of the most important combinations of study in the field of technology which help students make the jump from handlers of knowledge of technology to trendsetters. 'STEM Education', is comparatively a new buzzword in the Indian schooling/education segment.

A strong STEM education generates knowledgeable theorists, problem resolvers, and upcoming trendsetters/researcher. Captivating into attention India is among the countries that produces maximum number of researchers, scientists and engineers, the advent of STEM education now can be seen influencing significantly in the last few years.

Study shows that student started developing awareness in STEM education age of eight (an average).Technology, availability of resources, excitement are some reasons of it. The association between engineering-technology-entrepreneurship is bit less in India. But with the pace of technology and cross discipline it starting capturing bit market possible [1–11].

Major Objective:
To design a framework that can enhance teaching and Learning Process. For enhancing the teaching learning process Key Performance Indicator (KPI) will be:

- *Performance*
- *Timeliness*
- *Quality*
- *Placement/employability*
- *Entrepreneurship*

2 Framework for Technical Education

Teaching is a well-defined **process** which is a collaborative effort of a teacher and a student to understand and apply that knowledge, concepts using some innovative teaching learning process. It includes proposal, planning proper execution/delivery of content assessment and replication in form of result.

Teaching is engagement of students actively in learning; building of knowledge through teaching to students should involve active participation of student. An educator should have skill to make student learn what he intended to with self-participation of student and how to transmute them into quick learners. Best teaching, then, requires a commitment of teacher for better understanding of learning [5, 6, 12, 13].

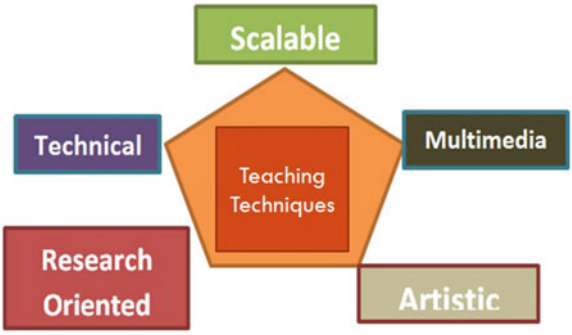

Fig. 1 SMART teaching techniques

In today's SMART era the Teaching Learning process has extended its horizon from simple process to SMART- (Scalable, Multimedia, Artistic, Research Oriented and Technical way to deal with teaching. The pace of teaching has to be SMART as students of this era are intelligent (Fig. 1).

The objective of teaching is not restricted to transfer knowledge, but too transmute students from just being receivers of someone's knowledge to dynamic in creation of their own. The educator can only achieve this through student's active participation. Teaching is primarily about building the pedagogical, ethical, social conditions by which student will get motivation for learning by its own individually and collectively.

Learning is process of capturing information, by all means of teaching, let it be classroom studying, practicing in labs, experiencing by own, getting knowledge by some other source. Learning in totality means what students do, and less about what teachers do.

Curriculum: For smooth functioning of teaching in education curriculum is one of the major factors that managing body should concentrate. Curriculum should be need based, as per industry standards, no gaps should be there in curriculum and industry requirement. Curriculum should be upgraded regularly.

Feedback: As it is mentioned in the earlier phase i.e.; curriculum that up gradation should be done regularly. Feedback plays a major role. Feedback need to be taken from stake holders of education system. The major stakeholders could be Teachers, Students, Alumni, Employers/Industry Experts. Their feedback should be properly processed and forwarded to the concern authority.

Evaluation Based on CO-PO: Due to the concept of Globalization a clear move is observed from traditional education to a outcome based education, where, outcomes are set prior to teaching. A focus is given on life-long learning rather than learning for a instance. Outcome-Based Education (OBE) is considered as student-centric learning prototype which helps educator/teachers to plan the course/lessons, assignment, exams and assessment considering outcome of course. Every Education system should be Out Come Based (OBE). It is believed that without target if one is trying to shoot a gun nothing will be achieved. Same thing will happen in education. So a great drift is done towards OBE system. Outcome based

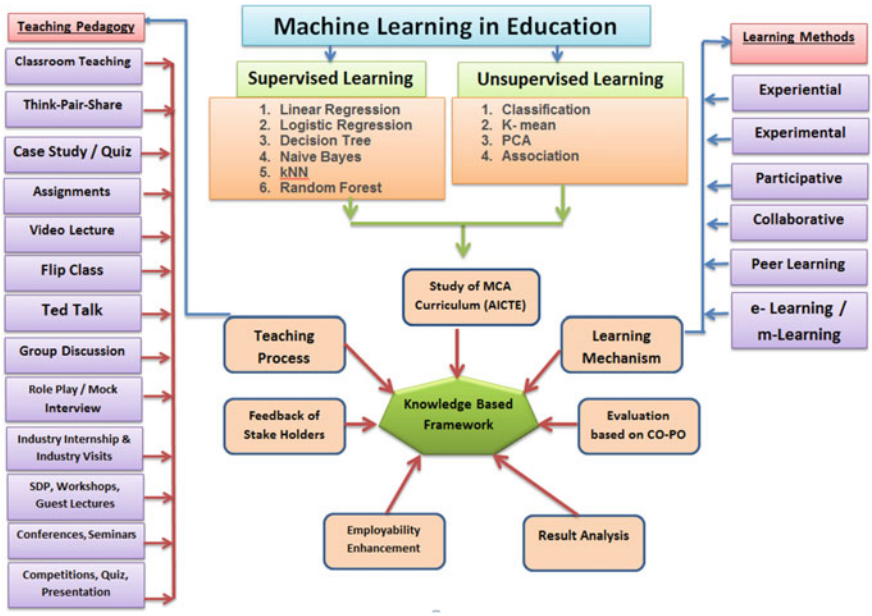

Fig. 2 Generalized framework for MCA (Technical) Education

education OBE emphases many positive outcome of teaching some of these can be listed as:

1. Expectation from our students about what they will be able to do after completing the program?
2. Measuring the student's knowledge for which they have been trained for, so as to know if they are capable to do what they are predictable to do
3. All the process like teaching and other academic/non- academic processes to facilitate learners to do what they are supposed to do (Fig. 2).

Machine Learning can be implemented in Education in various ways:

3 Machine Learning Process

Machine learning technology has enhanced the life style of people by predicting results of experiments in more accurate form with low uncertainty and high confidence. With the technical innovations and implementations of machine learning algorithm in modern systems and gadgets the prediction has gained a power and helped in improving the business, marketing, social problems and so on [14–16].

By using reinforcement learning algorithm we can make our machine get trained, think and react wisely on a condition on which system is not even trained.

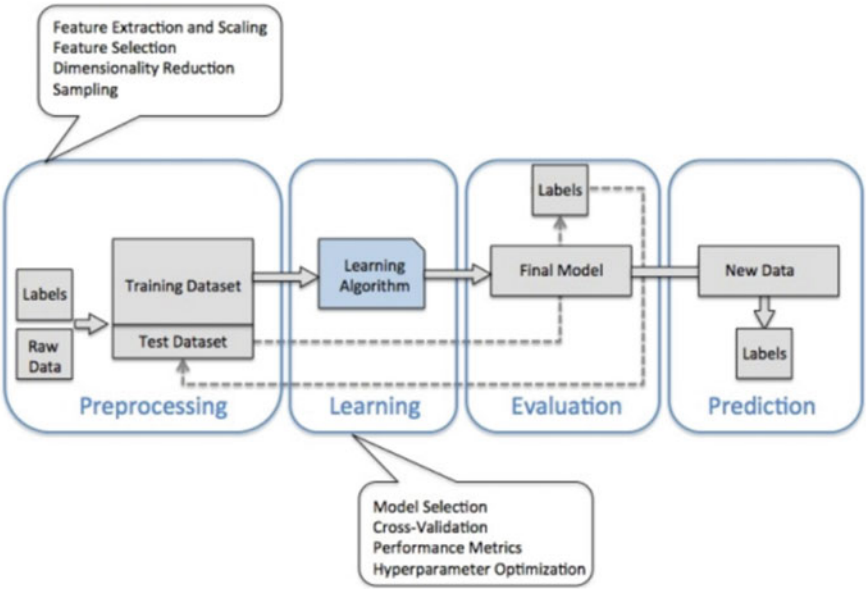

Fig. 3 Process of machine learning [3]

By training and testing data again and again the prediction, accuracy and level of significance can be improved. The newly arrived results can be matched, compared and analyzed with already existing results. Machine learning technology is fantastic, extremely revolutionary research in the area of Artificial Intelligence.

Various kinds of machine learning algorithms with some or major changes are created every time with improvement in already existing system. This algorithm can be either supervised or unsupervised (i.e. clustering, logistic, regression, k means, nearest neighbor, decision tree, random forest, deep learning, etc.) (Fig. 3).

4 Education and Machine Learning Approach

Education system needs to be reshaped and this can be done using machine learning process. Horizon of Machine learning is very vast, earlier it was restricted to student performance and teacher evaluation but now it can be used for enhancing.

Researcher has given techniques to teachers so that teaching learning can be constantly improved/enhanced by identifying teaching approaches, pedagogies and instructional tools. To adapt to ICT, or other teaching method/tool is entirely depend on the demand of subject, research, but it's always important to make some use of data available in student repository. Researcher have developed Data Driven Classroom Tuning in which the sessions which are taught, based on that results are

produced and suggestions are given to inculcate modification in session using this methodology.

4.1 Adaptive Learning Experience

In tradition classroom teaching much time is wasted in maintain records of each and every student. With using modern Machine Learning (ML) tool details can be easily maintained. Each child has uniqueness in learning pattern though the teacher is teaching equally to all the students in classroom.

After using this technique it is not required to devote much time on transferring ideas and creating objectives for student. The algorithm once get tested and trained properly it will perform the entire task by its own.

The basic intension in this study is to watch how knowledge is being transferred by the facilitator to the students. Thus, rather than giving simple instruction to the student, teachers/Mentor can realize which methods are performing well and which techniques is not performing well. And reasons can be stipulate how curriculum can be modified for better understanding of concept by the student.

4.2 Student's Career/Path Can be Predicted

One of the finely focused and discussed extents in the field of education is selecting correct path or career. On the basis of past data available of student, his/her career can be predicted along with success rates/percentage. It can tell the way a student can perform in future as well.

After analyzing continuous steps and activities of a student, the machine learning algorithm can recognizes their flaws/weal points in a student and after investigations they can predict weather they lead to removal or continual. After analyzing, student's performance Machine Learning algorithm recommends a better technique to acquire new material. The analysis begins with the existing knowledge. And once weak spots are identified, students receive recommendations concerning study resources and upcoming learning procedure.

4.3 Planned Process

By means of Machine Learning Techniques, course contents and curriculum can be managed in much better way. Because it can scrutinize what mechanisms/procedure is best and which theories/knowledge are gained by the students better with some techniques. Because of using these techniques, the effectiveness of education grows

remarkably and the students are satisfied and excited because they were able to learn the major topics in their own way in much more comfortable manner.

4.4 Spontaneous Result Generation Without Emotional Intervention

Student's assignments can be corrected by machines, as machine does not have any emotions attached with any students. Even the behavior and attitude of the evaluator will not the marks scores of students; it will be purely performance basis. Since it is bit complicated process, researchers are working to find out the best solution to this situation.

4.5 Ranking Student Performance

With the use of Machine Learning Techniques Student will now be able to get marks/score of the exam they have given but along with it they will be able to get feedback based on the test/exam/submission they have done. Once the machine is trained through algorithms for analyzing student's data, then student progress can be tracked, progress can be analyzed over the period of exams, assignment submissions. Concepts of teacher that is taught and the way students are taking it, everything can be deeply monitored.

Thus, teacher/tutor can now rearrange their lecture based on the analysis what student understood and how much student was able to take from the session. By analyzing data new patterns that they need to follow to achieve better results can be studied.

4.6 Suitable Teacher Match Using Machine

Selecting appropriate teacher for a course is also a big challenge when it is done manually; Time table formation as per student course selection is also a big task in this process. Here the best part of the Machine Learning technique is that Students enter the course as they are and the program adjusts according to them. And by this way we can say that "Learning process converts to Pleasant task."

4.7 Course Material Can be Generated and Reviewed

To get good results and maintain student's tempo in learning course material plays a very vital role. Student's interest also depends upon study material. So solve these issues Machine Learning system could be of great help. It can train and test the material according to students suitability in level of understanding of student course material can be simplified or expanded.

4.8 Personalized Course Can be Delivered by Setting Concerns

(1) As capability of learning varies from student to student. Machine Learning has proved to be major decision maker on personalizing course as per student requirement. This is implemented in reality and observed as it is helping students in growing the performance of the student.
(2) As per the usage and past accessing of data from the student with the help of machine learning application students area on interests, what's trending, scoring and sorting of most important topics, etc. can be easily tracked.

4.9 NLP in Teaching Learning Process

Natural Language Processing (NLP) is one of the important criteria which basically focus on enhancement and enrichment in the area of Teaching Learning as well. NLP provides conceptual basis for evaluation of the process of innovative techniques for providing support in the systematic learning by the use of algorithm. Natural Language Processing can be successfully implemented in the field of education for enhancing teacher's and student's skills. In the field of education NLP focuses on designing application and strategies for education which can help in enriching the teaching learning process.

Competitive Exam based questions can be outlined using Natural language processing. NLP is a method for judging the growth, development and enhancement in students learning many tools are available.

5 Conclusion

The framework will benefit society as teaching learning is always important to ensure that the education which is provided to student is of high quality and matches up to international and national standards. Knowledge Management in educational sector is a landmark that makes an eminent sense- a wonderful combination of good initiative, intuition, practical knowledge, and design what might be best described as an emerging practices focusing on the effective management of knowledge in educational institutes. A framework could be designed for how the quality can be assessed depending upon the data available with the educational institutes.

6 Future Enhancement

In this paper a framework is discussed. This need to be implemented and tested through machine learning technique.

References

1. Vesely AK, Saklofske DH Analytics for Education
2. www.bigdata-madesimple.com/8-ways-machine-learning-will-improve-education
3. Ahmad W The empirical influence of country-of-origin (COO) factor on Pakistani consumers' evaluation of French cosmetics
4. Duzhin F, Gustafsson A Machine Learning-Based App for Self-Evaluation of Teacher-Specific Instructional Style and Tools
5. Sakulwichitsintu S, Ellis L, Colbeck D, Turner P (2018) A peer learning framework for enhancing students' learning experiences in online environments. In: 2018 IEEE 18th International conference on advanced learning technologies
6. Nadkarni PM, Ohno-Machado L, Chapman WW (2011) Natural language processing: an introduction. J Am Med Inform Assoc 18(5):544–551
7. Maravanyika M, Dlodlo N An adaptive framework for recommender based Learning Management Systems
8. Al-Hunaiyyan A, Bimba AT A cognitive knowledge-based framework for social and metacognitive support in mobile learning
9. Liu K, Hogan WR, Crowley RS (2011) Natural language processing methods and systems for biomedical ontology learning. J Biomed Inform 44(1):163–179
10. De Vries MH, Monaghan P, Knecht S, Zwitserlood P (2008) Syntactic structure and artificial grammar learning: the learnability of embedded hierarchical structures. Cognition 107 (2):763–774
11. https://www.thehindu.com/education/nurturing-innovators/article23279020.ece
12. García-Peñalvo FJ, et al. (2017) Enhancing Education for the Knowledge Society Era with Learning Ecosystems
13. Srikant S, Aggarwal V A System to Grade Computer Programming Skills using Machine Learning

14. Wakelam E, Jefferies A, Neil Davey, A, Sun Y The potential for using artificial intelligence techniques to improve e-learning systems. University of Hertfordshire, Hatfield
15. Nashine D, Dhawale K Machine Learning Approach: A science to make System Smart – Literature Review
16. Mumtaz S Factors affecting teachers' use of information and communications technology: a review of the literature. J Inf Technol Teach Educ

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Impact Study of Internet of Things on Smart City Development

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Abstract The Internet of Things (IOT) is the best technology to develop a smart city. This paper gives a piece of brief information about developing a smart city with the help of IOT. It decreases the expenses and providing efficient services, reduces the wastage of time. IoT smart city mostly common problems are parking system, water, smart environment, and drainage system. This paper gives solutions to the above-mentioned problems. IOT can be sent the data and receive the data and it also stores the data. Smart city development using electronic devices, advanced sensors, and thousands of gadgets are used. The Internet of things consists of sensors, networks, etc. All these are connected to the internet and cloud, to develop the city as a smart city. Nowadays the technology is well developed and people are more interest in smart work intend of doing hard work.

Keywords IoT · Smart city · Smart home · Smart parking · Smart environment · Sensors

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_93

1 Introduction

Nowadays technology is running very fast and it can modify the city as a smart city. Smart cities consist of sensors and electronic devices. By using these technologies, we can develop the city as smart, save more amount of time and also easy to operate. The Internet of things plays a major role to develop a city in smart cities. Many people transformed from a village to a city due to addiction services in the cities. By using IoT, we can lead our life much easier in cities [1, 2].

The Global City Teams Challenge (GCTC)/SC3 expo is the prominent smart city event for technology innovators, municipal officials and federal government officials to discuss a possible area of collaboration. GCTC announced Mayor Mei, city of Fremont, California, USA, Mayor Wen-Ben Cheng, city of Taoyuan, Taiwan, and Mayor Gary McCarthy, city of Schenectady network, USA had joined hand to make his city smart.

The USAASEAN smart city partnership will work with GCTC/SC3 expo. It is a major opportunity to invite ASEAN officials and introduce them to smart city technologies and approaches. In collaboration with the department of state and international trade administration. They are inviting representatives from 10 countries and 26 states from ASEAN to come to attend the expo to search for solutions and opportunities for partnership. GCTC places a significant measure of the benefits for residents and citizens.

GCTC brings you the GCTC/SC3expo, co-hosted by NIST, the USA Department of Homeland Security Science and Technology Directorate(DHSC&T), and the National Telecommunications and Information Administration(NTIA). In this expo, hundreds of municipal governments and technology innovators around the world gathered and discuss this issue and possible solutions [3]. RERUM developing an IOT based framework of the infrastructure and services to improve the quality of life in future cities. The IOT is heterogeneous by nature comparing both hardware and software objects that are connected to sensors for different communication technologies. Insecurity control stations, objects that penetrate people's lives, forms a dynamic network, gains attention, intellectuality and communicate with each other easily. The goal is to make IOT the most reliability in directions of broadcasting operators/service providers and customer broadcasting service.

The common people desire is transportation becomes more systematic, eco-friendly. To provide transport mobility data with the baselines for travel estimation time IOT sensors needed. It feedbacks to the users to provide an incentive to measure and share the traffic data [4]. The IOT changes our live simple, modern and fast in all aspects like parking system, smart drainage system, vehicular technology, smart homes, and transport system [5–8].

Wireless sensor networks that are connected by using communication systems are Zigbee, WI-Fi, Bluetooth, and GSM. Wireless sensor networks do not need any physical connection and it transferred data and received and it also stores the data. It also helps full to find real-time characteristics of earth and its atmosphere [9, 10].

2 Literature Work

Biosensors applied to a wide area of different bio-based sensors. In electrochemical sensors, there are some materials for sensing part to transmittable modify the micro-organism for different classes and subclasses of bio-sensors. Based on the type of transducer as compared to on practice traditional an analytical approaches biomaterials advantages are high sensitivity, specificity, portability, cost-effectiveness, and mass production.

Biosensors started in 1970 by pioneers Clark and Lyons [11]. IOT systems are mostly preferable for small dimensions and long-range communications. The antenna consists of good radiation efficiency it is strongly miniaturized. Antennas are mainly used to connect to devices [12]. Integrated community service scenarios are completely based on public service systems contains services such as energy, water security purpose and public health, etc. All these things are connected to internet services using a device in a smart home.

By using these people in the environment can live a smart life anywhere Energy and water community service can adjust the usage of energy and water. The Security community provides security for people's information. Smart service is located in an integrated cloud. In these, the integrated community service takes the information and delivers to the context information [13].

Integrated management and interoperability of diverse IOT deployments achieved by providing a identification and execution of data modules of the IOT resources and these are best accessing modules for the IOT resources. Consideration of privacy legal and business information, security issues are solved on different architecture modules or platforms. The main use of this object that can approch the low-level capabilities of the IOT systems. IOT platform and data sources this stream different data sources stand to be integrated and virtualized into vital and data management service is the mainstream of vital OS [14].

3 Existing Methodology

Connecting physical things to the smart city by using the vital OS. The architecture consists of different modules of Vital OS organized with three main layers Arduino and raspberry pi are connected gateways to external hardware solutions IOT adapter enables an easy combination of different invention shield 2 GO boards for fast evolution development of IOT systems (3).

Software-defined networking ability to adjust network flow and services both cast efficiently and dynamically seems to be assured. In the exhibit, two separate IOT ecological communities are coordinatedto the cloud through the SDN infrastructure. Libliums gateway sends the information from sensors for every 3 min and gateway also stores the information in the outer database. But a row UDP stream is needed in this demo (4)(7).

It provides the functionality of managing data. Searching the space for parking the vehicle is a time-consuming process. It increases the irritation levels among the drivers as is completely based on trial and a lot of fuel also wasted to overcome these problems, they implemented few technologies by using these technologies we can save more amount of time.

People can book the availability slots. We can know how many slots are for booking and the payment process is opened and after confirming, payment and data are updated automatically itself (15). Saw delay line consists of an antenna and connected to the interdigital transducers and saw sensors gathers the energy from the RF signals received by an antenna. That is sent to an antenna and converted by the interdigital transducers. in the form of a saw sensor, the integrator generates a pulse signal (19). IOT approach different works show the possible of LORAWAN networks. By using remote sensing methodology connectivity data processing and interpreted information can be easily monitored.

To generate the monitoring networks that share the transformation of urban areas to developed areas. in these, the data was concentrated and the image is seen by using special software. The gateways are connected to the networks based on IP connections using this we can transmit large-area communications with low energy consumption. In this node-red tool was used for data collection and development of different protocol connectors and resourceful development and inherits the potential of non-blocking and simultaneous mode of NodeJS. The Influx DB engine is used for collecting the information. Grafanna environment means the present data and all networks are connected to the Wi-Fi and operated (21).

By using IOT we can track the vehicle where it was travelling and vehicles are connected by IOT having challenges like security, lack of global standards. Vehicles are connected to the cloud and enable vehicles to wireless share a diverse range of information can be shared with other vehicles, pedestrians, or fixed infrastructure (mobile towers, parking places, etc.) v2x follows a distributed over the network and it can share the information to nodes in the vicinity as well as remotely located.

Content centric networking well in highly mobile environments and it focuses more on data than its actual location. Autonomous vehicles must be have the potential of sensing objects around near by area and self-driving without human involvement to that, it uses boundaries of onboard sensors, radar ranges, GPS, video cameras and if any road accident occurs immediately the seats bags get opened in few milliseconds (12).

4 Design Methodology

Designing a smart city by using the internet, Cloud is connected to the IOT gateways by using the Arduino boards and raspberry pi. These are connected to sensors to enable the devices and they are connected through the internet. Cloud sends the

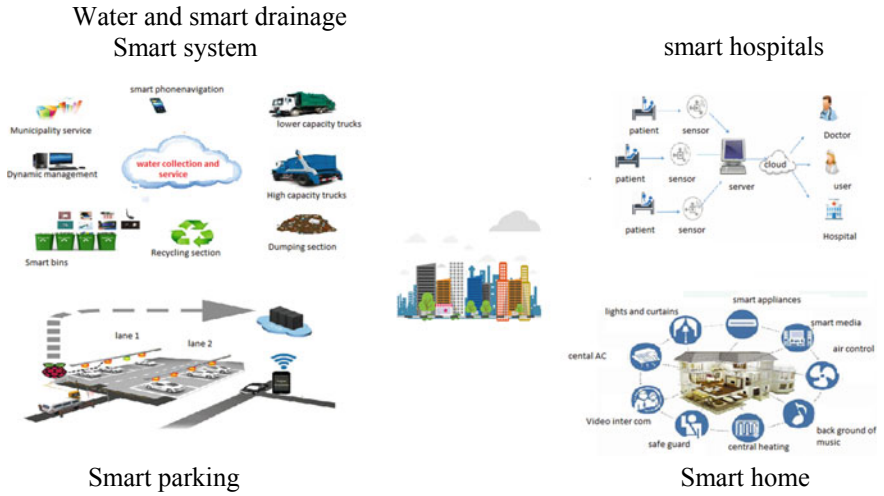

Fig. 1 Block diagram representation of smart city architecture by using IOT and cloud

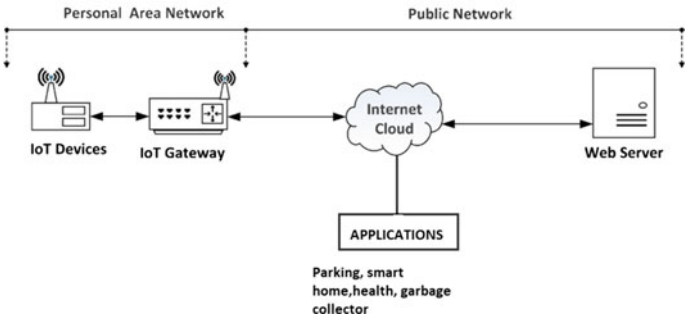

Fig. 2 Block representation of IOT network connected through the internet

information through web services and operating through mobile apps applications like parking, garbage collection, smart home, and health monitoring system (Figs. 1 and 2).

IOT solutions through smart cities lower costs and improving efficiency. In the smart work is done by sensors, networks, the internet, etc. smart work is also known as smart technology and smart idea. The first thing is collecting all the data about the town. The data of buildings, towns, parks. By gathering all these data, we can implement smart planning and next, we developed a smart city. Smart city development includes smart planning, environment and smart living.

5 Applications

There are various applications of IOT get available which make our cities smart and life comfortable. Few are below discussed.

5.1 Driverless Cars

In these driverless cars, there is no need for a driver to drive the car. Simple if we sit in the car it automatically activated and takes to our saying location. These cars fully upgraded by sensors and prototype stages. The car itself controlled by sensors.

5.2 Hospitals

In the hospital, we use an x-ray, machine to scan the inner body of the person and also we see in hospitals nearby the patient we observe monitor, EEG box, ventilator, electronic-photography, humidex monitor, etc. In monitor that displays the heart rate, blood pressure, and other vitals. In the EEG box, we observe multiple electrodes attached to the scalp that records the brain activity and a ventilator provide oxygen and assists or breathes for a patient.

5.3 Smart Hotel Rooms

Peoples are likes to travel to different places and stay in hotels. In that time hotel management is a smart locking system. They used a card-based locking system to the doors with mobile apps. There was a chip on the card when your place card in the door gets opened.

5.4 Road Safety

Nowadays people visit different tourism places they are like travelling. According to road safety, GM on a star is an embedded system in cars that can detect the accidents on roads and immediately it calls 9-1-1.it is automatically controlled.

5.5 Smart Parking

By using this system, we can save more amount of time. We can book the availability slots and system check the database existence of free slots .by using an online booking system. We can know how many slots are available for booking. After selecting proceed for payment book the slot after the conforming payment, the database is updated and a barcode is generated for itself.

5.6 Smart Garbage Collection

The garbage bin used to collect the unwanted or wastage material dumped over the public area. Sensors are connecting to the garbage bin after filing the wastage material that it indicates and sends the information to the garbage-collected driver.

5.7 Smart Transportation

Nowadays, the transportation system with efficient cost, eco-friendly, comfortable and safe is in demand. The characteristics of city buses to run on main streets and when no allegiance bus lines exist. Easy and safe transportation with less amount of time. Taxis are constantly running on a country navy in more diverse than those of buses a smaller number of passengers can travel. To provide the mobility data can be instrumental in providing the baselines for travel estimation time and its feedback to the users to provide an incentive to measure and share the traffic data.

5.8 Environmental Monitoring

Some health effects are caused by urban environments due to pollution. This system indicates the information about the environment it shows the temperature and pollution ranges in all aspects like water, air, radio, noise, and whether.

6 Result

The Internet of things is now crucial to developing technology all over the world. Sensors, networks application all come under IOT. Nowadays smart cities are based on IOT smart economy, smart homes, smart economy, smart governance, smart people, and smart mobility, etc. By using IOT man life becomes more comfortable

Table 1 Comparisons of IOT based smart cities in terms of advantages and disadvantages

Advantages	Disadvantages
Customers and companies interact continuously	High complexity
Automation and control	Privacy, security, and safety
Better quality of life and save money	Employment is decreased
New business opportunities and the best environment	Technology takes control of life
Data storage	The device must be constantly updated
Device management, data identity, and analysis services	Environmental issues
Tracking ability	Hindering from the government

and using IOT we learn new existing technologies and we can implement better ways for the coming years. Using IOT we can develop smart vehicles like driverless cars, smart health all these services are implemented by IOT. By using IOT we also measure humidity and harmful gases that are present (Table 1).

7 Conclusion

The paper discusses smart city development by using IOT and its applications. It will provide services like smart home, smart garbage collection, smart parking, and smart water distribution, etc. It will help people to live a better life. In a smart city as an huge collection of big data, which proceed and integrate in different ways, secure a smart life of people. By learning IOT we can bring new emerging technologies to our world, which means our life safe and secure. Implementing the internet of things in cities, the cites changed to smart cities and learning IOT we can solve many problems over the world. Nowadays and coming days people will depend on the internet and new existing technologies.

References

1. Dlodlo N, et al (2016) Internet of things technologies in smart cities. In: IST-Africa Week Conference, Durban, South Africa
2. Alkhamisi A, et al (2016) A cross-layer framework for sensor data aggregation for IoT applications in smart cities. In: IEEE International Smart Cities Conference (ISC2), Trento, Italy
3. Rhee S (2016) Catalyzing the Internet of Things and smart cities: global city teams challenge. In: 1st International Workshop on Science of Smart City Operations and Platforms Engineering (SCOPE) in Partnership with Global City Teams Challenge (GCTC) (SCOPE - GCTC). Vienna, Austria

4. Tragos EZ, et al (2014) Enabling reliable and secure IoT-based smart city applications. In: IEEE International Conference on Pervasive Computing and Communication Workshops (PERCOM WORKSHOPS), Budapest, Hungary
5. Pradhan MA, et al (2017) IoT for smart city: improvising smart environment. In: International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS), Chennai, India
6. Sadhukhan P (2018) An IoT based framework for smart city services. In: International Conference on Communication, Computing, and the Internet of Things (IC3IoT), Chennai, India
7. Yadav P, Vishwakarma S (2018) Application of Internet of Things and big data towards a smart city. In: 3rd International Conference On the Internet of Things: Smart Innovation and Usages (IoT-SIU), Bhimtal, India
8. Minoli D, Occhiogrosso B (2018) Internet of Things applications for smart cities. In: Internet of Things A to Z, pp 319–358
9. Bogatinoska DC, et al (2016) Advanced sensing and the internet of things in smart cities. In: 39th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), Opatija, Croatia
10. Li W et al (2018) Policy-based secure and trustworthy sensing for the Internet of Things in smart cities. IEEE Internet Things J 5(2):716–723
11. Gotovtsev PM, et al (2016) Biotechnology and Internet of Things for green smart city application. In: IEEE 3rd World Forum on the Internet of Things (WF-IoT). Reston, VA, USA
12. Lizzi L, et al (2016) Design of antennas enabling miniature and energy-efficient wireless IoT devices for smart cities. In: IEEE International Smart Cities Conference (ISC2), Trento, Italy
13. Kim E, Keum C (2016) Integrated community service platform system linked to smart home and smart city. In: Eighth International Conference on Ubiquitous and Future Networks (ICUFN), Vienna, Austria
14. Kazmi A, et al (2017) A QoS-aware integrated management of IoT deployments in smart cities. In: IEEE 10th Conference on Service-Oriented Computing and Applications (SOCA), Kanazawa, Japan

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Modeling and Analysis of Security in Design Phase of IoT Based Applications Using Security Patterns

E. R. Aruna, A. Rama Mohana Reddy, and K. V. N. Sunitha

Abstract The Internet of Things (IoT) claims the growing popularity of its applications due to its ability to transfer data through Internet. Security is a critical concern in IoT based applications since sensitive data is communicated through Networks. The major problem of IoT system is that the security is seldom considered. To consider the security in IoT, security features must be integrated in each phase of IoT application Development life cycle. In this paper, we model security features using mitigation use case diagrams which includes security patterns solutions in the design phase of IoT applications.

Keywords IoT · Mitigation use case · Security patterns

1 Introduction

Developing software system with security is a difficult process. Software architect or Designer along with security analyst having responsibility to define functional and security requirements. Modeling functional and nonfunctional requirements in Architectural Diagrams should accommodate core functionality and security of the Software System.

Due to time, cost and lack of security knowledge, most of the software developers are not included security during development process [1]. Guiding of selecting and implementing security mechanisms to developers is a vital task; it will reduce reengineering cost, time and effort in software development process [2].

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_94

Due to the lack of formal method to model security in design phase, code developers are facing problems to implement security. Security context specific to security requirement must available to programmers since all the developers may not be security specialists. Security Patterns are such solutions contains guidelines for security. Security patterns provide proven reusable solution for a security problem. Several techniques [3–10] proposed to represent security pattern guidelines in architectural diagrams.

Some of the available security modeling techniques is not supported to capture complete security pattern context, constraints and alternative solutions. Only particular solution can be presented but not all the security goals.

Scalability of IoT applications is enormously increasing because IoT create feasible connectivity among application.

Devices through Internet [11]. IoT fetch a lot of convenient in our daily life. The important concern while developing these applications is security because most of them are life care devices. Authentication, Authorization, Data Integrity, Secure.

Communication of data are some of security requirements in IoT based Life care applications.

In this paper, we have model and analyze security problems and pattern solutions in the form of mitigation use case diagrams in IoT based application using the methodology presented in [2] to guide the developers how to implement security mechanisms provided by the security patterns. We also presented the consequences of the non-existing of the pattern solution in the models.

2 Related Work

Kolias et al. [12] identified 3 security problems in IoT applications as unsecure wireless communication, unsecure application data and unsecure user information. Wen-Ten Lee et al. [13] applied 5 security design patterns such as Secure Logger, Secure Directory and Exception Manager for unsecure application data and Secure Adapter pattern and Input validation pattern for unsecure user information and unsecure wireless communication.

Lasse Harjumaa et al. [14] presented a procedure, results showed that mitigation usecases assisting in integration of the security characteristics into the product development in early phases. Misuse cases and corresponding mitigations assists programmers to deal the security from the requirements phase to the testing phase in SDLC. Test cases must be generated from mitigation to ensure the security targets.

Joshua [15] refined the process of using use case, misuse use case, and mitigation use cases in textual description in three phases. Joshua model use, misuse and mitigation use cases with relationships as “includes” & “extends”, “threatens” & “mitigates” to integrate the security cases in detail.

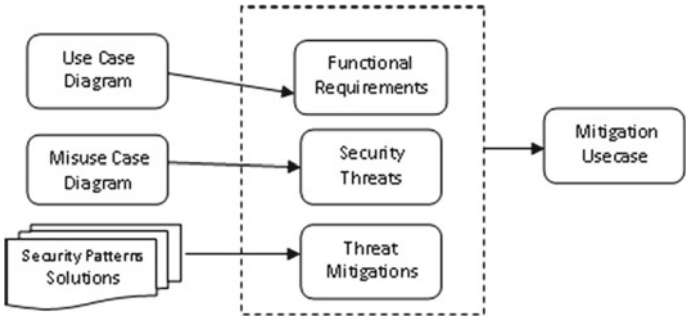

Fig. 1 Mitigation use case from Pattern Solution

Zulfiker Ahmed Meher et al. [2], proposed a method, "Threat mitigation represents in Mitigation use case diagram where the solution for threat is provided by security pattern", i.e. security pattern context for recurrent security problem is presents with mitigation usecase.

Figure 1 shows the general representation of mitigation Use case using security pattern solution.

This mitigation usecase diagram includes the solution provided by the security pattern helps to understand more about security problem and implementing solution by developers or programmers who may not be a security expert.

Rest of this paper organized as IoT system Design in Sect. 3, Model and analyze the security Pattern solutions for problems in [13] using mitigation usecase diagrams in Sect. 4, and conclusion and future work in Sect. 5.

3 IoT System Design Overview

The Fig. 1 shows the System Design Overview of the IoT based health care applications.

Through smart gateway, the sensed data is transferred to server and stored in the clod server database. Remote care taker access the patient data from database through server.

We are using mitigation use cases to represent the applied patterns in [13] for IoT Healthcare System in Fig. 2. These mitigation use cases will make developers (may not security experts) to understand and implement the security problems in a simple way since it is extended use case with use and misuse case in a single view with security pattern solution.

4 Model and Analyze of Security Patterns Solution with Mitigation USECASE Diagrams

In Fig. 2, for remote user input is validated by using Input Validation Pattern, Authenticating user access rights for the files in Server Database by using Secure Directory Pattern, to record and encrypt the log events in server by using secure logger pattern, to limit and secure the exposure of sensitive data by handling exceptions with exception manager Pattern, to preserve the security between arduino and server by overcoming hardware limitations we are using secure adapter pattern. The mitigation use case diagrams of five security design patterns are described in subsections.

Input Validation Pattern: This pattern solution is imposed in the mitigation usecase diagram to eradicate the many security exploits. The single view of integrated use cases (Use case, Misuse case and Mitigation use cases) of Input Validation pattern to validate the remote user is in Fig. 3.

In Fig. 3, shows the use case with pattern solution and the consequences of non-exiting of the Security Pattern. The user sent data is passed to Input validation Pattern to validate the correctness without any malicious data input, then input data from the valid user is send to server. In IoT health care application, the doctor, remote care taker needs to be authenticated by providing their input to see the patient sensitive sensor data from the Cloud database.

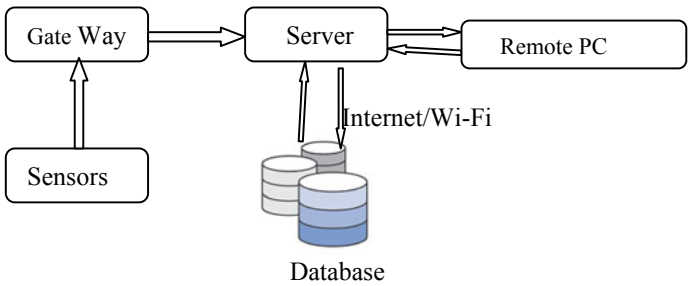

Fig. 2 IoT Health care System Overview

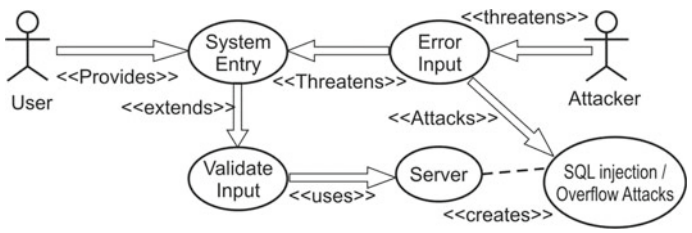

Fig. 3 Input Validation Pattern (Mitigation Usecase Diagram)

Secure Logger Pattern: This pattern solution is imposed in the mitigation use case diagram to protect from deletion or alteration of logs in server.

Figure 4 shows the use case with pattern solution and also the consequences of non-exiting of the Security Pattern. The log records(server actions) as well as additional forensic data like who, what, when, where as user, event type, server name, IP address respectively need to provided by the server based on request and response. The log data is encrypted and saved in secure logger, based on administrator requests, secure logger provides the decrypted log records by LogReader and displays with LogViewer.

In IoT health monitor application, the sensitive log data is very security critical component it decides the patient condition from time to time. Hence we must protect the server log data from being lost or altered by the attacker.

Secure Directory Pattern: This pattern solution is imposed in the mitigation usecase diagram to protect from manipulation of files from malicious user during usage of file by valid user.

File paths must be validated before providing access to them. The file system has connected all the system devices, security directory pattern protects files, validate all the file paths and user permissions for accessing files from the server. File system uses PathnameCanonicalization to know the canonical path and DirectoryValidator class validate the file directory to ensure the security respectively.

Figure 5 shows the use case with pattern solution and also the consequences of non-exiting of the Security Pattern.

In IoT based health applications, the stored files of various patients must be validated with proper paths, directories using secure directory pattern solution before accessing and store them.

Secure Adapter Pattern: This pattern solution is imposed in the mitigation use case diagram to preserve the security of the adapted entities.

Figure 6 shows the use case with pattern solution and also the consequences of non-exiting of the Security Pattern. When sensor data is received from Arduino, secure adapter pattern authorize Arduino device using role class and authenticate to send the sensor data to database using DB class.

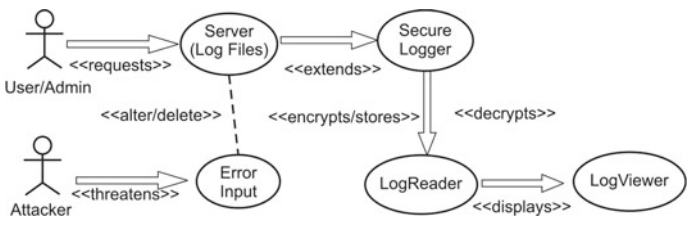

Fig. 4 Secure Logger Pattern (Mitigation Use Case Diagram)

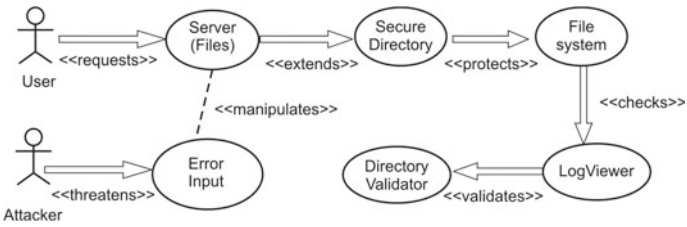

Fig. 5 Secure Directory Pattern (Mitigation Usecase)

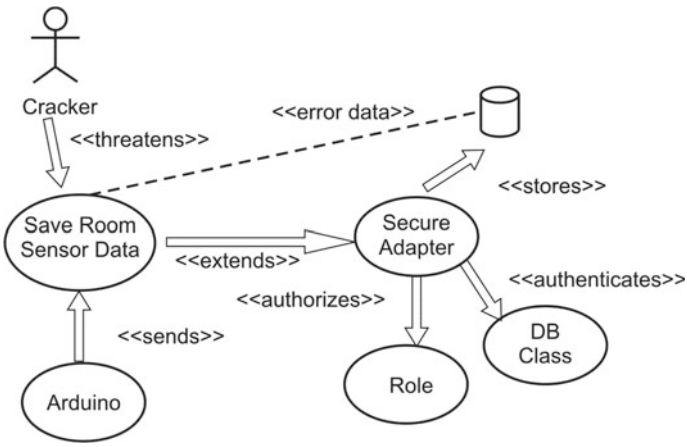

Fig. 6 Secure Adapter Pattern (Mitigation Use case)

In IoT Helath care applications, the sensor data from patient is received by Arduino, then the data is transferred to cloud database using smart gateways. Secure Adapter pattern authorize Arduino, then sensor data is authenticated and transferred to store in cloud server.

Exception Manager Pattern: This pattern solution is imposed in the mitigation use case diagram to protect sensitive data when server throws the security exception.

Figure 7 shows the use case with pattern solution and also the consequences of non-exiting of the Security Pattern. Exception Manager Pattern extends its services such as wraps the exception, process the exception and sanitize the sensitive data from expose of data due to security exception raised by server.

In IoT health applications, if an exception is thrown by the server, attacker views the exception which may contain the original information. Exception Manager pattern wraps and sanitize the sensitive data in the Exception returns as bad credentials and ensures original information is not leaked.

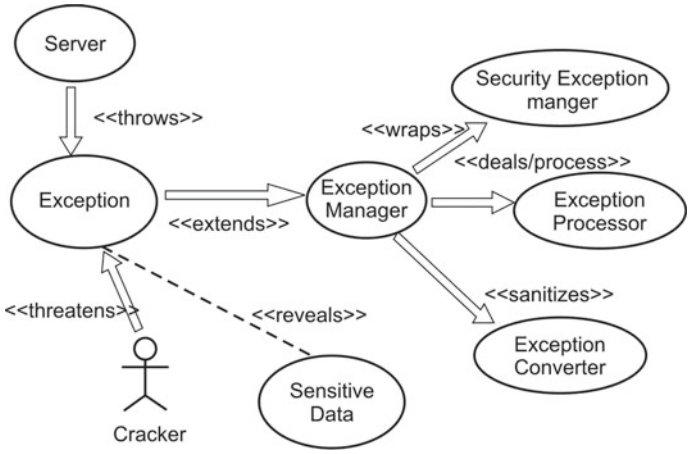

Fig. 7 Exception Manager Pattern (Mitigation Usecase)

5 Conclusion and Future Work

The proposed and existing security modeling techniques are seldom used in Industry to model security requirements in software architecture. To help the developers who may need not be a security specialist, enormous security patterns are existing. Due to abstract version of security patterns may not be able to model, apply and implement throughout the software development life cycle.

The main moto of this work is to model the security pattern solution in design of all the security critical applications like Internet of Things(IoT) health care applications. In our work, we presented security problem, proven security pattern solution using mitigation use case diagrams for security requirements if IoT based Health care Application. We extend our work to represent the consequences of misuse cases and security pattern solutions for consequences.

Good Number of Security patterns are commonly used as abstract proven solutions that help the designers, developers who may not expertise in security. Empirical studies on these patterns shows lot of problems due to improperly applying during implementation phase. In future work, we focus on implementation support of the security patterns to apply properly in the developing phase.

References

1. Mohammad A, Alqatawna J, Abushariah M (2017) Secure software engineering: evaluation of emerging trends. In: 8th International Conference on Information Technology (ICIT). IEEE
2. Maher, ZA, Shah S, Shaikh H, Rahu GA (2018) A methodology for modeling and analysis of secure systems using security patterns and mitigation use cases. In: 7th International Conference on Computer and Communication Engineering (ICCCE). IEEE
3. Jürjens J (2002) UMLsec: extending UML for secure systems development. In: « UML » 2002—The Unified Modeling Language, pp 1–9
4. Lodderstedt T, Basin D, Doser J (2002) SecureUML: a UML-based modeling language for model-driven security. In: UML 2002—The Unified Modeling Language, pp 426–441. Springer
5. Sindre G, Andreas L. Opdahl (2000) Eliciting security requirements by misuse cases. In: 37th International Conference on Technology of Object-Oriented Languages and Systems. TOOLS-Pacific. IEEE
6. Mouratidis H, Weiss M, Giorgini P (2006) Modeling secure systems using an agent-oriented approach and security patterns. Int J Softw Eng Knowl Eng 16:471–498
7. Li T, Horkoff J, Mylopoulos J (2014) Integrating security patterns with security requirements analysis using contextual goal models. In: PoEM, pp 208–223
8. Bouaziz R, Coulette B (2012) Secure component based applications through security patterns. In: 2012 IEEE International Conference on Green Computing and Communications, pp 749–754
9. Bouaziz R,. Kallel S, Coulette B (2014) An approach for security patterns application in component based models. In: International Conference on Computational Science and its Applications, pp 283–296
10. Maher ZA, Sani NFM, Din J, Jabar MA (2016) Use of Security Patterns for Development of Secure Healthcare Information System. J Med Imaging Health Inform 6:1541–1547
11. Gomes M, Da Rosa Righi R, Da Costa CA (2015) Internet of things scalability: analyzing the bottlenecks and proposing alternatives. In: International Congress on Ultra Modern Telecommunications and Control Systems and Workshops, vol 2015, pp 269–276, January 2015
12. Kolias C, Stavrou A, Voas J, Bojanova I, Kuhn R (2016) Learning Internet of things security hands on. IEEE Secur Priv 14(1):37–46
13. Lee WT, Law PJ (2017) A case study in applying security design patterns for IoT software system. In: Proceedings of the 2017 IEEE International Conference on Applied System Innovation IEEE-ICASI
14. Harjumaa L, Tervonen I (2010) Introducing mitigation use cases to enhance the scope of test cases. In: International Workshop on Security, pp 337–353
15. Pauli JJ (2014) Refining use/misuse/mitigation use cases for security requirements. J Softw Eng Appl 7:626

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Trends in 6G Wireless Molecular Communications: A Succinct Study

O. T. Ratna Deepthi, P. Sai Bhaktanjana Rao, P. Krishna Veni, and Durgesh Nandan

Abstract In this paper, we have discussed the capability of trends in 6G wireless molecular communications (MC) into upcoming generations of wireless networks. While 5G expected to be more significant in 2019, 6G is the burning topic of interest among researchers due to various drawbacks of 5G. Already initiatives have been taken in numerous republics focusing on the conceivable research on 6G machinery. The objective of this paper is to analyse the different aspects of 6G communication networks and motivate further investigation in this field. At first, the advantages of 6G wireless MC has been explained and compared with the traditional wireless communication systems using electromagnetic waves at different micro and macro scales. Subsequently, the main challenges have been identified that are restricting the implementation of 6G wireless communication into the upcoming generation of wireless networks. Finally, the significant application of 6G wireless molecular communications in the field of health care and smart groundwork has been discussed.

Keywords 5G · 6G applications · Molecular communication · Wireless networks

1 Introduction

In recent years, people focus on data single-minded adaptive and intelligent methods for the welfare of research in place of traditional logic-oriented [1]. The learning based on data-driven and computing based on quantum power-driven

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_95

methods have a lot of scope. Which helps understand the service for entirely intelligent for 6th cohort (6G) communication networks. As 5G is attainment its limits in the following period or so. The design aims for the next step of it have already begun to explore. Nowadays research community discussing the possibilities and challenges of 6G under different labels. An idea for 6G communication was offered and its necessities were argued dependent on extrapolation of the progress trend of mobile set of connections generation journey from 1G to 5G.

Research professional conferred need of revolutionary technologies to encounter the demands in communication fields. It is theocratically calculated that 5G will attain its maximum concert bounds inside ten years of its commence, and next generation technology 6G will have urgent mandatory to bring further increases of 100× in the entity and 50× the down link data rates, correspondingly. People also interested in know the exact required for 6G from beginning ending gap analysis stuck between the inventive desires and cumulative 5G network.

5th generation wireless communication (5G) is used to enlarge the speed, sensitivity of wireless network 5G and facilitate a sharp enhance in the quantity of data transmitted over wireless system outstanding to additional bandwidth. Sophisticated antenna design technology only improvement in speed and volume but 5G offers set of connections organization futures in that network slicing, its allow to create multiple designing. The development of ground mobile station for radio communication networks across numerous generations have been shown in Fig. 1.

Simulated network contained by a solitary 5G network. For example, if we take a self-driving car it would necessitate a system slice but proposals enormously fast, a low-latency connection so that the vehicle would find the way in concurrent in general, 5G is expected to generate a variety of new application as the technology is rolled out. Here we discuss some advantages of 5G wireless communication, Firstly

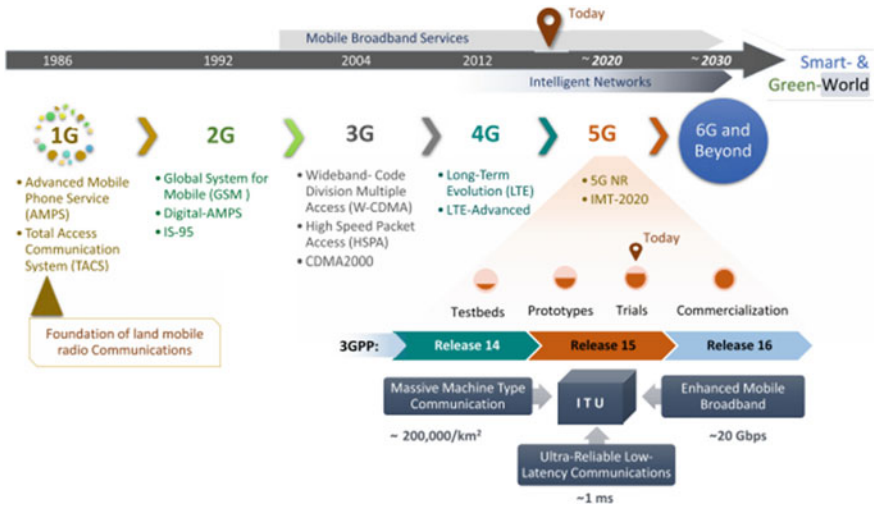

Fig. 1 Development of ground networks for mobile radio communication across numerous generation

the main advantage is increased bandwidth for all the uses, new expertise options may become available on 5G network, it gives faster speed as it is having more [1].

Although 5G networks are available, researches are exploring 6G wireless communication walid swad is an associate professor at Virginia tech. According to his research, he said that they are some drawbacks in 5G so they are focusing on exploring the next-generation 6G wireless system. Some of the main features of 6G compared to 5G will include a higher data rate, fast and reliable communication, an artificial intelligence system. Additionally, 6G could use drones to provide temporary connectivity in stadiums or rural areas (Fig. 2).

Advantages of 6G

- It will change the health-care industry by reducing the time and space barrier through remote surgery.
- It is designed in the way that it supports a greater number of mobile connection greater than 5G capacity.
- 6G overcome some challenges using sem to cells or Distributed Antenna Systems (DAS).

Many applications can make use of 6G wireless networks as it offers high data rate and low latency.

- 6G wireless communication uses visible lights that leverage the benefits of LED's such as illumination and high-speed data communication.

Applications of 6G in various fields

The main consideration of the system performance will be 4 new application domains. Block diagram of 6G enabling technologies has been shown in Fig. 3.

Fig. 2 Block diagram of 5G use cases

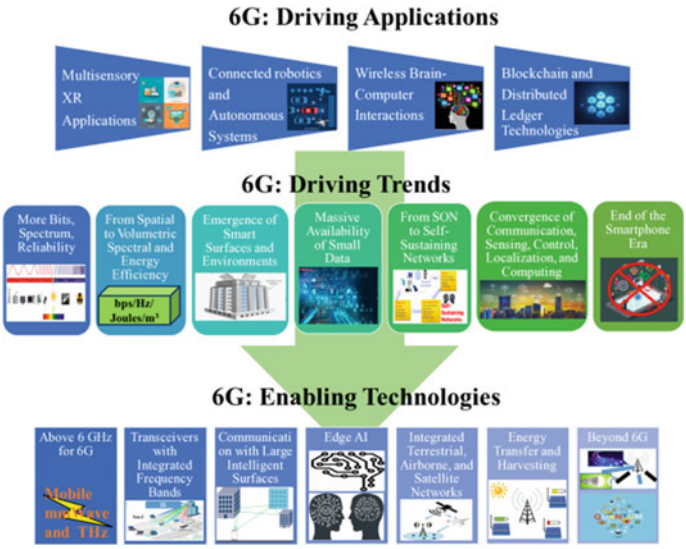

Fig. 3 Block diagram of 6G enabling technologies

1. **Multisensory XR application:** It generates many applications for six generation. Across the VR/MR/AR upcoming spectrum for 5G system, due to their incapability to convey extremely small latency for information rate concentrated applications fall undersized of provided that full immersive XR practice capturing all censoring inputs. Brain cognition, body psychology is some of the factors that affect QOPE [2].
   Wireless brain computer interaction (BCI): Ahead of XR, couture the wireless system to their human being uses is required to hold up services with undeviating BCI. Applications of BCI are related to health care scenarios. In that humans organize prosthetic limb using brain implants. The new creation of wireless brain computer interface and implanting will be transfigure the field and commence a new scenario which requires 6G connectivity. Wireless BCI services are similar to XR.
2. which requires high rates, high reliability, and ultra-low latency [2].
3. Coupled Robotics and Autonomous Systems (CRAS): The main thing following 6G system is the employment of CRAS which includes autonomous robotics, autonomous drone swans, autonomous car, vehicle platoons, drone delivery systems. The preamble of CRAS in excess of the cellular province is not a uncomplicated case [2].
4. Block chain and Distributed Ledger Technologies (DLT): These block chain and DLP are single of the troubles giving IOE technology these applications are considered as the subsequently production disseminated sensing services that require huge machine type communication to guarantee reliable connectivity, low latency, scalability [2].

Table 1 Comparison between 5G and 6G based on Use cases

Property	6G	5G
Center of gravity	Services based	User based
Ultra-sensitive applications	Yes	No
VAR	Massive scale	Partial
Time buffer	Real-time	Not exact
True AI	Yes	No
Reliability	Exact	Not exact
Capacity	3-D	1-D/2-D
VLC	Yes	No
WPT	Yes	No
Smart city components	Integrated	Separate
Satellite integration	Yes	No
Autonomous V2x	Full	Partially

The main difference between 5G and 6G is that in 5G the bandwidth capacity lies in the fact that it uses high radio frequencies, it means the higher you go up the radio spectrum the more you can carry. Speed and latency will also the main difference between 6G and 5G.

The organization of the paper is about the A Survey on the trends in 6G wireless molecular communications. In Sect. 2 we discuss the use cases of 6G over 5G. After that in Sect. 3, we discuss the research in 6G. In Sect. 4 we discuss in 6G wireless communication. In Sect. 5 we discuss the 6G Potential application. In Sect. 6 we conclude the topic.

2 Use Cases

From the 5G system in 6G records of the use cases will develop. Here we discuss where we use the 5G popularly as instances to say what 6G can take out beyond 5G [1]. A comparison between 5G and 6G use cases is shown in the below table. The examples are Haptic communication for VAR, Massive IoT Integrated smart city, Automation, and manufacturing. In haptic communication in VAR, we elaborate 3 major smart city applications such as smart homes, smart health care, connected vehicles and autonomous driving [1]. Comparison between 5 generation technology and 6 generation technology shown in Table 1.

3 Research in 6G

Area of research	Challenges	Open problems
3D rate reliability latency fundamentals	(1) 3D nature of 6th generation systems (2) Fundamental communication limits	(1) 3D accomplishment survey of rate reliability latency area (2) Exposure of achievable rate reliability latency goals
Surveying integrated and heterogeneous high frequency bands	(1) Smaller range (2) Lack of propagation models (3) Co-existence of frequency bands (4) Need for high fidelity hardware (5) Sensitivity to blockage	(1) Design of mm Wave small cells (2) Designing of high fidelity hardware for THz (3) Coverage improvement (4) Crossband physical, network and link layer optimization (5) Effective movable management for mm Wave and THz systems
3D networking	(1) High flexibility (2) Presence of user stations in 3D	(1) 3D platform performance (2) 3D flexibility management and network optimization (3) 3D transmit modelling
Communication with LIS	(1) Lack of propagation models (2) Lack of existence performance models (3) Difficult nature of LIS surfaces (4) Ability of LIS to provide different functions to perform (5) Heterogeneity of 6G devices and services	(1) LIS used for energy transfer (2) AI enabled LIS (3) LIS used across 6th generation services (4) Optimal distribution, location of LIS areas (5) LIS base stations vs. LIS refactors
AI for wireless	(1) Design of low complication solutions of AI (2) Vast, tiny data	(1) Augmentation learning for SON (2) Network management of ai powered (3) Huge, small data analytics
New QoPE metrics	(1) Accurate modelling of human perceptions and physiology (2) Incorporate raw metrics with perceptions of humans	(1) Real psychophysics experiments (2) Theoretical growth of QoPE metrics (3) Empirical characterization of QoPE (4) Measurement of realistic QoPE GOALS
Joint communication and control	(1) Handling of dynamic and multiple time scales (2) Combination of control and communication metrics	(1) Wireless-enabled control metrics (2) Control-enabled wireless metrics (3) Joint optimization for CRAS (4) Co-design of Communication and control systems

(continued)

(continued)

Area of research	Challenges	Open problems
3CLS	(1) Lack of earlier models (2) Integration of multiple models	(1) Joint 3CLS optimization (2) Design of 3CLS metrics (3) Energy efficient 3CLS (4) AI-enabled 3CLS
6G protocol designs	(1) Learning of the protocols that could acquire and to adopt to the surroundings (2) 6^{th} generation protocols should be run in 3D space and also across different propagation surroundings (3) Existence of wide-ranging devices with various abilities and movement designs	(1) Growth of flexible number of access protocols (2) Outline of scheduling, coordination, signaling protocols that do not require fixed, rigid frame structures (3) Outline of share out, edge AI-inspired protocols for performing numerous 6^{th} generation functions (4) Introducing latest authentication, recognition protocols customized to 6^{th} generation tools
Integration of RF and non-RF link ratio	(1) Dissimilar physical nature of RF or non RF interfaces	(1) System range study of joint RF and non RF systems (2) Design of joint RF and non-RF systems (3) Usage of RF and non RF systems for different 6^{th} generation services
Holographic radio	(1) Challenges of Hardware and physical layer (2) Absence of existing models	(1) 3CLS over holographic radio (2) Design of holographic MIMO using LIS (3) Network optimization with holographic radio (4) Performance analysis of holographic RF

4 Challenges in 6G Wireless Communications

The authors found the issues of developing 5G network and discussed how the 6G communication trends can have the above drawbacks [3]. Open challenges for emerging technologies beyond 5G: Here we list out near challenging and discussion how they can be addressing by promising technology that can express the development of six generation communication networks.

1. **Energy efficiency:**
   Both the operating costs and its carbon discharges will reduce by increasing mobile networks' energy efficiency. Energy efficiency usually demarcated as maintained the bit rate per Joule of energy paid by the communication connection. Consequently, if the main purpose of the 6G systems is to supply additional capacity and throughput than 5G network at analogous communication power level, then it will require the same raise in the energy effectiveness of 6G networks more than that of 5G network. One of the initial proposals is to better use of programmed planar meta-materials to consist of rearrangeable smart surfaces. The use of these surfaces is to coat walls and others and they planned for the contact with imposing electromagnetic waves that provide beam-steering (SNR) absorption or maximization of radiation to reduce interfaces etc. Also, for saving battery life of a device and for powering UAV BS's for continual operation, the model of energy harvesting, power relocate of wireless may provide salient features in 6G standardization efforts.
2. **Throughputs:**
   By comparing previous generations of mobile networks, the throughput targets are expected to increase than 5G networks in 6G networks. And also, virtual reality applications require large data rates than 5G. For these, they imagine individual user data rates up to 100G bits. In 6G communication, these are supported by large communication bandwidth. Another authorizing technology that supports maximum bit rate in Line-of-Sight (LOS) connection is the visible light communication (VLC) using the photodiodes as receivers and LEDs as transmitters [3].
3. **Network capacities:**
   The main promoter to increase the network capacity is a cell-densification strategy. With the enhance in the numeral of mobile users and smart cities cell-densification through stationary BSs cannot reach the progress in the competence demands. This quandary can be decreased by unmanned airborne vehicles (UAV) mobile BSs. The 3-D character of 6G coverage description has led to this technology. The volumetric metaphors of spectral effectiveness supplies are in bps.
4. **Data security:**
   An extensive quantity of data of the user is stored in movable networks in the form of text messaging and activity logs. The main important thing is to secure this data from the phone tapper. Physical layer security teams are developed to secure 6G communication links. The preceding discussions are that the 6G communications will hold strong hearing capability at different network layers to perform data security, network management, etc. [3].

5 6G Potential Applications

The following are the factors in which the 5G technologies have always been affiliated. The factors are deployment costs, and-2-and reliability, hardware complexity, latency, communication resiliency, power consumption, experienced throughput. By the year 2030, the market demands more requirements (such as energy efficiency, low latency, capacity, high reliability) for wireless systems. Six generations will come up to fill in this gap

Some of the applications are Massive scale communication [4], smart city [5], indoor coverage [6], E-health [7], industry and robotics [8], unmanned mobility, augmented reality (AR) virtual reality (VR), holographic telepresence [9, 10].

Virtual Reality (VR) and Augmented Reality (AR)
These VR and AR over wireless are used as the main application in so many cases like gaming, entertainment, education and training, workspace communication. These applications will pay some challengers related to increase per-user capacity sub-ms latency, increased quality of emersion. Some computing techniques like cloud and fog, the mobile edge will carry aptitude to end uses, to carry efficient data spreading by satisfying networks heterogeneous needs and limitations. 6G will develop on these [11].

Smart City
6G will work on the problem and give a solution for smart cities, mainly focusing on environmental monitoring, traffic control, city management automation. 6G will cost-effectively provide support for the smart city if we compare 6G may help a lot than the 5G in this point of view [11].

6 Conclusion

As 5G is in the last testing state which is getting ready for its launch in the latter year, researchers had already begun the discussion that what 6G may give in the future. Around the world, they are high-profile initiative whose goal is to develop technology for 6G. This article has an approach to identifying the enabling technology which are possible for 6G and also illustrate the futures and applications they convey beyond the potential of 5G. Not only these, but OAM and quantum communication may also appear in 6G. Also, in this article, we have discussed the limitations of 5G and we have given the use cases of 6G. Finally, we like to add that 6G will bring a new transform in wireless communication which is somewhat different from 5G.

References

1. Nawaz SJ, Sharma SK, Wyne S, Patwary MN, Asaduzzaman M (2019) Quantum machine learning for 6G communication networks: state-of-the-art and vision for the future. IEEE Access 7:46317–46350
2. Tariq F, Khandaker MRA, Wong K-K, Imran M, Bennis M, Debbah M (2019) A speculative study on 6G, 6 August 2019, pp 1–8. https://arxiv.org/pdf/1902.06700.pdf
3. Ali A, Gonzalez-Prelcic N, Heath RW (2018) Millimeter wave beam-selection using out-of-band spatial information. IEEE Trans Wireless Commun 17(2):1038–1052
4. Xu X, Pan Y, Lwin PPMY, Liang X (2011) 3D holographic display and its data transmission requirement. In: 2011 international conference on information photonics and optical communications, October 2011, pp 1–4
5. Pathak PH, Feng X, Hu P, Mohapatra P (2015) Visible light communication, networking, and sensing: a survey, potential and challenges. IEEE Commun Surv Tutor 17(4):2047–2077
6. Lee J, Bagheri B, Kao H-A (2015) A cyber-physical systems architecture for Industry 4.0-based manufacturing systems. Manuf Lett 3:18–23
7. Zanella A, Bui N, Castellani A, Vangelista L, Zorzi M (2014) Internet of Things for smart cities. IEEE Internet Things J 1(1):22–32
8. Wang M, Cui Y, Wang X, Xiao S, Jiang J (2018) Machine learning for networking: workflow, advances and opportunities. IEEE Netw 32(2):92–99
9. Saad W, Bennis M, Chen M, Tariq F, Markit I (2017) The Internet of Things: a movement, not a market. White Paper
10. Zhang Q, Liu J, Zhao G (2018) Towards 5G enabled tactile robotic telesurgery. arXiv preprint arXiv:1803.03586
11. Goyal S, Liu P, Panwar SS, Difazio RA, Yang R, Bala E (2015) Full duplex cellular systems: will doubling interference prevent doubling capacity? IEEE Commun Mag 53(5):121–127

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Traffic Accident Injury and Severity Prediction Using Machine Learning Algorithms

Nithin Kashyap, Hari Raksha K. Malali, Koushik S. E, Raju G, and T. H. Sreenivas

Abstract Traffic crashes are the severe issues confronting the world as they are the root reason for numerous deaths, wounds, and fatalities just as financial misfortunes consistently. Effective model to deduce the severity of an accident is very helpful for both traffic department and general public. This examination sets up models to choose a lot of compelling variables and to develop a model for arranging the severity of wounds. These models are planned by different machine learning methods. Both supervised and unsupervised learning methods are actualized on accident data. The major aim of this is to find the relationship between various sorts of the accidents with the kind of the injuries that might have occurred. The discoveries of this investigation demonstrate that unsupervised learning methods can be a promising instrument for anticipating the damage severity of Traffic crashes.

Keywords Machine learning · Accident severity · Prediction

1 Introduction

Today the world is witnessing lakhs of accidents and escalation in death rate. A recent study conducted by the Ministry of Road, Transport and Highways has prepared a survey in which it has said that around 450 people die in road mishaps

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_96

every day alone in India and out of them around 52% are youth. The report further informs that around 19 people lost their lives in more than 50 road accidents every hour last year. This dreadful disclosure by the concerned ministry stated myriad number of reasons for the severity caused. It stated jumping of signals, reckless driving, speeding, roadway designs, poor roadway maintenance topped the list. With the increase in demand of number of vehicle users has in turn increased vehicles on road and also have led to increase in traffic during peak hours. This is directly proportional to the increase in the road accidents leading to the major road accidents leading to fatal injuries and death around the globe. In the National Crime Records Bureau in 2016 report it is recorded that there were more than four and half lakh accidents in the year 2015. Of these, road collisions accounted for 464,664 collisions which led to 148,757 traffic causing fatal deaths in India. The top three states of India reported highest total number of fatal death that includes states of Uttar Pradesh, Maharashtra and Tamil Nadu, and this resulted to account for more than 30% of total Indian traffic fatal deathsin 2015. According to the survey conducted, the top three highest traffic fatality rates per one lakh people in the year 2005 were reported by Tamil Nadu, Haryana, and goa with a male to female injuries ratio of about five times to one. The recorded total fatality, rates per 1 lakh people and regional differences in accidents varies from source to source.

2 Literature Study

Mehmet Metin Kunt, Iman Aghayan and Nima Noii, model for anticipating graveness of crashes is developed by utilizing many parameters that affect the nature of crash, in genetic algorithms, pattern searching and neural networks [1].

Jian Zang, Zhibin Li, Ziyuan pu, Chengcheng Xu, in their paper compares different machine learning algorithms and rank them on the basis of their performance and accuracy. This paper helps us in comparing the pros and cons of different algorithms so that we get to know when to use what algorithm [2].

Tadesse Kebede Bahiru, Prof. Dheeraj Kumar Singh, Engdaw Ayalew Tessfaw, Accident severity is measured using certain data-mining strategies like decision trees, Naïve Bayes which are made use of on a stored data that holds information regarding previous accidents [3].

Tibebe Beshah, Shawndra Hill, This paper deals with mapping of severity of accidents to that of parameters that lead to accidents, This is intended to help the Ethiopian Traffic department to reduce the accident by nullifying effect of the parameters that cause the accidents [4].

Ming Zheng, Tong Li, Rui Zhu, Jing Chen came up with accurate and timely prediction of severity for a successful disposition of intelligent transportation framework to give medicinal help and transportation in a convenient way utilizing Prediction-Convolutional Neural Network model [5].

Zhen Gao, Ruifeng Pan, Xuesong Wang, Rongjie Yu, This paper uses Association mining techniques to generate many item sets, the rules in these item

sets can be used to uncover the relationship between parameters causing the accidents which then can be used to prevent the same. The data for this paper is taken from Shanghai Expressway accident dataset for the year 2014 [6].

Miao Chong, Ajith Abraham, Marcin Paprzycki, This paper deals with four machine learning techniques which are used to predict the traffic accident severity. The major methods used in this paper are Neural networks, SVM, Decision tree algorithms and a model developed using both neural networks and decision tree [7].

K. Geetha, C. Vaishnavi,here the authors in their proposed paper have come up with a model using data mining algorithm to maintain the traffic severity using traffic accident data set which predicts the traffic accident injury level. It also helps to fetch the various parameters like road condition, weather condition and even the drivers behavior [8].

Fang Zong, Xiangru Chen, Jinjun Tang, Ping Yu, Ting Wu, This paper deals with building a network for mapping factors or parameters causing accidents with its severity by using a model comprising of both Bayesian network and information entropy [9].

Rabia Emhamed Al, Keneth Morgan Kwayu, Maha Reda Alkasisbeh, Abdulbaset Ali Frefer, In their paper examine and exert which builds up models to choose a lot of compelling elements what's more, to design a model that helps in predicting the severeness of the injuries. These ML models are figured by using different machine learning methods. They made use of many supervised machine learning algorithms like AdaBoost, Logical regression etc. [10].

Reference no	Objective	Methods used	Results or outcomes	Advantages	Disadvantages	Recommendations
[1]	Anticipating the severity of traffic accidents or collisions using many methodologies like Artificial neural networks, pattern searching and genetic algorithm strategies	Artificial neural networks, Pattern searching, genetic algorithms	Artificial neural networks provide the highest accuracy which is followed by combination of genetic algorithm and pattern searching then genetic algorithm only	Model has the capacity to improve itself over the time after the addition of new data which then can be used for classification	Artificial neural networks require processors which have the capacity of performing parallel computations	
[2]	To compare different machine learning and statistical strategies to deduce the algorithm providing highest accuracy and	In this paper, for comparison they have made use of K-Nearest Neighbor, Support vector machines and also decision tree algorithms	K-Nearest neighbor predicts most accurately with an accuracy of 54%	Statistical models are easy to deduce, and Markov logic networks provides better relation between parameters and severity	K-Nearest neighbor takes more time to learn the data, Decision tree has a problem of overfitting and Random forest is not so robust	

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Reference no	Objective	Methods used	Results or outcomes	Advantages	Disadvantages	Recommendations
	ease of use for predicting traffic casualty severity					
[3]	Identify accident causing factors and predict traffic crash severity using different data mining classification techniques	Using WEKA, implementing machine learning strategies like Decision tree and naïve Bayes	J48 of decision tree provides the best accuracy but Naive Bayes provides better performance when in comparison with J48 or CART	Decision rules are easy to extract from these kind of structures	Decision tree algorithms like ID3, J48 or CART have comparatively lower accuracies	Can make use of more effective algorithms like K-Nearest Neighbor
[4]	To help the Ethiopia's traffic agency to improve safety by relating traffic parameters to accident severity by using data mining strategies	Machine learning strategies like decision tree, Naive Bayes and KNN algorithms are used	K Nearest Neighbor algorithm predicts with better accuracy (80.8%) when compared to Decision tree with 80.22 percent and Naïve Bayes (79.99%)	K Nearest Neighbor is more stable and robust when compared to other algorithms	For decision trees little change in data may lead to a big change in the structure	
[5]	To predict traffic collision severity by mapping traffic features to that of accidents with the help of convolutional neural network strategies	Convolutional neural networks mainly traffic accident severity prediction (TASP)	TASP-CNN provided better accuracy results than other machine learning methods	Flexible, efficient and easily available	Overfitting is the major issue when speaking about convolutional neural networks	
[6]	To promote the usage of association rules in transportation field	Association rule mining	Rule 1: In highways rear end accidents are common Rule 2: In a rear end accidents 32% results infer death Rule 3: Evening is peak for accidents	Intuitive and easy to communicate	For comparatively smaller data sets chances of false rules formation are high	

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Reference no	Objective	Methods used	Results or outcomes	Advantages	Disadvantages	Recommendations
			Rule 4: No streetlights results in rear end accidents Rule 5: Usage of seat belts and helmets reduce probability of accidents by a lot Rule 6: Car accidents usually occur during night Rule 7: Affected pedestrians are usually elderly			
[7]	Compare and contrast different machine learning models to calculate the effect of the accident	Neural networks, SVM, decision trees and a hybrid model of neural networks and decision trees	Hybrid approach provides better performance and accuracy when compared to the rest	Extraction of classification rules from the model structure becomes an easy task	Large amount of data is required for neural networks than any other machine learning algorithm	
[8]		Artificial Neural Networks, genetic algorithms, decision trees. K Nearest Neighbor and hybrid model of decision tree and Artificial neural network	The model developed with combination of artificial neural networks and decision trees performed with the highest accuracy than other methods	Model is Comprehensive, versatile and robust	ANN requires high computing processors with parallel processing ability	
[9]	To establish a connection between traffic severity and other affecting parameters	Bayesian network and information entropy	The maximum accuracy fallacy is of 0.00054, average accuracy fallacy is 0.0048 and max relative	With many more such data this model can be used to analyze severity of crashes due to traffic in a more efficient manner	In spite of high efficiency performance drops for large number of data	

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Reference no	Objective	Methods used	Results or outcomes	Advantages	Disadvantages	Recommendations
			accuracy error is 0.00485. Hence, we can infer that the model predicts with high accuracy			
[10]	Identify a factor which helps in mapping severities to injuries	Supervised machine learning algorithms like AdaBoost, Naïve Bayes, Random forests, SMOT and Logistic regression techniques	Random forest algorithm predicts with the highest accuracy than other algorithms	Random forests work very well with higher dimensional datasets	Random forests consume more time and are harder to implement	

3 Conclusion

From the above table we see that many authors have used different machine learning algorithms like neural networks, Naïve Bayes, etc. But considering many parameters such as performance, ease of use, etc. we can conclude that for predicting the severity of accidents K-Nearest neighbour algorithm provides a better accuracy with ease of use when compared to the rest.

References

1. Kunt MM, Aghayan I, Noii N (2011) Prediction for traffic accident severity: comparing the artificial neural network, genetic algorithm, combined genetic algorithm and pattern search methods. Transp 26(4):353–366
2. Zhang J, Li Z, Pu Z, Xu C (2018) Comparing prediction performance for crash injury severity among various machine learning and statistical methods. IEEE Access 6:60079–60087
3. Bahiru TK, Singh DK, Tessfaw EA (2018) Comparative study on data mining classification algorithms for predicting road traffic accident severity. In: ICICCT
4. Beshah T, Hill S (2010) Mining road traffic accident data to improve safety:role of road-related factors on accident severity in Ethiopia. In: AAA1 spring symposium
5. Zheng M, Li T, Zhu R, Chen J (2019) Traffic accident's severity prediction: a deep learning approach-based CNN network. IEEE Access 7:39897–39910

6. Gao Z, Pan R, Wang X, Yu R (2018) Research on automated modeling algorithm using association rules for traffic accidents. In: IEEE International Conference on Big Data and Smart Computing
7. Chong M, Abraham A, Paprzycki M (2005) Traffic accident analysis using machine learning paradigms. Informatica 29:89–98
8. Geetha K, Vaishnavi C (2005) Analysis on traffic accident injury level using classification. IJARCSSE 5:953–956
9. Zong F, Chen X, Tang J, Yu P, Wu T (2019) Analyzing traffic crash severity with combination of information entropy and bayesian network. IEEE Access 5(2):953–956
10. AlMamlook RE, Kwayu KE, Alkasisbeh MA, Frefer AA (2019) Comparison of machine learning algorithms for predicting traffic accident severity. In: IEEE Jordan International Joint Conference on Electrical Engineering and Information Technology (JEEIT)

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A Survey on Diabetes Prediction Using Machine Learning

K. J. Amulya, S. Divya, H. V. Deepali, S. Divya, and V. Ravikumar

Abstract Diabetes mellitus is a problem that affects people around the world, nowadays the persons from young to old are suffering from diabetes. We can replace the traditional methods of diabetes prediction by modern technologies which saves time. There are many researches carried by researchers to predict diabetes, most of them have used pima Indian dataset. We are planning to use machine learning algorithms like Support Vector Machine and Naïve Bayes. By using these algorithms to predict diabetes we can save time and obtain more accurate results.

Keywords Diabetes prediction · Machine learning · Naïve Bayes · SVM

1 Introduction

Diabetes has an immediate sign of high glucose, together with some effects which includes continuous urination, weight loss increased hunger and increased thirst. It is a disease which affects how the body uses blood sugar level, in which either the insulin production is insufficient or the body's cells are not responding correctly to inulin. This may cause failure of many organs, particularly kidneys, eyes, veins and heart. Lack of knowledge about diabetes mellitus causes death among the population, so we should spread awareness about the disease. The diabetic patients need regular treatment, if not it will give rise to several risky inconveniences. The

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_97

diabetes is resolved to have the 2-h post-load plasma glucose being at rate 200 mg/dL [1], and the need of recognizing diabetes will acquire various examinations about diabetes affirmation. The causes for diabetes mellitus is not correctly discovered, the researchers have the belief that environmental factors and hereditary elements both are involved. Nowadays it is believed that diabetic is common in grown-ups so is called as "adult-onset" diabetes.

Prediction of diabetes in early stages is of great importance because it is a dangerous disease and it may lead to death also if not identified and treated properly. Recently many algorithms are used for predicting diabetes, including machine learning algorithms. Previously research has been carried out using Generalized Discriminant Analysis (GDA), Support Vector Machine (SVM), Naïve Bayes Algorithm, Artificial Neural Network (ANN), Deep Neural Network (DNN) etc. Machine learning applies statistical learning technique to identify patterns in the data. By using these techniques we can obtain highly accurate prediction [2].

Detecting diabetes mellitus at the early stage is very important, considering its complications. The existing system is manual process where the doctors analyses the test reports of the patients manually. Some of the medical test used to predict diabetes are urine test, glycosylated hemoglobin (HbAlc), FBS, RBS, PPBS. Nowadays patients can use glucose monitoring devices and can test the glucose level in the body at their home also. One touch, Beato smartphone glucose meter are some of the examples for the devices which can be used at home.

The drawback of the existing system is, time consumption. It takes few months to predict diabetic by doctors. There are many glucose monitoring devices, one such device is one touch. The results obtained from these devices are less accurate. These devices can be used to get approximate results.

2 Related Works

Veena Vijayan V and Anjali C has proposed a system for diabetes prediction. There are four phases in implementing this system. Initial phase is collecting dataset. The data set obtained from UCI (University of California) repository is used in training phase. It includes 9 attribute and 768 instances. They collected dataset from places in kerala and used this data set for validation. They used AdaBoost algorithm for diabetes prediction. They considered many base classifiers. The classifiers used are SVM, NB, Decision Stump and Decision Tree [3].

Muhammad Azeem Sarwar, Wajeeha Hamid, Nasir Kamal and Munam Ali Shah in their paper discussed predictive analytics, they used 6 machine learning algorithm in their research work. They used the data set downloaded from UCI Repository. The dataset has 768 patients record and in the dataset all the patients are females and all female patients are above 21 years of age. The aim is to help doctors to predict diabetes in the early stage [4].

Ashraf Hossain, Md. Mahbubur Rahman and Samrat Kumar Dey has built a web-based application based on the machine learning algorithm to predict the diabetes disease. They have used pre-existing dataset which is known as Pima Indian Data set to prepare and assess the model, in which the dataset is an open source. Here, they have used machine learning algorithms to recognize the information like Function Based, Rule Based, Probability Based and tree Based. They have also make use of few machine learning libraries like Matplotlib, Scikit-Learn, Pandas Tensor Flow and Numpy [5].

Sudhir N.Dhage and Ayman Mir has built a classifier tool using WEKA to predict diabetes. They have used Pima Indian Diabetes Dataset, which is collected from the National Institute of Diabetes. They also make use of 4 supervised algorithm such as Naïve Bayes, Support Vector Machine, Random Forest and Simple CART algorithm. They play out the examination dependent on their outcomes to recommend the best way to deal with diabetes [6].

Sneha Joshi, Megha Borse, they introduced a software tool to detect and predict the diabetes based on the ANN. This network consists of Input layer which has 8 parameters, then Hidden layer which has 10 neurons and Middle layer and 1 output layer to predict the good results. To make the tool user friendly they developed GUI. The patients can obtain accurate results of the test even in doctors absence [7].

Rahul Barhate, Pradnya Kulkarni has discussed in their paper about different classification algorithms that is based on patent's health history and the doctors to identify the presence of early diagnosis treatment which are conducted on pima Indian diabetes dataset. According to the International Diabetes Federation 451 million people across the world have diabetes and can rise up to 693 million people by 2045. It also shows that about 80% of the complexities arise from type 2 diabetes which can be prevented by identifying earlier of the patient who are at risk. It includes various classifiers like KNN, Decision trees, Random forest, Regression, Gradient Boosting, SVM and Neural network by providing better accuracy [8].

S. Saru and S. Subashree in their paper discussed machine learning techniques to predict diabetes. They have used Decision Trees, NB, K-nearest neighbors algorithms. They employed WEKA software tool. They compared the performance of these algorithm to know which performs better [9].

Ayush Anand, Divya Shakti has discussed in their paper on establishing diabetes risk in a person's lifestyle activities like his/her eating habits, sleeping habits etc. They used the dataset which was collected manually by questionnaire. They collected 2 types of dataset first for diabetes patient and next for normal person. These features are considered by them are roadside eating, sleeping time, exercise, BP, heredity, junk food and gender. They have used certain machine learning algorithms on the data and also they use cross validation technique to remove the bias in results [10].

Priyanka Sonar, K JayaMalini has proposed an advance system mistreatment information processing shows whether the patient has diabetes or not by using some of techniques used in machine learning like that of Decision Tree, ANN, Naive Bayes, SVM. The dataset used by them has 768 instance and nine attributes. Out of 768 instance they used 75% for training and 25% for testing. The aim is to predict

the diabetes disease by developing a system of the patient with a finer accuracy [11].

Sidong wei, Chunyan Miao and Xuejiao Zhao proposed a system to predict diabetes. They used Pima Indian dataset. They considered 8 features including diabetes pedigree function. The experiment carried by them had 4 steps, the initial step is finding the data pre-processor which is best for each classifier, followed by optimization of the parameters of classifier compare the techniques by accuracy achieved by them and in the final step they considered the relevance of features. They used 2 data pre-processor techniques they are LDA (Linear Discriminant Analysis) and PCA (Principal Component Analysis). They used DNN and SVM to identify diabetes. DNN performed the best with the accuracy of 77.86% [12].

Md. Faisal Faruque, Asaduzzaman and Iqbal H. Sarker has proposed a system to predict diabetes. They used the dataset collected from MCC (medical Center Chittagong). It contain 16 attribute of 200 patients. They used four algorithms, they are C4.5 DT, NB, KNN and SVM. On comparison with other algorithms decision tree with 73% accuracy performed better [13].

K Sowjanya, DR. Ayush Singhal, Chaitali Choudahary, in their work, they created a android application which uses machine learning techniques and predicts the users diabetes level. They used four ML algorithms. They collected the data from a hospital in Chhattisgarh, India. It has 40 female and 105 male candidates. They used 75% of data set for training and 25% for testing. Decision tree gave the highest accuracy compared to other techniques [14].

3 Comparison of Different Methods Used for Diabetes Prediction

The table gives the idea about the different methodologies used for diabetes prediction. It also gives the recommendation which can be implemented in future.

Reference no.	Objective	Method used	Results/outcomes	Advantages	Disadvantages	Recommendations
[3]	The proposed system uses AdaBoost algorithm for diabetes prediction and the different classifiers used are SVM, Naïve Bayes, Decision Stump and Decision Tree	ML, AdaBoost algorithm	The AdaBoost-decision support system gives an accuracy 80.729% with low error rate	Uses global dataset which contains 768 instances, 9 attributes and for validation it uses local dataset	It is used to predict diabetes in pregnant women only	Can be implemented with other classifiers like K Nearest Neighbour, Artificial Neural Network for more accuracy
[4]	They used 6 different ML algorithms are used for diabetes	ML, Naïve Bayes, KNN, SVM, DT, RF, LR	They applied the algorithms on PIMA Indian dataset. The KNN	This system compared the accuracy of different ML	Limitations of this issome of the attribute values were	

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Reference no.	Objective	Method used	Results/outcomes	Advantages	Disadvantages	Recommendations
	prediction. The aim is to help doctors to predict diabetes in the early stage		and SVM algorithm gave 77% accuracy which is higher than other 4	techniques and revealed which algorithm is better	missing in the dataset taken by them	
[5]	The proposed system is based on the supervised machine learning Algorithm	SVM, KNN, Naïve Bayes Algorithm, ANN	The Artificial Neural Network results in the highest accuracy among all other algorithms with Min-Max scaling on Pima Indian Dataset	Using the Min-Max scaling method they have achieved more accuracy in diabetes prediction	The artificial neural network has achieved less accuracy of detection	It can be implemented using other classifiers like Decision tree, K-Means
[6]	The classifier uses WEKA tool to predict the diabetes and it is based on four supervised learning algorithms	Naïve Bayes, SVM, Random Forest, Simple CART algorithm	According to classification accuracy the SVM has a highest accuracy 79% when compared to all other classifier	Proposed model has been built using WEKA tool, experimental results can be evaluated in e		
[7]	The proposed system they have used is a software tool which is worked in MATLAB. This software tool acts as an intermediate among specialist and the patient	Artificial Neural Network	It results whether the patient has diabetes or not within few seconds with 81% accuracy	As the obtained accuracy is 81%, so the time consumption is reduced	They used only one machine learning technique	Can be implemented using different algorithms, comparing which performs better
[8]	The proposed system consists of machine learning algorithms such as KNN, Decision trees Random forest, SVM by using Pima Indian dataset	KNN, Regression, Decision trees, Random forest, Gradient boosting, SVM snd Neural network	The results shows the best accuracy of 79.7% that performs well on dataset	By using different classification algorithms, doctors can identify the early presence to promote the diagnosis of the treatment		Can be implemented with k-fold of cross validation technique and can also use confusion matrix.
[9]	They have used machine learning algorithms to predict diabetes. They used classification techniques	KNN, NB, DT	They used Random Forest classifier, Logistic Regression and Super Vector Machine. and compared the performance of these algorithms. Without bootstrapping Decision tree with 78.43% gave better performance	They applied different classification algorithms to know which algorithm performs better	They have used single dataset and the number of attributes considered by them is less	It can implemented by taking different dataset and also by increasing the size of the dataset
[10]	They have used certain machine	They have used	Chi-Squared Test of Independence	By using cross-validation		

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Reference no.	Objective	Method used	Results/outcomes	Advantages	Disadvantages	Recommendations
	learning algorithms.	Classification and regression trees (CART)	will be performed initially followed by the application of CART	the bias in results will be removed		
[11]	The proposed system consists of machine learning algorithms such as Decision Tree, ANN, Naive Bayes, SVM	Decision Tree, ANN, Naive Bayes, SVM	The results shows that, for the decision tree the accuracy is 85%, for Naive Bayes 77% and 77.3% for SVM	Proposed an advance system mistreatment information which shows whether the patient has diabetes or not with a better accuracy	If the result of both the algorithm are different, then they considered the decision to be unstable	
[12]	The proposed system uses Support Vector Machine and Deep Neural Network to predict diabetes and data or information pre-processing methods. They used Pima Indian data set	ML, DNN, SVM	DNN performs the best with 77.86% accuracy. And this technique can be used on new dataset. But the data must be pre-processed utilizing Scale	The main advantage is that the technique used is practical and it can be used on any new dataset directly	This system can be used to predict diabetes in pregnant women only	The accuracy can be improved by adding more number of hidden layers. And involving some advanced tricks like dropout layer
[13]	The proposed system uses four machine learning techniques to predict diabetes. They used may risk factors which helps in early prediction of diabetes	SVM, C4.5 Decision Tree, Naïve Bayes, KNN	C4.5 achieved highest accuracy that is 73.%. Decision Tree performed better than other techniques or classifiers	They used different techniques for predicting diabetes and compared t accuracy and decided which technique is better		
[14]	They developed an android application which can used to predict diabetes. They used machine learning techniques	Naïve Bayes, J48, Multilayer perceptron, SVM	J48 performed better than other techniques with 0.89. Performance of Multilayer perceptron, SVM is same and Naïve Bayes recorded least value	They developed an android application which is user friendly and the application also provides suggestions and knowledge about the disease		

4 Conclusion

In this survey we have analzed various methods used to predict diabetes mellitus. Most of them have used technologies like SVM, Decision trees, Naive Bayes, ANN where their aim is to provide a better accuracy and to make a convenient system for the patients and the doctors.

There are some disadvantages in the existing system and most of the researches are concerned in predicting diabetes in pregnant women. We are planning to introduce a system which can be used to predict diabetes for general data set and overcome the problems that are present in the existing system. We are expecting more accurate results by using machine learning algorithms.

References

1. Kandasamy JP, Balamurali S (2015) Performance analysis of classifier models to predict diabetes mellitus. Procedia Comput Sci 47:45–51
2. Kaur H, Kumari V (2018) Predictive modelling and analytics for diabetes using a machine learning approach. approach. Appl Comput Inform. https://doi.org/10.1016/j.aci.2018.12.004
3. Veena Vijayan V, Anjali C (2015) Prediction and diagnosis of diabetes mellitus - a machine learning approach. In: Recent advances in intelligent computational system (RAICS). IEEE
4. Sarwar MA, Kamal N, Hamid W, Shah MA (2018) Prediction of diabetes using machine learning algorithms in healthcare. In: Proceedings of the 24th international conference on automation & computing, Newcastle. IEEE
5. Dey SK, Hossain A, Rahman MM (2018) Implementation of web application to predict diabetes disease-an approach using machine learning algorithm. In: 21st international conference of computing and information technology (ICCIT). IEEE
6. Sudhir AM, Dhage N (2018) Diabetes disease prediction using machine learning on big data of healthcare. In: Fourth international conference on computing communication control and automation (ICCUBEA). IEEE
7. Joshi S, Borse M (2016) Detection and prediction of diabetes mellitus using back-propagation neural network. In: International Conference on Micro-Electronics and Telecommunication Engineering. IEEE
8. Barhate R, Kulkarni P (2018) Analysis of classifiers for prediction of type-2diabetes mellitus In: Fourth international conference on computing communication control and automation (ICCUBEA). IEEE
9. Saru S, Subashree S (2019) Analysis and prediction of diabetes using machine learning. Int J Emerg Technol Innov Eng 5(4):167–175. ISSN: 2394-6598
10. Anand A, Shakti D (2015) Prediction of diabetes based on personal lifestyle indicators. In: 2015 1st international conference on next generation technologies (NGCT-2015), 4–5 September 2015
11. Sonar P, Malini KJ (2019) Diabetes prediction using different machine learning approaches. In: Proceedings of the third international conference on computing methodologies and communication (ICCMC 2019). IEEE
12. Wei S, Zhao X, Miao C (2018) A comprehensive exploration to the machine learning techniques for diabetes identification. In: 4th world forum on Internet of Things. IEEE
13. Faruque MF, Iqbal, A, Sarkar H (2019) Performance analysis of machine learning techniques to predict diabetes mellitus. In: International conference on electrical, computer and communication engineering (ECCE). IEEE

14. Sowjanya K, Ayush Singhal DR, Choudahary C (2015) MobDBTest: a machine learning based system for predicting diabetes risk using mobile devices. In: International advanced computing conference (IACC). IEEE

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E-governance for Public Administration

Mahesh Kaluti and K. C. Rajani

Abstract The objective of public administration is to make excellent governance in our country and the plan of the one country is different from other countries. Public administration is an efficient, translucent to clear instructions to citizens and reacting quickly for their service requests in positive manner is more important for proper functioning of the country. The better e-governance is having some government strategies to accomplish the multiple objective services can be executed. Online interface likewise goes about as a stage for Citizens to benefit data and for the Administration Office to spread mindfulness. Utilizing this office, office working can be made known to the general population subsequently making the framework straightforward.

Keywords Public administration · Governance · Administration office

1 Introduction

For the development of good governance the electronic government uses information and communication technologies as a supporting tool. The variety of good services provided by the e-government. The E-government is provide new ideas and new thinkingness and leadership qualities and approaches for citizens about e-government services and applications. Public administration and governance structure are essential facilitators for this responsibility. This paper discuss with real and effectiveness of e-governance services on poorness reduction and it prove the social equality of different citizens. E-governance derives its framework to find key elements of e-governance and partnership services at plan execution level. Here, the

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_98

individual citizen and organizational end users of e-governance projects are influenced by skills, educational facilities and resources.

Basic Objectives:

- The e-governance needs to leverage the information and communication technologies for develop a shared vision between government, stakeholders, citizens, business and academics for realizing good governance.
- For successful adoption of e-governance by a government to citizens. The responsible factors like educational, financial, technological and security provided when information sent over internet.

The governance services enable better policy outcomes, higher quality services and greater engagement with citizens.

Simplification of rules and regulations and processes of government through the use of information and communication technology. This technology provide services to citizens in a public and private sector in easy way with quick accessing services using internet facilities and it improves the efficiency and transparency between government and citizen. These accomplished factors for successful adoption of e-governance is not satisfied by the government.

2 Literature Survey

Paper [1] The present research try to accomplish relation between the factor like education, finance, technology, security take leadership for make effective platform for execution of e-governance. In each and every country government try to achieve service delivery to citizens in a quick and very easy way without any delay. In this paper it make an effort to study the projects related to e-governance to survey the execution plan of the every projects to receive advantages from government to citizens. By considering the advantages of project the project is stated as successful project.

Paper [2] In this paper the duty of the government and public administration is to make an action in a easy method that is helpful to citizens, institutions, organizations, business for this functions and services of the city, state, country are provided & it provide service over the internet and it is secured. Public administration plays important role to establish transparent relation between government and citizens.

Paper [3] the developed countries as well as developed countries has key agenda like direct and indirect forces globalization and governance. The information and communication technology is help to add a new view to the e-governance concept. The information and communication technologies are faster than ever before and it tends to give good governance to citizens and their services. It gives the effective tools of services to citizens or customers applications. Good governance is widely accepted as effective tool for service delivery in developed and developing countries.

Paper [4] When e-governance technology is implemented it helps citizen and customers etc. to involve and make decision in their administration services provided by e-government to improve communication between government and citizen through Information and communication technology.

Paper [5] In today's life citizen requires a multiple public services. The objective of the all e-governance public service process is citizen centricity. To prove the citizen centricity mainly required objectives of service responsive and value and enhanced citizen experience. In future e-governance service can be implemented in mobile also. This helps to more citizen in country because now a days phone users are in high quantity. The mobile users of the country must be provided with simplified versions of the digital services and also they get the services easily. These type of services is to improve the country.

3 Proposed System

The proposed study approaches both the qualitative and quantitative analysis research. This proposed system as quantitative because it uses number of ways to try to understand services and the services are developed by government employees from government organizations, government offices, government agencies and services are developed based on service objective. The study is qualitative because the developed services gives the better and good services to citizen from government. These services are help to improve globalization as well as citizen ideologies and it gives better experience to citizen.

This proposed system builds on the principle of services in the public administration office, these principles makes to give better & best services provided to citizens. In this system it is very useful to citizen to understand what is going on in our city so, definitely everyone will curious to see the public information (Fig. 1).

4 Models

Models of E-governance are

1. Government to Government model.
2. Government to Business model.
3. Government to Citizens model.
4. Government to Employees model.

1. **Government to Government Model (G2G):** G to G is the transmission of vital information among governments through online mode. It is the relationship between government department, government organization and government agencies. The communication and cooperation between governments helps to share information stored in databases and resource. The

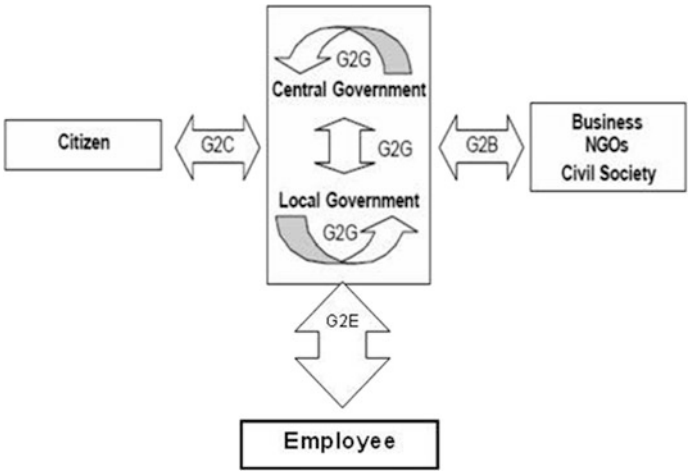

Fig. 1 Block diagram

information like civil rights, policies, rules and compensation. The main objective of G to G is to help and improve e-governance service basic needs by improving communication, information access & sharing.

2. **Government to Business (G2B):** G2B is the second major type of e-government category. It is a method of sharing of information and service from government to business sectors. The services provided by the business are government procurement, online meeting, sending and receiving messages electronically, sending filled out electronic forms are insurance forms, tax forms, electronic auctions. The services provided by government sectors are memos, policies, rules and regulation distributed.
3. **Government to Citizen (G2C):** In this model government provide information and services to citizen. Therefore, citizen can easily can take information and services quickly and conveniently any information in anywhere else in the government these services provided by government sector. It is the direct interaction between the government and citizens. It establishes relation between government & citizens. It is focused on customer centric and integrated services.
4. **Government to Employees (G2E):** Government provide services in terms of software that help employees to maintain sensitive information. The sensitive information like personal information i.e., bank account information, credit card details, health records and employees important documents. Government provide technologies to employees to take benefits from this technologies like e-payroll->like pay bills, tax information, e-training->it provide opportunity to new employees to train and learn a new information, using this technologies the employees improve their knowledge and sharing of information among employees.

4.1 System Overview

In this architecture Central Admin will login to the cloud application in android phone and an OTP is generated, he will Login using that username and OTP. He will add templates and applications for central schemes regarding railways, schemes related to farmers and agriculture. He can view users request and reply to them. State Admin will login to the cloud Application and an OTP is generated, he will Login using that username and OTP. He will add templates and applications regarding state government schemes such as scholarship to minority, women empowerment, identity for unorganized workers, free education for girls etc. He can view users request and reply to them. Local Admin will login to the cloud application and an OTP is generated, he will Login using that username and OTP. He will add templates and applications. He can view users request and reply to them. Users of this application can download the applications added by the admin regarding various schemes. When admin add schemes of government the user will receive message. Users can send request to Admin and view reply (Fig. 2).

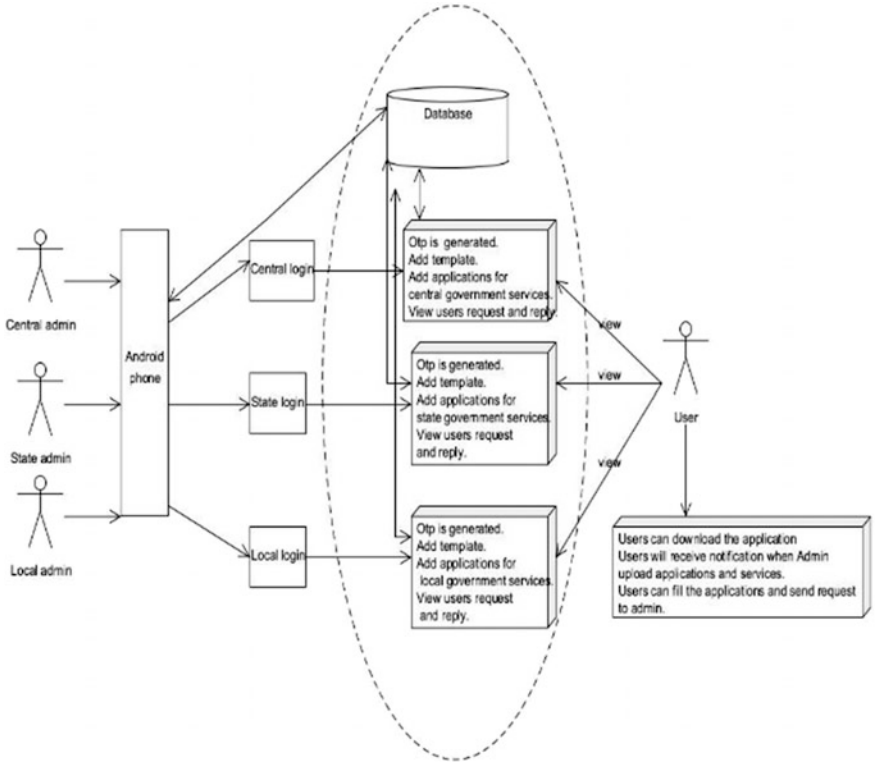

Fig. 2 System architecture

4.2 Modules

Central Admin
Central Admin will login to the cloud application and an OTP is generated, he will Login using that username and OTP. Central Admin will add templates and applications for central schemes regarding railways, schemes related to farmers and agriculture. He can view users request and reply to them.

Central government services:

1. Atal Pension Yojana.
2. Ayushman Bharat Yojana.
3. Pradhan Mantri Gramin Awaas Yojana.

State Admin
State Admin will login to the cloud Application and an OTP is generated, he will Login using that username and OTP. State Admin will add templates and applications regarding state government schemes such as scholarship to minority, women empowerment, identity for unorganized workers, free education for girls etc. He can view users request and reply to them.

Local Admin
Local Admin will login to the cloud application and an OTP is generated, he will Login using that username and OTP. Local Admin will add templates and applications. He can view users request and reply to them.

Users
Users of this application can download the applications added by the admin regarding various schemes. When admin add schemes of government the user will receive message. Users can send request to Admin and view reply.

5 Conclusion

This paper gives strategic objective of the electronic governance and it describe the relation between government, citizens and business. The e-governance gives the simple and better services to citizen. These services are must give the positive impact & better quality services to citizens. The citizen can change their ideologies about services and they get the better services from government sector. This improves and helpful to globalization of country.

References

1. Ho A (2002) Reinventing local government and the e-government initiative. Public Adm Rev 62(4):434–444
2. Bala A (2017) Role of public administration in good governance and local government. Int J Econ Commerce Manage 5:593–601
3. Rezaul Karim M (2015) E-government in service delivery and citizen satisfaction. IJMPICT 5 (2):49. https://doi.org/10.5121/ijmpict.2015.6205
4. Zouridis S, Thaens M (2003) E government: towards a public administration approach. Asian J Public Adm 21(2):159–183
5. Stoilov T, Stoilova K (2005) Routing algorithm in computer networks. In: International conference on a computer system and technologies, CompSysTech 2005

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Phishing URL Detection Using Machine Learning Techniques

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Abstract A criminal act performed online by impersonating others to obtain confidential data like passwords, banking details, login credentials, etc., is known as phishing. Detecting such websites in real-time, is a complex and dynamic problem, which involves too many factors. This work focuses on identifying the important features that distinguish between phishing URLs and legitimate URLs. To detect significant features, statistical analysis is done on the phishing as well as legitimate datasets. Based on the statistical exploration, certain features based on the URL, HTML, JavaScript and Domain were extracted. The prominent and most relevant features to identify the phishing URLs are identified using correlation. The identified subsets of features are then used to train different machine learning based classifiers and the accuracies obtained have been compared. From the experimental analysis it is observed that the extracted features have efficiently detected phishing URLs and the Decision Tree classifier has found with highest accuracy for making the predictions.

Keywords Phishing · Decision Tree · Random Forest · Support vector machine · Logistic Regression

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_99

1 Introduction

People all around the world are acquainted to rely on internet to get data of interest whether related to their business, entertainment, or academics. Simultaneously the internet turns out to be the most commonly used platform by criminals to victimise the users. One of the most common attacks is the drive by download in which attackers place malicious URLs in the web pages as a bait. Once a user clicks on such malicious URL, the phishing web page is opened without the notice of the user. The attacker can now retrieve the victim's sensitive data like user credentials or credit card data which is available on the host system and which inturn may cause financial loss to the user.

Phishing can be done by an individual or a group of people to steal sensitive information such as login credentials, OTPs banking information etc. from the customers for financial gain, identity theft, or other deceitful purposes. Phishing websites are forged sites that are conceived by malicious individuals to mimic real web pages. Typically, victims receive a message that appears to have been sent by a known contact or organization which will ultimately redirect them to the phishing websites.

As per the RSA's online fraud report [1], 37% of the fraud attacks were observed to be phishing attacks. The phishing attacks alone increased by 6% since 2018.

As more people are going online and relying more on Internet to retrieve information because of its ease of access, there is a substantial increase in the disastrous phishing attacks, which in turn led to the loss of user trust on the Internet. The increase in these sorts of attacks posed a threat to electronic commerce businesses. As the technology is advancing, infrastructures that allow phishing attacks are more developed.

Both long term and short term economic damage can be caused by these phishing attacks. The systems which can effectively detect such phishing sites, withstand cybercrime and ensure cyber security is the need of the hour, as these online fraudulent identity theft is increasing at a fast pace.

In this work we present an approach to identify the feature, value pairs which discern between phishing and legitimate phishing URLs and then using these discriminators to develop a system which classifies websites into phishing or non-phishing category by applying various machine learning techniques.

2 Related Work

Phishing methods can be either visual similarity or heuristic based, that retrieve website content can end up in undesired side effects. The [2] exploits the anatomy of phishing URLs structure. It mainly focuses on extracting features which distinguish URLs into phishing and legitimate. It does not require any knowledge of the corresponding web page content. In this 14 features are extracted from the

URLs based on the heuristics that have been defined. From these features association rules are mined using apriori as well as predictive apriori to determine the legitimate and phished URL. From the obtained association rules the most prevalent features are identified which aids in recognising phishing URLs. Only strong rules with confidence in the range of 90 - 100% are considered for classifying a given URL and the others are left out. But in this the number of features that have been used are limited. Nishanth et al. in [3] mines the structure of the financial data using algorithms from machine learning. Chen et al. in [4] proposed an approach that uses CCH to estimate the similarity degree between legitimate and fake web page.

Zhang et al. in [5] proposed a method using TF-IDF used in Information Retrieval Systems to detect Phishing Web Sites. It was developed to address the false positive cases. CANTINA examines the source code of a web page to determine whether a given URL can be labelled as legitimate. It makes use of the TF-IDF algorithm to find out the most frequently occurring keywords. The obtained keywords are googled and if a domain name match is found with the top N search results, then the website is classified as legitimate or otherwise labelled phishing. The main disadvantage of CANTINA is that it is effective for small scale websites and does not support large websites. Xiang et al. in [6] proposed CANTINA+, a machine learning based framework with a rich feature set for detecting phishing web sites as an extension to CANTINA. In this, apart from google search engine, 8 novel features extracted from the Document Object Model (DOM) of HTML and third-party services have been included. These new features have been added to achieve better results. This method also relies on search engine google and contents that are retrieved from web pages.

An SVM based approach to identify phishing URL was proposed by Huang et al. [7]. Li et al. in [8] have proposed a learning method which is semi-supervised for the identification of phishing web pages based on transductive SVM (TSVM). In this approach, the features grey, colour histograms and sub graphs spatial relationships of web images are extracted and TSVM model is trained. It considers the information distributed that is implicitly embodied in the unlabelled samples of large quantity of data. Its performance is much better than traditional SVM which simply trains the model by learning a little from the labelled samples. Since only limited number of features has been considered in this method, the accuracy is a little low. Chen et al. in [9] proposed a hybrid approach that uses supervised classification strategies by extracting textual, key phrase, financial data to determine the venomous of phishing attack. Cabanillas et al. in [10] proposed a technique to extract the features that are used most frequently in financial institutions to compute the trust in electronic banking.

3 Problem Definition

To identify phishing URLs, it is important to know the structure of a URL and how attackers think while creating phishing domains. To address the web pages the URL i.e. Uniform Resource Locator is created. Fig. 1 gives a typical URL structure and its relevant parts.

URL starts with a protocol to access the page. The web page hosted by server is identified by fully qualified domain name. It consists of a top-level domain name i.e. TLD and registered domain name i.e. second-level domain. The portion of domain name is restricted as it must be registered in Registrar of domain name. A subdomain name and a domain name forms a host name. The subdomain portions can be controlled by a phisher by setting any value to it. A phisher can also change the path and file components which may present in a URL.

Any unregistered domain name can be registered by an attacker. Only once this URL part can be set. A new URL can be created by a phisher by changing the FreeURL i.e. the subdomain name and path. The uniqueness of the FreeURL in the website domain causes the security defenders to struggle a lot in detecting the phishing domains. In order to convince the users the attackers cleverly choose the domain names and use the Free URL to cause the detection difficult. A user can be easily prevented from accessing a fraudulent domain once it is detected as such.

All earlier heuristic or visual similarity based anti-phishing approaches extract content from webpage that causes unwanted side effects like acknowledging a credit card receipt or signing up to mailing list. The classification schemes of phishing URL only examine the suspicious URL to alert the end user from unwanted events. Solution for detection of Phishing URL doesn't need any deep knowledge regarding webpage content.

4 Framework of the System

The objective of the proposed system is to determine whether a user given website is legitimate or phished. The architecture of proposed system has two phases: (1) Legitimate repository search (2) Feature extraction.

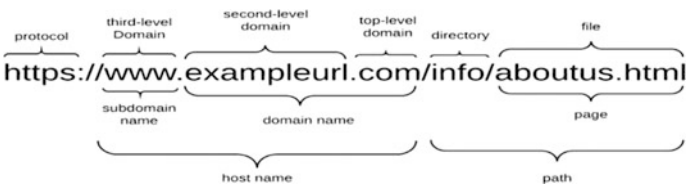

Fig. 1 The typical URL structure

In Legitimate repository search phase, a search is carried out prior to moving to the Feature extraction and prediction phase. The URL of the website given by the user is first searched in the repository of legitimate URLs. If a match is found, the website is considered a legitimate website. Otherwise it is moved into the next phase which is the feature extraction and prediction phase. This is done to improve the performance of the system by reducing the overall time as it eliminates the unnecessary feature extraction step in case of a known legitimate URL.

In the Feature extraction and prediction phase, 25 distinguishing features are extracted from the URL based on the heuristics that are obtained from the analyses of the URL datasets. These features are then used to classify a given input URL as phishing or legitimate using a model trained using the URL datasets. The proposed system architecture is shown in Fig. 2.

A. Data Collection

For the accurate prediction of the legitimacy of a given URL, large amount of data is required to train the prediction model. The raw data of phishing and legitimate URLs has been collected from several sources. Some sources for legitimate URL data are listed in Table 1. Around 5000 legitimate URLs have been collected.

Phishing URLs have similarly been collected from Phishtank database maintained on the website http://www.phishtank.com.

B. Extraction of Features

The raw data of URLs cannot be directly used to train the model. The raw data was processed to extract features that discriminate between legitimate and phishing URLs and a new feature dataset has been created. These features have been

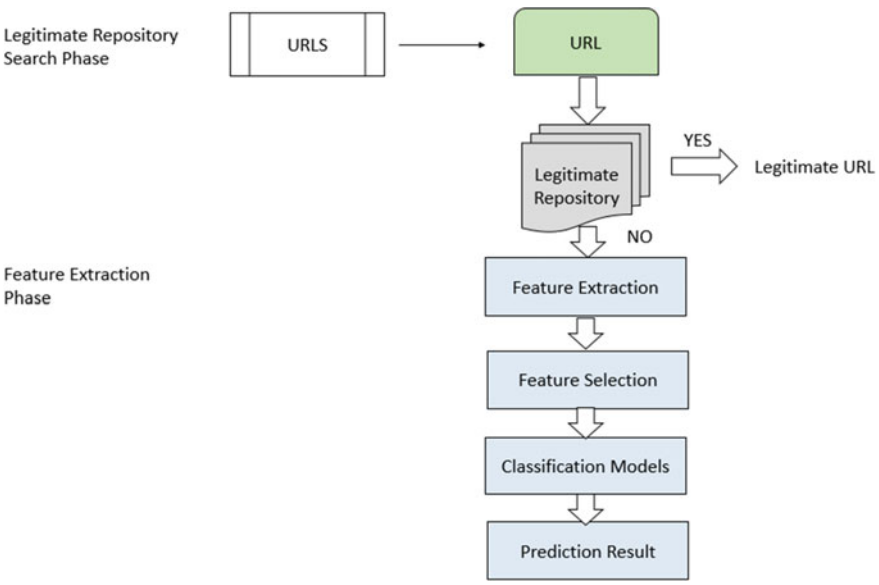

Fig. 2 Proposed system architecture

Table 1 Legitimate data sources

Source	Link
Alexa top sites	https://www.alexa.com/topsites
Netcraft's most visited websites	https://toolbar.netcraft.com/stats/topsites
Quantcast's top US sites	https://www.quantcast.com/top-sites/US
SimilarWeb's top websites	https://www.similarweb.com/top-websites

identified by carrying out statistical analysis on legitimate and phishing datasets. Based on the heuristics defined, the features of the URLs are extracted under three categories: URL based features, HTML JavaScript based features and Domain based features. Total 25 features have been extracted and the features were given a value of either 0 or 1 where 0 represents legitimate URL and 1 represents phishing URL.

Heuristic 1: Length of the Host Name of the URL

On extraction and analysis of the host names of the URLs, it was found that the average length of the hostname in phishing URLs is greater than 25 characters whereas the average length in case of legitimate URLs is around 20 characters.

$$\text{Rule}: \begin{cases} \text{if } (\text{length}(\text{host})) > 25 \rightarrow \textit{Phishing} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

Heuristic 2: Number of slashes in the URL

Generally, the phishers try to make a phishing URL look legitimate by adding slashes to the URL. On analysing the datasets, it was observed that the average number of slashes in phishing URLs is greater than or equal to five whereas it is around 3 in legitimate URLs.

$$\text{Rule}: \begin{cases} \text{if } (\text{Number of slashes}) \geq 5 \rightarrow \text{Phishing} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

Heuristic 3: Number of dots in the Host Name of the URL

On analysing the datasets, it was found that the phishing URLs have more than four dots in the host name part of the URL whereas legitimate URLs have around 3 dots.

$$\text{Rule}: \begin{cases} \text{if}(\text{Number of dots in host name}) > 4 \rightarrow \textit{Phishing} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

Heuristic 4: Existence of Redirection Symbol "//" in the URL

Phishers try to trick users by including "//" in the URL path which redirects the user to another website. It was found that "//" usually occurs in Phishing URLs.

$$\text{Rule}: \begin{cases} \text{if}(\text{"//"} \text{ in URL Path}) \rightarrow \text{Phishing} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

Heuristic 5: Existence of "@" Special Character in the URL

Including the "@" symbol in an URL allows everything preceding the symbol to be ignored. Phishers often use this to trick users by including the actual address after the "@" symbol. On analysing the datasets, it was observed that "@" symbol occurs mostly in Phishing URLs.

$$\text{Rule}: \begin{cases} \text{if}(\text{"@"} \text{ in URL}) \rightarrow \text{Phishing} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

Heuristic 6: Presence of IP Address in the URL

Sometimes the Phishers use IP address to address the websites instead of the domain name in order to hide the domain name and trick users into believing that it is a legitimate website. It was found from the dataset that IP is usually used to address Phishing URLs.

$$Rule: \begin{cases} if(IP\ address\ is\ present\ in\ URL) \rightarrow Phishing \\ Otherwise \rightarrow Legitimate \end{cases}$$

Heuristic 7: Transport Layer Protocol

Https protocol ensures the secure transmission of data over the network. Therefore, on analysing the protocol part of the URL it was found that most of the phishing URLs do not have transport layer security. They are using http protocol which, unlike https is not secure.

$$Rule: \begin{cases} if\ (Protocol\ is\ http) \rightarrow Phishing \\ Otherwise \rightarrow Legitimate \end{cases}$$

Heuristic 8: Subdomain

Phishers usually add subdomains to the URLs to make a Phishing URL look legitimate as they have full control over the subdomain part of the URL. On analysing the datasets, it was found that mostly the phishing URLs have subdomains whereas legitimate URLs donot.

$$Rule: \begin{cases} if(URL\ has\ subdomains) \rightarrow Phishing \\ Otherwise \rightarrow Legitimate \end{cases}$$

Heuristic 9: Presence of Specific Keyword in the URL

The phishers usually include keywords like confirm, PayPal, suspend in the URL path to trick the users into believing that it is a legitimate URL. On investigating the URLs datasets, it was observed that certain keywords occur frequently in the path of the phishing URLs.

$$Rule : \begin{cases} if\,(Specific\ Keyword\ present\ in\ URL\ Path) \rightarrow Phishing \\ Otherwise \rightarrow Legitimate \end{cases}$$

Heuristic 10: Top Level Domain part in the URL

Host name of a URL generally consists of three parts: top-level domain, secondary-level domain and third-level domain. Upon analysing the top-level domains of the URLs in the dataset it was found that most of phishing URLs do not have top level domain.

$$Rule : \begin{cases} if\,(Top\ level\ Domain\ is\ not\ existing) \rightarrow Phishing \\ Otherwise \rightarrow Legitimate \end{cases}$$

Heuristic 11: Number of Dots in the Path of the URL

Phishers add dots in the path portion of the URL to trick users. On examining the URL datasets, it was found that the phishing URLs using dots in the path have at least two dots.

$$\text{Rule} : \begin{cases} \text{if (Number of dots in URL path)} > 2 \rightarrow \text{Phishing} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

Heuristic 12: Existence of Hyphen '-' in the Host Name of the URL

Phishers tend to add hyphens in the domain part of the URL so that the it looks like a URL of a legitimate website. On analysing the URL dataset it was found that the Legitimate URLs have no hyphens in majority cases.

$$\text{Rule} : \begin{cases} \text{if (hyphen present in URL)} \rightarrow \text{Phishing} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

Heuristic 13: Length of the URL

Phishers usually use long URLs to hide the suspicious part of the URL. On carrying out the analysis on the URL dataset it was observed that the average length of the legitimate URLs is around 40 whereas the average length of phishing URLs is greater than 75.

$$\text{Rule} : \begin{cases} \text{if (length of URL)} > 75 \rightarrow \textit{Phishing} \\ \text{if (length of URL)} > 40\,\textit{and}\,\leq 54 \text{ Suspicious} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

Heuristic 14: Usage of "TinyURL" URL Shortening Services

URL shortening services like TinyURL allow URLs to be made smaller in length while still leading to the required webpage. This is done usually to easily share very long links by shortening them. Phishers use this to hide the actual domain name and trick the users.

$$\text{Rule}: \begin{cases} \text{if}(\text{URL is Tiny URL}) \rightarrow \text{Phishing} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

Heuristic 15: Existence of .exe

Existence of .exe represents an executable file. Phishers can make use of the .exe format in the URL to run malicious software in the system to retrieve user's personal information or login credentials.

$$\text{Rule}: \begin{cases} \textit{if}(\text{.exe in URL}) \rightarrow \text{Phishing} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

Heuristic 16: Age of the Domain

Phishing domains usually have short life period. This data has been extracted using the WHOIS database. On examining the data, it was found that the legitimate URL domains are at least 6 months old.

$$\text{Rule}: \begin{cases} \text{if}(\text{Domain Age} \geq 6\,\text{months}) \rightarrow \text{Legitimate} \\ \text{Otherwise} \rightarrow \text{Phishing} \end{cases}$$

Heuristic 17: Statistical-Reports Based Feature

PhishTank and StopBadware are some parties which keep formulating statistical reports on phishing websites over a given time period. These statistics like "Top 10 Phishing Domains" and "Top 10 Phishing IPs" are used in the extraction of this feature.

$$\text{Rule}: \begin{cases} \text{if}(\text{Host belongs to Top Phishing Domains or IPs}) \rightarrow \text{Phishing} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

Heuristic 18: Registration Length of the Domain

Phishing websites usually have a short life span. Therefore, phishing domains are generally registered for a short period unlike legitimate domains that are registered for several years. On examining the data, it was found that maximum of the phishing domains have been registered for less than a year.

$$\textit{Rule}: \begin{cases} \text{if}(\text{Domain Expiration date} \leq 1\,\text{year}) \rightarrow \textit{Phishing} \\ \text{Otherwise} \rightarrow \textit{Legitimate} \end{cases}$$

Heuristic 19: Number of Links Pointing to the Site

Legitimate sites generally have several links pointing to them. Analysing the data, it was found that the majority of phishing websites have no links pointing to them whereas legitimate websites have more than 2 links pointing to them.

$$Rule: \begin{cases} \text{if(No. of Links Pointing to the site)} = 0 \rightarrow \text{Phishing} \\ \text{if(No. of Links Pointing to the site} \geq 0 \textit{ and } \leq 2) \rightarrow \textit{Suspicious} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

Heuristic 20: Iframe Tags

IFrame is a HTML tag that can be used to display another webpage onto the current webpage. Phishers use the iframe tags to show content of other webpages to trick the users. It was observed that iframe tags were mostly used in phishing websites.

$$\text{Rule}: \begin{cases} \text{if(Site is using iFrame)} \rightarrow \text{Phishing} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

Heuristic 21: Disabling the Right Click

Phishers disable the right click by making use of JavaScript so that users cannot view the source code. This is more common in Phishing websites than legitimate websites.

$$\text{Rule}: \begin{cases} \text{if(Right Click is Disabled)} \rightarrow \text{Phishing} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

Heuristic 22: Using Pop-Up Window

Sometimes phishers use pop-up windows to collect user's personal data. Pop-up windows in legitimate websites are generally used to alert users or broadcast messages. The usage of input fields in pop-up windows was found to be a feature of phishing websites.

$$\text{Rule}: \begin{cases} \text{if(Pop - up window contains input fields)} \rightarrow \text{Phishing} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

Heuristic 23: Status Bar Customization

Phishers make use of Javasript events to show a fake URL in the status bar. Events like onMouseOver enable the phishers to hide the original URL. The usage of onMouseOver event was found to be more common in phishing websites.

$$\text{Rule}: \begin{cases} \text{if(Status Bar is changed using onMouseOver)} \rightarrow \text{Phishing} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

Heuristic 24: Website Forwarding

Phishing websites sometimes collect the user's information and redirect the user to the original website. On analysing the URLs, it was found that legitimate websites are redirected only once max. Whereas, phishing websites are redirected at least 4 times.

$$\text{Rule}: \begin{cases} \text{if}(\text{Number of Redirections} \leq 1) \rightarrow \text{Legitimate} \\ \text{Otherwise} \rightarrow \text{Phishing} \end{cases}$$

Heuristic 25: Sending Information to Email

Phishers use server-side script language like mail() and mailto() functions to send user's information to their personal email. These functions are more frequently used in phishing websites.

$$\text{Rule}: \begin{cases} \text{if}(\text{Using mail() or mailto() functions}) \rightarrow \text{Phishing} \\ \text{Otherwise} \rightarrow \text{Legitimate} \end{cases}$$

C. Classification of URLs

Detection of Phishing URLs is a classification problem. Once the dataset is generated with the extracted feature values, the next step is to train the models using different classifiers. The model that yields the best accuracy will be used for making the predictions.

The four classifiers that have been used are

i) Logistic Regression Classifier
ii) Random Forest Classifier
iii) Decision Tree Classifier
iv) Support Vector Machine Classifier

The classifiers have been applied by splitting the input data into training and testing sets. The split has been performed by taking 80% of random samples for training purpose and 20% for testing purpose. The accuracy of a model is calculated by comparing the labels of the test set with the predictions made by the trained model.

5 Experimental Results

The system has been tested under various circumstances. This section shows the results and analyses the performance of various tests that have been performed.

The system was initially tested with a dataset consisting of only URL based features and the legitimate and phishing data has been taken in the ratio 50 to 50 i.e. equal number of legitimate and phishing URLs have been taken. The four classifiers have been applied on the dataset consisting of 15 URL based features and the accuracies have been compared.

Table 2 shows the accuracies obtained using different classifiers when only URL based features have been considered.

It can be observed from Table 2 that the highest accuracy obtained is 84.33% using Decision Tree classifier. To improve the accuracy, 10 other domain based and HTML, JavaScript based features have been added and the dataset now consisting

Table 2 Accuracies obtained using URL based features

Classifier	Accuracy
Logistic Regression	80.34%
Random Forest Classifier	84.15%
Decision Tree Classifier	84.33%
Support Vector Machine Classifier	81.51%

Table 3 Accuracies obtained using all URL based, Domain based and HTML, JavaScript based features

Classifier	Accuracy
Logistic Regression	86.57%
Random Forest Classifier	88.24%
Decision Tree Classifier	90.02%
Support Vector Machine Classifier	85.32%

Table 4 Accuracies obtained using all URL, Domain and HTML, JavaScript based feature with legitimate to phishing data in 60 to 40 ratio

Classifier	Accuracy
Logistic Regression	90.69%
Random Forest Classifier	90.56%
Decision Tree Classifier	91.01%
Support Vector Machine Classifier	89.98%

of 25 features has been used. The same four classifiers have been applied to the new dataset and the legitimate and phishing data has been taken in the ratio 50 to 50 i.e. equal number of legitimate and phishing URLs have been taken. Table 3 shows the accuracies obtained using different classifiers when all URL based, domain based and HTML, JavaScript features have been considered.

It can be observed from Table 3 that the highest accuracy obtained is 90.02% using Decision Tree classifier.

The system has now been tested by taking legitimate and phishing data in the ratio 60 to 40 and the same four classifiers have been applied to the new dataset.

Table 4 shows the accuracies obtained using different classifiers when all URL based, domain based and HTML, JavaScript based features have been considered and the legitimate to phishing data has been taken in 60 to 40 ratio.

It can be observed from Table 4 that the highest accuracy obtained is 91.01% using Decision Tree classifier. Since this model is giving the highest accuracy, it can be saved using the pickle module and can be used to predict a given URL as either phishing or legitimate by extracting the 25 features.

6 Conclusion

Detection of phishing plays a pivotal role in many cyber security applications. The machine learning approaches are promising in this direction. The features of the URL are extracted and analysed to select prominent features of phishing URLs. After selection of necessary features, various classification algorithms are applied on the resulting dataset to generate models and the accuracies of the different models have been compared. The highest accuracy was obtained using the Decision Tree classifier 91.01% which is used to make the final predictions. The limitation that comes with this system is the unavailability of large datasets of legitimate URLs with the address portion. Most of the sources are providing only the domain names of the legitimate URLs. In the future, more number of legitimate URLs with address portion can be considered as dataset of legitimate URLs to get more accurate predictions. Further analysis could also be performed on the datasets to increase the number of features and simultaneously increase the accuracy.

References

1. https://www.rsa.com/en-us/offers/rsa-fraud-report-q2-2019
2. Carolin S, Eijah Blessing J (2016) Intelligent phishing URL detection using ARM. In: Proceedings, vol 5. Springer, pp 1–19
3. Nishanth K, Ravi V, Ankaiah N, Bose I (2012) Soft computing based imputation and hybrid data and text mining: the case of predicting the severity of phishing alerts. Expert Syst Appl 39:10583–10589
4. Chen KT, Chen JY, Huang CR, Chen CS (2009) Fighting phishing with discriminative keypoint features. IEEE Internet Comput 13(3):56–63
5. Zhang Y, Hong JI, Cranor LF (2007) CANTINA: a content based approach to detecting phishing web sites. In: Proceedings of the 16th International Conference on World Wide Web, Banff, vol 13, pp 639–648
6. Xiang G, Hong J, Rose CP, Cranor L (2011) CANTINA+: a feature rich machine learning framework for detecting phishing web sites. ACM Trans Inf Syst Secur (TISSEC) 14:21
7. Huajun H, Qian L, Wang Y (2012) A SVM based technique to detect phishing URLs. Inf Technol J 11(7):921–925
8. Li Y, Xiao R, Feng J, Zhao L (2013) A semi-supervised learning approach for detection of phishing webpages. Optik 124:6027–6033
9. Chen X, Bose I, Leung ACM, Guo C (2011) Assessing the severity of phishing attacks: a hybrid data mining approach. Expert Syst Appl 50:662–672
10. Liebana Cabanillas F, Nogueras R, Herrera LJ, Guillen A (2013) Analysing user trust in electronic banking using data mining methods. Expert Syst Appl 40:5439–5447

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Stock Market Prediction Using ARIMA, ANN and SVR

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Abstract The forecasting and estimation is the process to estimate the future price of the market stock as well as other financial commodities during the exchange. The efficacious estimation of the company's stock price may yield fruitful results for the company in term of their increased turnover. The efficient-market hypothesis advocates that current price of the stock market be a sign of all presently accessible information and a little change in the stock market price are not based on not only the newly revealed information thus are inherently unpredictable and irregular. Others deviate and those with this viewpoint possess myriad models, methods and expertise which purportedly permit them to estimate future price information. Machine Learning methods such as Support Vector Regression (SVR), Artificial Neural Network (ANN) and other models may be thought of as mathematical function approximators. The most familiar form of ANN for stock market prediction is the feed forward network employs the backward propagation of the errors algorithm to update the network weights. The dataset for the proposed work has been collected from MSFT (Microsoft Inc) in which historical daily prices data is taken and all stock price data is kept for deliberation. The proposed work is based on the development of the stock prediction model based on SVR.

Keywords Machine learning · SVM · SVR · ANN ARIMA · FFNN

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_100

1 Introduction

In the world of technology, the financial exchange is so entangled and numerous things can influence the adjustment in a cost. Machine learning approach that is destined to be equipped with the historical stocks information and thus with the increased knowledge and afterward utilizes the gained learning for an accurate and real time forecast [1]. In this specific situation, the proposed work makes use of the machine learning algorithm called Support Vector Machine (SVM) or SVR to foresee stock costs for the huge and little capitalizations and in the three distinct markets, utilizing costs with both day by day and regularly updated frequencies. The way SVM developed on risk minimization problem giving better results over the artificial neural network and ARIMA which minimizes the risk in training phase [2].

Propelled by the complex natural neuron framework in our cerebrum, the artificial neurons were proposed utilizing the edge rationale. It is freely found the back propagation calculation which could prepare complex multi-layer perceptron viably by processing the inclination of the target work as for the loads, the convoluted neural systems. At the point when the stock is once gotten it is kept until the main sell sign happens, regardless of whether there is more purchase flag meanwhile where utilize a multilayer perceptron with two shrouded layers and with hyperbolic digression enactment works in all layers, including the info one.

Support vector machine, in view of measurable learning hypothesis, was initially proposed by Vapnik. It has been broadly utilized in the budgetary estimating in light of its guideline of auxiliary hazard minimization, which can maintain a strategic distance from the over learning issue and subsequently guarantee the speculation of the model. The key understanding of SVM is that those focuses nearest to the straight isolating hyperplane.

1.1 SVM for Regression

SVR outflanks or is in the same class as the MLP for a transient expectation as far as mean squared mistake and hazard premium, separately [3]. SVR is a valuable and amazing AI procedure to perceive designs in time arrangement datasets and connected SVR to anticipate financial exchange costs just like patterns [4]. Expect that a lot of preparing tests is

$$\{(x_1, y_1)\} i = 1, 2, \ldots, m$$

where $x_i = \left(x_{i1}, x_{i2}, \ldots, x_{in}\right) t \in R_n$ is the information precedent and Yi ∈ R is the objective incentive for I = 1, 2, m, where m compares to information preparing tests. Let lattice $D \in R_{m \times n}$ signify the info models where is the I-th line and $y = (y_1, \ldots, y_m)$ is the vector of watched esteems. The principal objective of SVR is to rough the relapse work f(.) in the structure

$$f(x) = x^t w + b$$

$$min_{(w,b,\in 1,\in 2)\in R^{n+1+m}} \frac{1}{2} w^t w + C(e^t \xi_1 + e^t \xi_2)$$

$$min_{(w,b,\varepsilon_1,\varepsilon_2)} x_i^t w + b - y_i < \varepsilon + \xi_{2i}$$

where, $\xi_2 = \xi_{1i}$ $\xi_2 = \left(\xi_{21,}\ldots..., \xi_{2m}\right)t$ are slack factors in vector structure, and $C > 0$ and $\varepsilon > 0$ indicate the information parameters. Here, the arrangement of the above issue is gotten by presenting Lagrange multipliers where the Lagrange multipliers are $\lambda_1 = (\lambda 1_1, \ldots, \lambda_m)t$ and $\lambda_2 = (\lambda_{21}, \ldots, \lambda_{2m})t$ in Rm, which give the answer for the above quadratic issue.

2 Related Work

In this section, various machine learning techniques are deeply discussed. Further the description of previous work is explained for better understanding of present-day research work.

Lawrence [5] spurred by the KNN trap gave in the weighted twin bolster vector machines with nearby data (WLTSVM), It is proposed novel K-closest neighbor build up basic twin help vector machine (KNNSVM). By applying the intra-class KNN strategy, various loads are given to the examples in a single class to improve the auxiliary data. Through apportioning the preparation set, the SVM loads and inclination are communicated systematically utilizing the help vectors. The creators additionally decide how their methodology normally reaches out to entireties with nonlinear pieces while diverting the need to utilize Lagrange multipliers and duality hypothesis.

Kaastra and Boyd [6] explained neural systems involve a huge region in money related applications and research. In particular, securities exchange estimating is an extremely dynamic field of investigation. Analysts have distributed a few works setting rules for structure great ANNs. Prominently, talk about a well-ordered methodology for the correct structure of ANNs for gauging money related and monetary time arrangement. Lawrence [5] explored that neural systems are utilized to foresee securities exchange costs since they can learn nonlinear mappings among data sources and yields. In spite of the EMH, a few scientists guarantee the financial exchange and other complex frameworks display turmoil.

3 Methodology

The detailed analysis of different machine learning algorithms led to various research issues related to stock market forecasting and stated particularly in present work are applied predictions using ARIMA, ANN and SVR in linear regression and capture all the performance measuring metrics [7]. On the basis of previous year stock next week stocks are going to prediction with this algorithm and camp up with enhanced venture expanse to all the stocks and recommended a method which will provide us the maximum yield [8].

As the goal of building up a higher exactness stock expectation model, distinctive innovative models will be thought around different algorithms. Predict the transient cost by conveying and looking at changed AI techniques. Forecast the stock development pattern utilizing dissimilar information sources [9].

3.1 Dataset Description

The dataset for the proposed work has been collected from MSFT (Microsoft Inc) in which historical daily prices data is taken and all stock price data is kept for deliberation.

Stock costs esteem are expressed as far as its closing price and its adjusted closing price. The end cost is the crude value which is only the money estimation of the last executed cost before the market closes. The balanced shutting value factors in whatever may influence the stock cost after the market closes [10].

Review of the literature [11–14] revealed that selection of machine learning methods such as ANN and SVM are quite beneficial towards the effective prediction of stock market price. The ANN and SVM technique was encouraged with one day slacked values so used to foresee the following day's nearby price (AdjCloseL1). A train and test set was made which was basic for all the four techniques. The range was as per the following: Preparing Set Range: 01 Jan 1993–20 June 2018, Test Set Range: 21 June 2018–20 June 2019.

3.2 Preprocessing

In this historical daily price from Microsoft Corporation (MSFT). The balanced shutting cost was picked to be displayed and anticipated. This is on the grounds that the balanced shutting cost reflects not just mirrors the end cost as a beginning stage, however it considers factors, for example, profits, stock parts and new stock contributions to decide a worth (Table 1).

Table 1 MSFT price

Date	Open	High	Low	Close	Volume	Adjclose
1/3/2012	26.55	26.96	26.39	26.77	22.1566	64731500
1/4/2012	26.82	27.47	26.78	27.4	22.67749	80516100
1/5/2012	27.38	27.73	27.29	27.68	22.90923	56081400
1/6/2012	27.53	28.19	27.53	28.11	23.26512	99455500
1/9/2012	28.05	28.1	27.72	27.74	22.95889	59706800
1/10/2012	27.93	28.15	27.75	27.84	23.04165	60014400

The ration for training and testing is 80:20 which is based on k-cross validation is a resampling methodology used to assess machine learning models on a constrained information test.

The system has a solitary parameter considered k that alludes to the quantity of gatherings that a given information test is to be part into. Thusly, the strategy is frequently called k-overlay cross-approval.

At the point when a particular incentive for k is picked, it might be utilized instead of k in the reference to the model, for example, k = 10 getting to be 10-fold cross-approval. In the wake of managing all of the inconsistencies, failures and missing data in our dataset we continue ahead to feature planning.

A component is a quality or property shared by most of the free units on which assessment or gauge is to be done. Feature building is the route toward using space data of the data to make significant features that make machine learning counts perform well.

1. Missing worth attribution: Weekends and MSFT occasions ascribed with last working days balanced shutting cost.
2. Continuous Date Missing: Generated a consistent date group and converged with unique information and connected above missing worth ascription for a considerable length of time.
3. Attributes Chosen: Data and Adjusted Closing Price.

3.3 Performance Criteria

In technical analysis of stock market data 52 different parameters markers and oscillators have been characterized. Despite the fact that every marker gives some extra data about the stock, utilizing every last one of them will make the framework mind boggling and moderate. The following is the rundown of most broadly utilized parameters.

Where At is actual value and Ft is forecast value. Where f = forecasted value, O = observed value, where y and $\hat{y}$ represents the actual and predicted output value.

3.4 Computation Techniques

ARIMA is also known as the Box-Jenkins method. This model has been employed in the proposed work to ensure that the non-stationary information can be made streamlined and stationary by using the differencing arrangement, y_t. The y_t may be composed on the basis of Eq. 1:

$$\begin{aligned} y_{t=\Phi_1} y_{t-1} + \Phi_2 y_{t-2} \ldots \ldots \Phi_p y_{t-p} \\ + \in_t + \theta_1 \in_{t-1} \theta_2 \in_{t-2} \ldots \ldots \theta_q \in_{t-q} \end{aligned} \tag{1}$$

y_t = differenced value of the time series
ϕ and θ = unknown parameters
$\in$ = distributed error terms with zero mean.

In this equation *yt* is represented by its previous values as well as the values of error terms.

The particular AI model specialist was a feedforward ANN with multilayer perceptron utilizing backpropagation and prepared utilizing managed learning. The standard ANN model was exposed to both a preparation stage and a testing stage from the accessible information. The objective of preparing SVM/SVR is to discover a hyperplane that expands the edge, which is comparable to limit the standard of the weight vector for each help vectors, subject to the compels that make each preparation test legitimate, i.e., for SVR. RBF is a general-purpose kernel, used where no prior knowledge about the data.

$$k(x_i, x_j) = \exp\left(-\gamma \left|\left|x_i - x_j\right|\right|^2\right) \tag{2}$$

The objective of preparing SVM/SVR is to discover a hyperplane that expands the edge, which is comparable to limit the standard of the weight vector for each help vectors, subject to the compels that make each preparation test legitimate, i.e., for SVR, the improvement issue can be composed as

$$\min \frac{1}{2} ||w||^2 \tag{3}$$

$$y_i - w^t x_i - b \leq \varepsilon_1 \tag{4}$$

$$w^t x_i + b - y_i \leq \varepsilon \tag{5}$$

where x_i is a preparation test with objective y_i. This work did not demonstrate the subtleties here, however augmenting its Lagrangian double is a lot less difficult quadratic programming issue.

4 Results and Discussion

This chapter gives information about the technology used in the implementation of proposed work, dataset description to identify research method and validate the result of proposed methods to predict the stock market using historical data.

In Support vector regression we used Linear regression and RBF regression for linear dataset where we get the result in RMSE 1.65226 and 1.65 respectively. SVR utilizes a similar essential thought as Support Vector Machine (SVM), a grouping calculation, however, applies it to foresee genuine qualities as opposed to a class. SVR recognizes the nearness of non-linearity in the information and gives a capable expectation model. A noteworthy advantage of utilizing SVR is that it is a non-parametric method.

The preparation parameters were set as pursues: decay rate = 0.00001, number of units in the hidden layer = 10, and age size = 10000. At last, the system was tried with the informational collection to gauge its speculation capacity. In Support vector regression we used Linear regression and RBF regression for linear dataset where we get the result in RMSE 1.65226 and 1.65 respectively. SVR utilizes a similar mechanism as Support Vector Machine (SVM), a grouping calculation, however, applies it to foresee genuine qualities as opposed to a class. SVR recognizes the nearness of non-linearity in the information and gives a capable model. Figures 1, 2, 3, 4 and 5 represent the results obtained during the analysis.

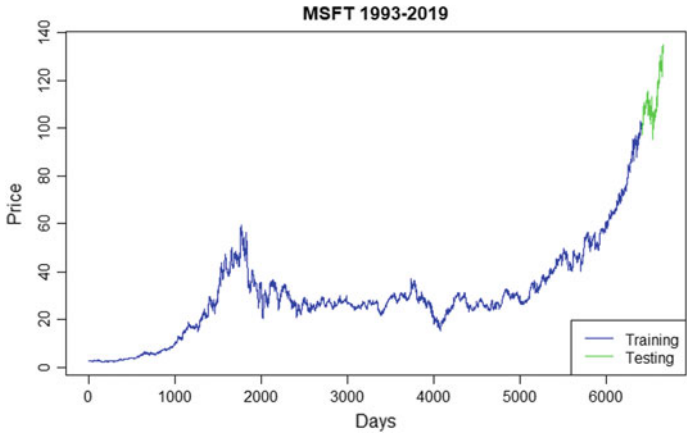

Fig. 1 Trained and test the dataset

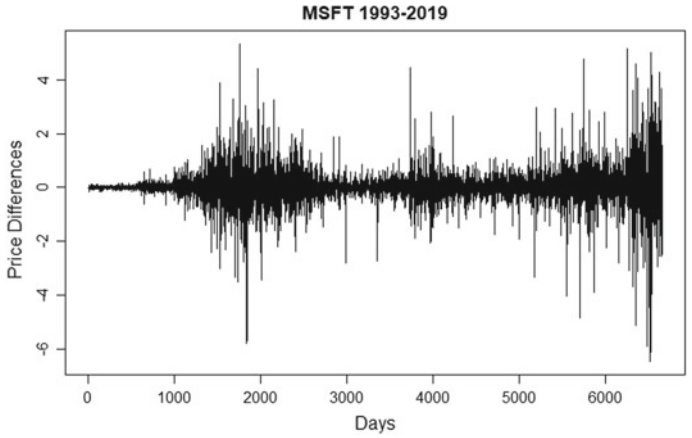

Fig. 2 Time series differencing

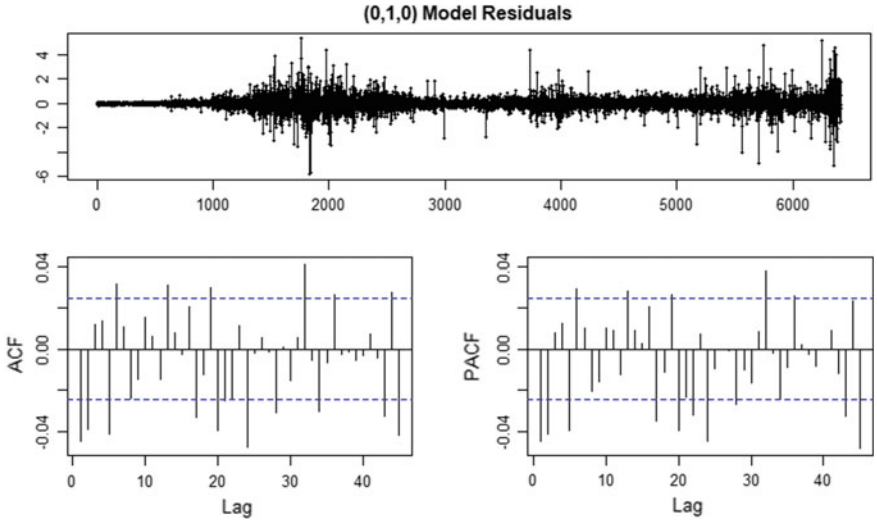

Fig. 3 ARIMA (0,1,0) model

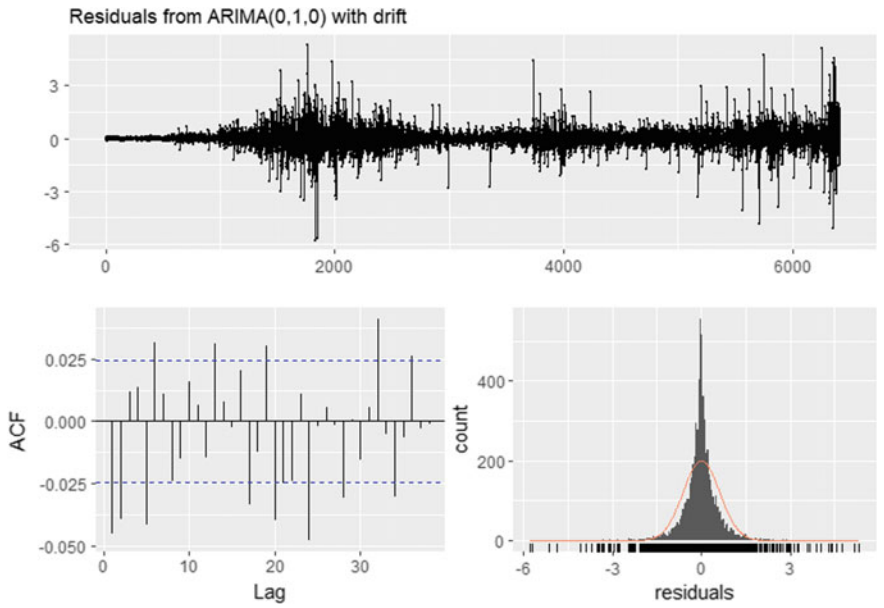

Fig. 4 Check residuals

	Date	AdjClose						AdjCloseL1	NN_Prediction	SVM_Prediction
6546	2018-12-27	99.30	101.19	96.40	101.18	100.04501	49498500	95.14	95.18255	95.07635
6422	2018-06-29	98.93	99.91	98.33	98.61	96.71226	28053200	97.38	97.42348	97.31039
6545	2018-12-26	95.14	100.69	93.96	100.56	99.43198	51634800	97.68	97.72361	97.60960
6424	2018-07-03	100.48	100.63	98.94	99.05	97.14380	14670300	98.10	98.14378	98.02848
6420	2018-06-27	99.58	100.02	97.40	97.54	95.66285	31298400	98.82	98.86408	98.74657
6423	2018-07-02	98.10	100.06	98.00	100.01	98.08531	19564500	98.93	98.97413	98.85628
6547	2018-12-28	102.09	102.41	99.52	100.39	99.26388	38196300	99.30	99.34428	99.22530
6426	2018-07-06	99.89	101.43	99.67	101.16	99.21320	19234600	99.50	99.54436	99.42477
6550	2019-01-03	100.10	100.19	97.20	97.40	96.30742	42579100	99.55	99.59439	99.47464
6421	2018-06-28	97.38	99.11	97.26	98.63	96.73187	26650700	99.58	99.62440	99.50455
6552	2019-01-07	101.64	103.27	100.98	102.06	100.91515	35656100	99.72	99.76446	99.64418
6427	2018-07-09	101.65	102.25	101.25	101.85	99.88990	18212000	99.89	99.93452	99.81373
6419	2018-06-26	98.82	100.08	98.75	99.08	97.17323	26897200	100.00	100.04457	99.92344
6551	2019-01-04	99.72	102.51	98.93	101.93	100.78661	44060600	100.10	100.14461	100.02317
6418	2018-06-25	100.00	100.11	97.30	98.39	96.49649	35433300	100.41	100.45475	100.33235
6425	2018-07-05	99.50	99.92	99.03	99.76	97.84013	18977400	100.48	100.52477	100.40217
6430	2018-07-12	102.77	104.41	102.73	104.19	102.18488	24335900	101.15	101.19505	101.07038
6549	2019-01-02	99.55	101.75	98.94	101.12	99.98570	35329300	101.29	101.33511	101.21001
6544	2018-12-24	97.68	97.97	93.98	94.13	93.07410	43935200	101.63	101.67525	101.54910
6553	2019-01-08	103.04	103.97	101.71	102.80	101.64684	31514400	101.64	101.68525	101.55908
6428	2018-07-10	102.00	102.51	101.86	102.12	100.15471	19293100	101.65	101.69526	101.56906
6523	2018-11-21	103.60	104.43	102.24	103.11	101.95337	28130600	101.80	101.84532	101.71866
6558	2019-01-15	102.51	105.05	101.88	105.01	103.83206	31587600	101.90	101.94536	101.81839
6429	2018-07-11	101.15	102.34	101.10	101.98	100.01741	19644600	102.00	102.04540	101.91812
6548	2018-12-31	101.29	102.40	100.44	101.57	100.43064	33173800	102.09	102.13544	102.00788
6525	2018-11-26	104.79	106.63	104.58	106.47	105.27568	32336200	102.17	102.21547	102.08767
6559	2019-01-16	105.26	106.26	104.96	105.38	104.19790	29853900	102.51	102.55562	102.42677
6431	2018-07-13	104.37	105.60	104.09	105.43	103.40101	24635200	102.77	102.81572	102.68608
6572	2019-02-05	106.06	107.27	105.96	107.22	106.01727	27325400	102.87	102.91577	102.78582
6554	2019-01-09	103.86	104.88	103.24	104.27	103.10036	32280800	103.04	103.08584	102.95536

Fig. 5 Neural network prediction AND support vector regression prediction

	ARIMA	Neural Network Prediction	Support Vector Regression(Linear)	Support Vecto Regression(RBF
RMSE	1.67	1.66436	1.65226	1.65
Adjclose(Predicted)	103	106	104	99

Fig. 6 Comparison of neural network, SVR(Linear), ARIMA, SVR(RBF)

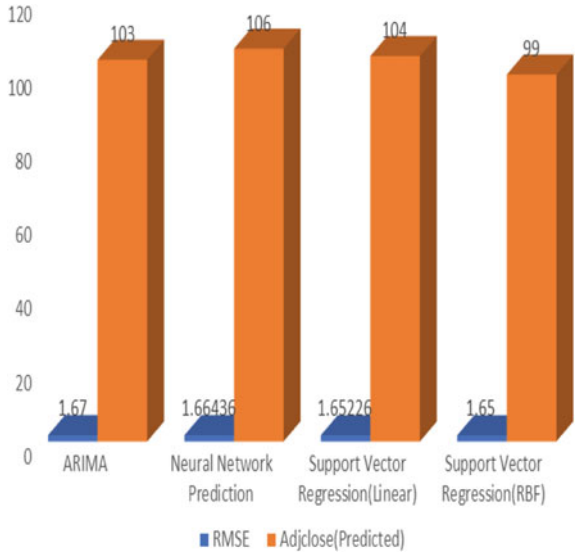

Fig. 7 Result after comparison of 3 models

5 Conclusion

The experimental findings in the proposed work are based on the use of SVR (Linear, Polynomial and RBF), ANN and ARIMA model for the efficient and reliable forecasting of the stock market using the price on the daily basis. The dataset for the proposed work has been collected from MSFT (Microsoft Inc) in which historical daily prices data is taken and all stock price data is kept for deliberation. The Autoregressive Integrated Moving Average (ARIMA), Artificial Neural Network (ANN) and Support Vector Regression (SVR) are used to design stock market prediction using historical database in which data should be trained and tested has been implemented using R software. The Root Mean Square Error (RMSE) has been used as a performance comparison parameter in this work. The performance of the SVR (RBF) has been outperformed the, SVR (Linear), ANN as well as ARIMA model. RMSE value for SVR (RBF) is 1.65, SVR (Linear) is 1.65226, ANN is 1.66436 and ARIMA is 1.67 (Fig. 6). The proposed work explored that the SVR model has shown higher accuracy in the estimation of the daily stock price as compare to the other models (Fig. 7).

References

1. Bahnsen AC, Aouada D, Ottersten B (2015) Example-dependent cost sensitive decision trees. Expert Syst Appl 42:6609–6619
2. Simon A, Deo MS, Venkatesan S, Ramesh Babu DR (2015) An overview of machine learning and its applications. Int J Electr Sci Eng 1(1):22–24

3. Blanco F, Avila JC, Jimenez GR, Carvalho A, Diaz AO, Bueno RM (2016) Online adaptive decision trees based on concentration inequalities. Knowl-Based Syst 104:179–194
4. Atsalakis GS, Valavanis KP (2009) Surveying stock market forecasting techniques-part II: soft computing methods. Expert Syst Appl 36(3):5932–5941
5. Lawrence R (1998) Using neural network to forecast stock market prices. Research gate, pp 1–21
6. Kaastra I, Boyd M (1996) Designing a neural network for forecasting financial and economic time series. Neuro Comp 10:215–236
7. Bao D, Yang Z (2008) Intelligent stock trading system by turning point confirming and probabilistic reasoning. Expert Syst Appl 34(1):620–627
8. Bengio Y, Grandvalet Y (2004) No unbiased estimator of the variance of k-fold cross validation. J Mach Learn Res 5:1089–1105
9. Chandana C, Vijitha K (2019) Stock market prediction using machine learning techniques. Int J Comput Sci Mob Comput 8(2):44–48
10. Cootner PH (1964) The random character of stock market prices
11. Ostertagova E (2012) Modelling using polynomial regression. Procedia Eng 48:500–506
12. Han J, Kamber M, Pei J (2011) Data mining: concepts and techniques. Elsevier, Amsterdam
13. Pan X, Luo Y, Xu Y (2015) K-nearest neighbour based structural twin support vector machine. Knowl-Based Syst 88:34–44
14. Peng X, Rafferty K, Ferguson S (2016) Building support vector machines in the context of regularized least squares. Neurocomputing 211:129–142

A Mining Framework for Efficient Leakage Detection and Diagnosis in Water Supply System

P. Vasanth Sena, Sammulal Porika, and M. Venu Gopalachari

Abstract A smart city smart meter water grid have to be reliable and capable to safeguarding the 24 * 7 trustworthy water distribution network that guarantees less wastage by leakages in the pipeline. Distributors and Consumers are turning to the Internet of Things and deep learning to meet requirement. Continuously monitoring the system and taking requirements manually is tedious job. Smart nodes with hall sensors provide continuous measurements and warehoused in database captured from the smart city water distribution network using smart meters. This paper deals with detection of leakages using deep learning technique. In order to find out leakage estimation and exact leakage position in water distribution pipelines the proposed framework uses the pulse rate, flow rate and quantity as prime attributes. Experiments carried had exhibit the significance of deep learning in leakage detection.

Keywords Classification · Deep learning · Leakage detection · Smart meters

1 Introduction

Due to Day to day increase in population, the natural resources maintenance and saving has become more important than ever before in the next few years. Smart water grid is the needy solution that targets to minimize water wastage and also cost effective. One of the major challenge for smart water grid is the leakages occurred in the water distribution network that causes a significant amount of water wastage.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_101

These leakages in the distribution network might occur either due to maintenance related issues such as iron cracks, rust, external damages by human errors or due to climatic situations such as extreme weather conditions like too hot or too cold, abnormal pressure conditions etc. The early detection of leakages with accurate location tracking can minimize the water loss in turn can reduce damage to the distribution network. Though various traditional methods were exist for leakage detection such as using acoustic signal method, which measures the sound waves from the leakage location in the network, the time and effort consumed are not optimal [1]. These methods may incur demerits such as signal disturbance due to the noise from external environment, soil condition and material used for distribution network etc., in turn deviates the accuracy of finding exact leakage location.

In literature, some non-acoustic methods also defined for leakage detection [11]. One method is injecting some tracing substances into the water pipelines expecting the outage from the leaks along with water, which leads to the risk of contamination in water [4]. A few solutions involved with the sensors installed within the pipe, which analyses sensor data accumulated such as temperature variations and radio frequency using transient signal analysis technique [2]. Though the solution provided seems to be effective but the necessity of the manual intervention with complex knowledge of the hydraulic conditions about the pipelines and use of sophisticated sensors makes this solution not practical [6, 7]. The other category of methods focus to analyze the flow and pressure measures in the distribution network using the populated data from various location points that assess the state of the entire system. The leakages that cause to alter the pattern of the flow can be recognized by applying the machine learning techniques to classify the leakage and non-leakage conditions.

In this paper, the deep learning classification techniques are applied on the real time data set which consist of pulse rate, flowrate and quantity parameters generated from the water distribution network [18]. Based on the pattern of pulse rate and flow rate, deep leaning technique classifies the leakage and non-leakage points and predicts the location and size of the leakage.

This paper is divided into six sections. Section 2 briefly explains the background review; Sect. 3 describes the proposed approach and problems faced while collecting data. Section 4 deals with the preprocessing stage and the different implementation methods followed by Sect. 5 which explains result and statistical analysis of customer water usage levels in different aspects, Conclusion and future enhancement are briefed in the last section.

2 Related Work

There were some approaches mentioned in the literature for the leakage detection. Statistical modeling is one of the approaches that use methodologies such as MNF-MLR technique to assess the leakage in water pipes [3]. Its precision is 85.5 percent only. The issues are indirect leak detection, only two sensors used in this

method, and there is no novelty approach to identify leakage location. In [1], author predict the water leakage in water distribution network using binary classifier C4.5 algorithm applying on department of International development flow rate data set.

The accuracy of this technique is 82.5, and it is implemented in laboratory using fifteen sensor nodes only, this case study [2] was based on support vector regression technique, in this approach so may anomalies were detected while preprocessing the dataset. The research article entitled with Measurement Error Sensitivity Analysis for leakage detection in water network and locating the leak using Support Vector Machines and Artificial Neural Networks [4, 5] are used support vector machine and artificial neural network techniques. They used 6 sensors nodes only and there is no real data to prediction. In [14], Belsito et al. an ANN technique was designed to calculate the magnitude of the water leak and to identify the location. This methodology localizes and identifies the leakage with the probability of success more than fifty percent and even with small amount of inlet flow. A frequency reaction method is proposed by Mpesha et al. that works on open loop water network system to detect leakage and to identify leakage [15]. A time domain reflectometry, which is a continuous snooping method for sensing and detecting leaks across the pipes using pressure waves transmission and their reflection in the network [16].

In this method the pressure at a point of the network is recorded by sending a transient wave and then search for the negative pressure at the same point. With the time stamps of the transient waves at starting time and reflected time the leak of the network is identified. In [17], Fend et al. proposed to use the flow rate and pressures at inlet and outlet, and in turn the difference of the flow rates, to detect water leakage with the help of fuzzy decision approach. However, these methods were limited in terms of performance and scalabilty.

3 Methodology

The methodology part divided into various categories like existing methods, proposed approach and challenges faced on collecting of data sets.

In the traditional approach, the water distribution networks are static, altitude parameter is not considered, On the other hand it was unable to find out the exactly leakage location in the pipe lines. By these approaches, it knows the leakage water leakage details, but unable to prevent these repetitions of water leakages.

In proposed approach, detection of the water leakage exact location by applying deep learning techniques such as artificial neural networks with LSTM ensemble with D-matrices and leakage localization algorithms. In this method, it finds out leakage location particular sample as well as stream data of sensor nodes.

The challenges Faced On Collecting Data Set: As it know that collecting data is a challenging issue. This problem addressed by developing water distribution network used sensor smart meters with the help of IOT concepts. In this experiment, the network has constructed with 100 smart meters and the smart meter itself

generates the attributes like pulse rate, flow rate, quantity, longitude, latitude and altitude parameters generated and stored in acquisition data base based on second billing and working procedure of smart meter are discussed in research paper [7]. The maintained of network and collecting data sets is cost effective and water flow from the smart meter need to be carefully observed. The data collection from the network is explained in the research article [8]. The big data sets are generated by running the application in number of days are discussed in expose [9].

In the Preprocessing stage, the main steps are add schema of data store, describe each and every field in that data set, Remove un relevant and weakly relevant attributes and address over fitting problem.

The attribute Transaction_id is unique key in the data set. Smart meter_id is used to identify the particular meter with location by use of latitude and longitude attributes and the attribute altitude is used to find out the height of that smart meter. The node address is similar to IP address of a machine. Pulse rate, flow rate and Quantity are prime attributes in our research work. The fields date and time are used to know the time series. Remaining attributes common frequency, common band width and common spread factors are used for network related issues. The field other is used to hold any other issues while running the application.

The application tested under smart city project work and collected the data set based on second billing, nearly one Giga byte data set are ready to use.

The frequency of the square wave (Pulse rate) was directly proportional to the fluid velocity [7, 10]. So flow rate is also directly proportional to velocity. Flow rate = (1/k) pulse rate, where k is kinematic viscosity, It is different for different fluids. The volume of liquid which travels from one particular location to other in certain time is called as the quantity of liquid. It varies based on the area of a pipe or a channel that the liquid is moving through velocity of liquid. Removing irrelevant and less relevant fields: The attributes transaction id, smart meter id, common frequency, bandwidth and spread factors are weakly relevant, henceforth these fields are removed in Preprocessing stage.

Training the Model: In this stage the data set trainee by deep learning model. In this training phase the model learn from the smart meter IP address only instead of entire data set, so accurate model not yet generated, hence the this attribute also remove from the data set to build accurate training model. On the other hand failure samples are less than 10% of data set, the over fitting problem also raised. In order to address this issues, when we are collecting the data sets, take care to maintain more than 10 percent of failure sample.

Once the model has trained by the deep learning model, we tested this model on two ways. The first one is by collecting any one smart meter data and supply this data as input and know whether there is leakage in that pipeline or not. The second method is that by considering all the smart meter reading on second billing and test on model, develop a spy line for that output, if there is any variation in that reading. These methods implicitly identify the leakages.

3.1 Leakage Position Estimation

$\Delta t = t_j - t_k$ = cross correlation(S_j, S_k)

$$d_1 = \frac{1}{2}(D + c\,\Delta t) \tag{1}$$

$$d_2 = \frac{1}{2}(D - c\,\Delta t) \tag{2}$$

j and k are nodes, D Pipe length,
C flow rate,
Burst occur time- tB
Sj water Smart meter with index J
Sk water Smart meter with index K
Tj time period at node J
Tk time period at node K

The dataset collected from smart meters are not labeled. So we can't apply classification technique directly. In order to get labeling apply k-means partitioning technique. The input parameters for k-means partition clustering algorithm are number of clusters and acquisition data set. The number of clusters is two, one for non-leakage sample other for leakage samples. Experiment is conducted 45:15 time units to address the problems of over fitting and under fitting (Fig. 1).

3.2 Architecture of Convolution Neural Network

The architecture of the CNN model, consisting of two convolution operations, two operations of pooling that gives rise to 4 categories of feature maps, with the fully connected layer at the end is given in Fig. 2. The last layer is a fully connection layer. This layer takes the inputs for the 4th category of feature maps after flattening all elements in it. Full connection layers are stack continuously with one another in the end and remaining convolutional and pooling layer could be merged together to stack at the head of the framework.

The statistics in Fig. 2 refer to the dimensions of the equivalent layer. Mainly, the input data is with 24 × 24 pixels, the output will be with 128 × 1 vector, and

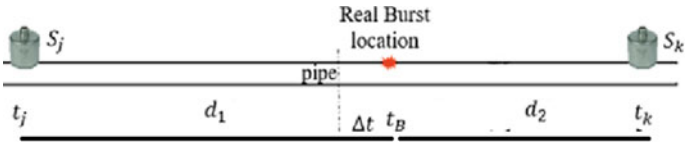

Fig. 1 Leakage localization

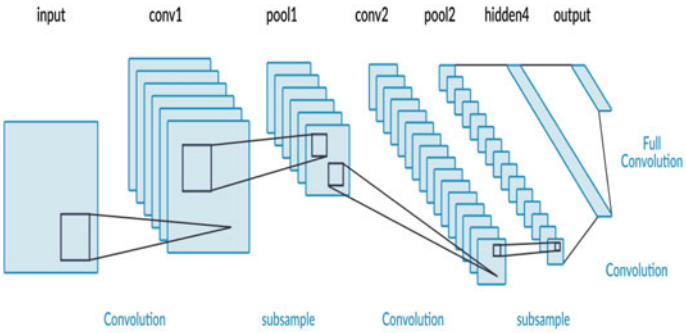

Fig. 2 Architecture of convolution neural networks

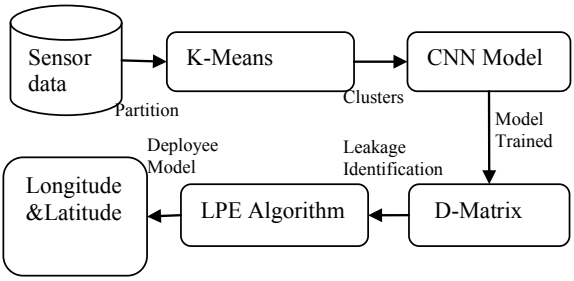

Fig. 3 Block diagram of CNN-LPE model

the other numbers represent the feature map outlines. For instance, 4 at 20 × 20 indicate there were four feature maps, each with the size of 4 × 4.

Adding a bias term the system can get convolution results regarding each filter and after that with the nonlinearity, such as ReLU (Rectifier Linear Unit), preceded when they are warehoused in the feature map. Clearly, the involved parameters in one convolution operation are the filter height and filter width, the number of feature maps, the stride height and stride width, the type of convolution and the connection weight in the filter. The pooling operation except for the element-wised product is similar to the convolution operation and the resulted values of the corresponding feature map. Concisely, a predefined sliding window serviced by a pooling operation. It is the kernel which is used to gather the mean of the highest value of the slider elements. This slide size is also known as stride (Fig. 3).

3.3 Algorithm to Identify Leakage Location Using Smart Meter in WDN

Step 1: Applying partitioning clustering technique on given data set.

Step 2: Two categories are generated. Small cluster identified as leak records, other one is non leak records. Leak records are class labeled by 1 and non-leak records are indicated by 0 as class label.
Step 3: Train CNN (Convolution neural network) on modified data set. (classification technique).
Step 4:CNN model had been trained.
Step 5: Classify new data based on trained model to identify leak location, Then we find precision of the model.
Step 6: The Model will return the leakage record. This record contains smart meteridand other attributes.
Step 7: By using these fields, we can find out location of the smart meter, it indicates that there is a leakage in water pipe line before that smart meter.
Step 8:The leakage size can be predicted, based on D-matrices (information model) using principle of equivalence. D-matrices contains entire graph of WDS in the form of adjacency matrix and all the essential attributes of our data set.
Step 9: To identify the exact location of leakage, then apply leakage location estimation algorithm.

4 Experimental Results

In order to carry the experiments for the proposed framework, a data set from smart water network is considered. This data set contains 98,000 samples consists of various parameters such as longitude, latitude, altitude, flow rate, pulse rate, quantity etc. Here we considered several existing models to compare the performance on the mentioned data set such as Multinomial Naive Bayes (MNB), Support Vector Machine (SVM), Logistic Regression (LR) and Random Forest (RF)[12, 13]. Naive Bayes classifier calculates the probabilities for every factor, and then it selects the outcome with highest probability. This classifier assumes the features are independent. A Support Vector Machine (SVM) is a discriminative classifier that the distance between the supporting vectors and the hyper plane are as far as possible i.e., optimal hyper Plane. The types of SVM are linear kernel, Radial basis function, Polynomial and sigmoid.

Logistic Regression is a technique that had supervised learning to assign a discrete label which is predefined to a continuous variable. Logistic regression converts its output using the logistic sigmoid function to return a probability value. Random forest classifier constructs a set of decision trees from arbitrarily selected subset of training set. It then aggregates the positions from different decision trees to choose the final class of the test object. This works well because of a single DT may be prone to a noise, but aggregate of many DT reduce the effect of noise producing more accurate results.

In order to compare the performance of the proposed technique upon the existing models precision, recall and accuracy measures were calculated. The calculations for the performance measures were done as shown in the Eqs. 3, 4 and 5.

$$precision = \frac{True\ Positives}{(False\ positives\ +\ True\ Positives)} \tag{3}$$

$$recall = \frac{True\ Positives}{(True\ positives\ +\ False\ negatives)} \tag{4}$$

$$accuracy = \frac{(True\ Positives\ +\ True\ Negatives)}{Total} \tag{5}$$

The values of the performance measures of various models are given in Table 1. It is clearly observable that the CNN model outperforms other models on the considered data set.

These are some more significant statistical find outs which the system has recognized. They include:

1) The average water usage of pupil is 18.78 L per day with respective to feature date.
2) The water used percentage decreased from class area (31.43) to mass area (15.98) based on the feature longitude and latitude.
3) Water flow rates changes with respective to feature altitude increases.
4) Water wastage percentage is slowly decreased from first month to third month and then nearly linear flow rate takes place.
5) The people think to save water by seeing their meter reading and they switch off the water taps on unnecessary needs.

Also the comparison of the models is shown in Fig. 4. The models LR and SVM are also performing near to the CNN but the CNN outperformed the other models on the data set. Multinomial naïve Bayes algorithm produces least accuracy. Support vector machine with accuracy 87 percentages, logistic regression with accuracy with 88 percentage, Random forest ensemble method with accuracy 91.5 and the convolutional neural network model produces most accurate results 98.7 with different function. Number of layers used in CNN model are 3 and different mathematical functions are deployed to produce better results.

Table 1 Precision, recall and accuracy values of CNN, SVM, MNB, LR, RF models

Algorithm	Precision	Recall	Accuracy
SVM	82.3	85.6	87.4
MNB	67.8	70.3	72.5
LR	83.5	86.2	88.4
RFEM	86.5	89.4	91.5
CNN	94.4	97.5	98.7

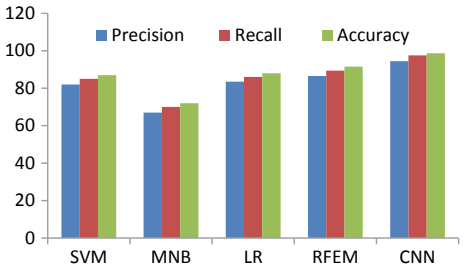

Fig. 4 Comparison of SVM, MNB, LR, RFEM, CNN models

5 Conclusion and Future Enhancement

As mentioned in the introduction, A Mining Framework for Efficient Leak detection and diagnosis in Water Distribution System is used to identify leakage location estimation and also in lot of statistical analysis. The data samples gathered from sensors are clustered into two groups as leak and non-leak sample. The system has trained by various deep leaning techniques and model has generated. It has used to predict to the newly incoming samples are identified as leak or non-leak records and leakage localization algorithms used to estimate leakage location estimation. In the future the altitude parameter need to various differently, more number of sensors will come into existence in real life applications. It will leads to scalability problem, maintains of these many sensors, collection of samples and storage are the big issues.

References

1. Gamboa-Medina MM, Ribeiro Reis LF, Capobianco Guido R (2014) Feature extraction in pressure signals for leak detection in water networks. In: Procedia Engineering, vol 70. Elsevier Ltd., pp 688–697. https://doi.org/10.1016/j.proeng.2014.02.075
2. Mounce SR, Mounce RB, Boxall JB (2011) Novelty detection for time series data analysis in water distribution systems using support vector machines. J Hydroinformatics 1,13(4): 672–686. https://doi.org/10.2166/hydro.2010.144
3. Schuetze T, Santiago-Fandiño V (2013) Quantitative assessment of water use efficiency in urban and domestic buildings. Water 5(3):1172–1193
4. Tornero V, Georg H (2016) Chemical contaminants entering the marine environment from sea-based sources: a review with a focus on European seas. Mar Pollut Bull 112(1–2):17–38
5. Allen M, Preis A et al (2013) Water distribution system monitoring and decision support using a wireless sensor network. In: 14th ACIS International Conference on Software Engineering, Artificial Intelligence, Networking and Parallel/Distributed Computing. IEEE, USA, July 2013
6. Cardell-Oliver R, Scott V, Chapman T (2015) Designing sensor networks for leak detection in water pipeline systems. In: IEEE Tenth International Conference on Intelligent Sensors, Sensor Networks and Information Processing, IEEE
7. Gurung TR, Stewart RA, Sharma AK, Beal CD (2014) Smart meters for enhanced water supply network modeling and infrastructure planning

8. Convey HJ, Booth MJ (2002) Development of a water leak detection system. Comput Control Eng J 13(1):33–38
9. Chalam RVRK, Teja JR (2010) ITRA Research. Self Powered Smart Water Meter for Water Quantity Metering of Water Supply Distribution Networks, at media lab asia, May 2010
10. Thewodros GK (2014) The potential future innovative application of municipal water supply database. Int J Sci Eng Res 2:9
11. Moczulski W (2016) The case study - a methodology of leakage detection and location in water distribution networks. In: 3rd Conference on Control and Fault-Tolerant Systems. IEEE
12. Kadri A (2012) Characterization of an acoustic wireless sensor for water leakage detection in underground pipes. Elsevier
13. Bansal A, Rompikuntla SK, Gopinadhan J, Kaur A, Kazi ZA (2015) Energy consumption forecasting for smart meters. ArXiv abs/1512.05979, Cornell university. Elsevier
14. Belsito S, Lombardi P, Andreussi P, Banerjee S (1998) Leak detection in liquefied gas pipelines by artificial neural networks. AIChE J 44(12):2675–2688
15. Mpesha W, Gassman SL, Chaudhry MP (2011) Leak detection in pipes by frequency response method. J Hydraul Eng 127:134–147
16. Misiunas D (2005) Failure monitoring and asset condition assessment in water supply system. PhD thesis, Department of Electrical Engineering and Automation, Lund University, Sweden
17. Feng J, Zhang H, Liu D (2004) Application of fuzzy decision-making in pipeline leak localization. IEEE, Budapest, Hungary, pp 25–29
18. Glorot X, Bordes A, Bengio Y (2011) Deep sparse rectifier neural networks. In: Proceedings of the Fourteenth International Conference on Artificial Intelligence and Statistics, pp 315–323

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Wireless Powered Uplink of NOMA Using Poisson Cluster Process with Two Orthogonal Signal Sets

Ashok Kumar Kona, R. Anil Kumar, and Sanjeev Kumar

Abstract NOMA is the mobile technology that embraces and satisfies all the needs of the upcoming mobile communication generation. In this regard, we are analyzing the behavior of NOMA in wireless communication with two orthogonal waveforms. In this paper, we overviewed the previous generations of mobile communication technology and their features. We discuss the need, basic principle involved in NOMA and the features of NOMA. We focus on the drawbacks and research challenges in NOMA by discussing various methods to approach NOMA by comparing different processes. We discussed on some parameters that NOMA should achieve and have already achieved to produce high efficiency.

Keywords Mobile communication · NOMA · Relays · Interference

1 Introduction

Day by day technology has been evolving rapidly and the need for faster and efficient communication technology is required. In such a process of invention of several mobile communication technology 5G is the required and upcoming technology for future generations to facilitate technologies like Internet of things (IoT), high-resolution graphics and signal processing [1, 2, 23]. From past years mobile communication technologies are based on different multiplexing techniques like CDMA, FDMA and more. For 5G communication, these technologies cannot bring

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_102

efficient output unlike CDMA, FDMA, and OFDMA, NOMA can transmit and receives information by any kind of multiplexing (time, frequency, and code spreading) [2]. To improve the efficiency of 5G communication NOMA technology is under research which can overcome the limitations of previous mobile communication technology that was invented in the year 2002. NOMA is being preferred as the required technology for 5G as the abilities of NOMA like having the flexibility of change in transmission rate depending on a number of users and noise rate, high reliable data transmission, reduced latency. Another advantage of NOMA is all users are operated in the same band and at the same time by varying their power levels individually.

Although NOMA is overcoming the limitations of previous mobile communication technologies it is having some drawbacks, drawbacks like unbalanced power between user interfaces, interference of signals (in Orthogonal frequency division multiplexing and multi carrier-code division multiple access) and less limited lifetime of communication equipment. These drawbacks can be slightly reduced by NOMA with orthogonal signals of two sets. Based on the applications and research on NOMA is divided into POWER domain NOMA and CODE domain NOMA [4].

In NOMA Power domain employs superposition code (SC) strategy and successive interference cancellation (SIC) at transmitter and receiver respectively to access many users with successive data transmission and detection (with a drawback of interference of signals) [3]. In the code domain, NOMA number of user signals will be multiplexed by their specific spreading sequences.

2 Literature Review

To increase the efficiency of the NOMA spectrum, superposition coding is processed in the coordinated system to transmit downlink signals simultaneously to users near to base station and far from the base station. Almost code is employed with the CSC system results in improved spectral efficiency reasonable transmission to cell edge user without neglecting the rate of transmission to the user near the base station [5]. Better outrage performance is achieved by NOMA than other orthogonal multiple access techniques by specifically chosen user rates and power coefficients. NOMA performance and power gain are insignificant at a low SNR ratio [6]. The performance of NOMA is dependent on the efficient multiplexing of signals based on the divided power spectrum. NOMA produces improved fairness under CSI and average CI. Many algorithms are derived for NOMA downlink, which is a low complex that provides an approximate order of magnitude better than TDMA [7]. Multiple user signals are superimposed on a single transmitted signal by using the power domain in NOMA which in turn creates interference at the receiver. Walsh-Hadamard transform is implemented to reduce interference which is more efficient than successive interference cancellation [12]. Multiple code packets are transmitted based on NOMA using random linear network coding (RLNC) with an improved success probability of packets. With the help of SIC (successive

interference cancellation) and gauss Jordan elimination coded packets can be received by the receivers with a delay based on the technique used (NOMA or OMA) [8]. When the relay is close to the mobile user the outage performance of NOMA is less when compared to the outage performance of conventional OMA [9]. The conventional CRS achieves less spectral efficiency than CRS using NOMA when Signal to Noise Ratio and average power of channel are less in S-to-D and R-to-D links compared to S-to-R links [10]. Spectral efficiency is improved by using NOMA in CDRT. CDRT with Non-orthogonal multiple access facilitates 5G networks when macro cells having a group of micro-cells to achieve high efficiency of the spectrum and during the transmission, between macro and micro cells more capacitive gain will be achieved [11, 12]. Rayleigh fading with closed-form resulting to find accurate average spectral efficiency of NOMA at variant factors including SNRs and user power allocation [13]. Nagakami fading also establishes the exact average spectral efficiency of NOMA at various users' individual power and various conditions of channel and can further deal with OMA and OFDMA [14–17]. Further investigations in NOMA lead to deal with SC-NOMA and MC-NOMA.

3 Methodology

3.1 Basic Principle of NOMA

As the previous generations of mobile communication are failed to transmit signals if the user powers are unbalanced.by using NOMA we can overcome this drawback. The main principle of NOMA is transmitting information between the users even though users are at a long distance from the base station and having unbalanced powers. For better understanding let consider Fig. 1.

In the above fig User 1 having high signal power and user 2 having low signal power. Due to the low power of user 2, it will be difficult to detect signal 2 by the

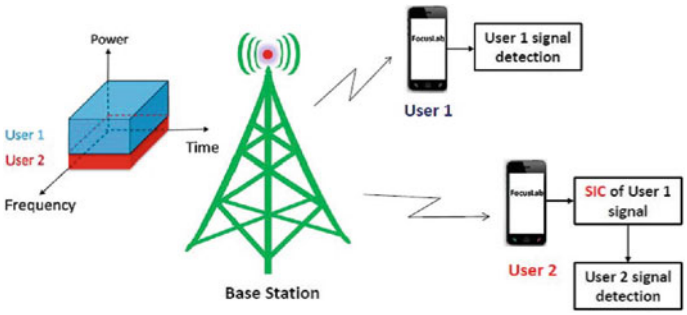

Fig. 1 Generalized model of wireless communication systems

base station. Hence in order to overcome this problem cognitive radio NOMA principle is developed which will incorporate the quality of service of both.

3.2 Categories in NOMA

See Fig. 2.

3.3 Features of NOMA

Improved Spectral Efficiency: Unlike the remaining multiple access techniques, NOMA has high spectral efficiency as it does not depend on the condition of the balanced powers of a signal. It transfers information even though the user signals are having unbalanced powers and far from the base station.

Massive Connectivity: NOMA provides massive connectivity than other multiple accesses without restricting and limiting the number of users. Other multiple access techniques transmit different signals at different time slots. In NOMA all the signals are transmitted in the same time slot by using orthogonal source allocation. This results in improved spectral efficiency and efficient utilization of time and bandwidth.

Reduced Transmission Latency: In NOMA amount of latency is than the other multiple access techniques. In the previous multiple access techniques, uplink signals from the user must send a request to the base station and the base station has to downlink the respective signal based on the received request.

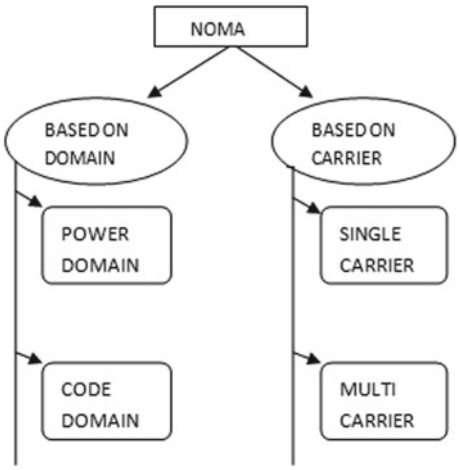

Fig. 2 Classification of NOMA

3.4 NOMA with Two Orthogonal Waveforms

Frequency NOMA is the technique to access multiple users using two sets of orthogonal signal waveforms. OFDMA and MC-CDMA are combined used in NOMA. In this technique, the OFDMA system has an X number of carriers. The total bandwidth is 1/T Hz, where T is a symbol period of OFDM, and carrier spacing is 1/XT Hz. The maximum number of the carriers will be X where each carrier is assigned to each user. by using X Walsh-Hadamard spreading sequences the length of MC-CDMA has to set M in order to accommodate additional users where every spreading sequence is assigned to a different user. Now in multiple access technique K = X + M there will be no internal interference in OFDMA and MC-CDMA but the set of OFDMA carriers will interfere by MC-CDMA carriers and vice versa. To avoid the interference SIC receiver is used. SIC alone cannot provide interference-free transmission. Hence we use an iterative receiver.

3.5 Uplink of NOMA in Wireless Communication Using Poisson Cluster Process

As shown in the above figure different users are having individual powers at different distances from the base stations. This figure representing the uplink process of NOMA in wireless communication. In the cluster of the uplink of NOMA each user transmits individual signal xi with an individual power pi and defined as $y^{\wedge} = \sum_{i=1}^{c} \sqrt{pihix^{\wedge}i}$ at the base station. To decode signals by applying at SIC we

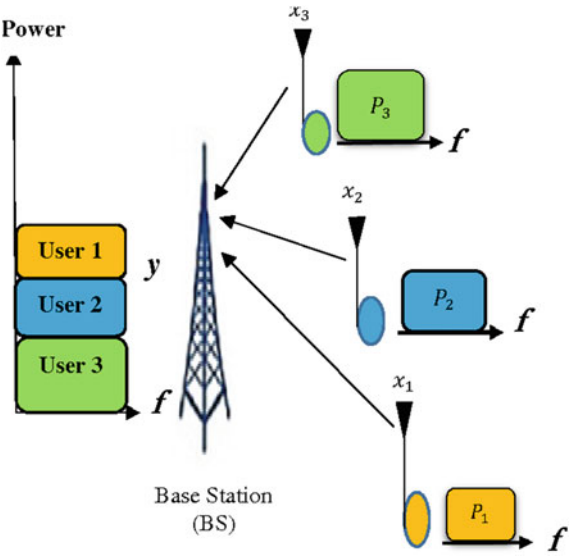

Fig. 3 Frequency division

have to strictly maintain the distinctness among signals which are superposed within. Therefore different users experience different and distinct channel gains (Fig. 3).

4 Result

Table 1 shows an analysis of different characteristics of technologies used in 5G communication. SCMA with MPA algorithm is complex to implement but it is having a high signal to noise ratio when compared to the other approaches. RSMA is not efficient in any of the characteristics that we have discussed. Spectral efficiency is high in both NOMA and SCMA. The appreciable rate of outrage probability is employed by IGMA, WSMA, MUSA. By considering all the characteristics into consideration, NOMA is the technological approach for the next generation of communication (5G) with greater compatibility implemented many experiments. Power domain NOMA gives efficient results and low complex than code domain NOMA as per the experiments. Uplink and downlink of signals can be done by using different algorithms. Outage probability, spectrum efficiency, user fairness, low latency are achieved better through NOMA are analyzed by comparing with other methods. Transmission of signals in NOMA is flexible and efficient in different ways as it transmits information simultaneously of different users without establishing a scheduled time for each user individually. The detection of NOMA is more complex due to the simultaneous arrival of information at the receiver that needs to be decoded entirely to reach the respective destination. Although several algorithms like Nagakami, Almouti code which is not satisfying all the required ranges of each characteristic that a communication technology should have. Regardless of its advantages, NOMA has to improve several features to secure reliability and efficiency. These challenges regarding multiple characteristics leading further researches to achieve and employ NOMA successfully with high efficiency.

Table 1 Comparative analysis of the published paper

Ref.	Technology used	Algorithm used at receiver	Complexity	Signal to noise ratio	Spectral efficiency	Outrage probability
[19, 20]	SCMA	MPA	High	0.97 dB	High	Less
[19, 21]	RSMA	ESE	Medium	0.85 dB	Moderate	Less
[19, 22]	PDMA	MPA	Medium	0.84 dB	Moderate	Moderate
[19]	IGMA	ESE	Low	0.68 dB	Low	High
[19]	WSMA	MMSE-SIC	Low	0.66 dB	Low	High
[19]	MUSA	MMSE-SIC	Low	0.65 dB	Low	High
[18, 19]	NOMA	POISSONS	Low		High	Moderate

5 Conclusion

This paper discusses the need and evolution of 5G communication, the technology used for 5G and researches, experiments implemented on NOMA technology. It is clear that NOMA facilitates the upcoming mobile technology than the other multiple access techniques. In order to achieve all the requirements, much research was implemented and being implemented many experiments. Power domain NOMA gives efficient results and low complex than code domain NOMA as per the experiments. Uplink and downlink of signals can be done by using different algorithms. Outage probability, spectrum efficiency, user fairness, low latency are achieved better through NOMA are analyzed by comparing with other methods. Transmission of signals in NOMA is flexible and efficient in different ways as it transmits information simultaneously of different users without establishing a scheduled time for each user individually. The detection of NOMA is more complex due to the simultaneous arrival of information at the receiver that needs to be decoded entirely to reach the respective destination. Although several algorithms like Nagakami, Almouti code which is not satisfying all the required ranges of each characteristic that a communication technology should have. Regardless of its advantages, NOMA has to improve several features to secure reliability and efficiency. These challenges regarding multiple characteristics leading further researches to achieve and employ NOMA successfully with high efficiency.

References

1. Islam SMR, Avazov N, Dobre OA, Kwak KS (2017) Power-domain non-orthogonal multiple access (NOMA) in 5G systems: potentials and challenges. IEEE Commun Surv Tutorials 19 (2):721–742
2. Ding Z et al (2017) Survey on non-orthogonal multiple access for 5G networks: research challenges and future trends. IEEE J Sel Areas Commun 35(10):2181–2195
3. Maatouk A et al (2018) Frequency-domain NOMA with two sets of orthogonal signal waveforms. IEEE Commun Lett 22(5):906–909
4. Choi J (2014) Non-orthogonal multiple access in downlink coordinated two-point systems. IEEE Commun Lett 18(2):313–316
5. Ding Z et al (2014) On the performance of non-orthogonal multiple access in 5G systems with randomly deployed users. IEEE Signal Process Lett 21(12):1501–1505
6. Park S, Cho DH (2015) Random linear network coding based on non-orthogonal multiple access in wireless networks. IEEE Commun Lett 19(7):1273–1276
7. Kim B, Lee IH (2015) Capacity analysis of cooperative relaying systems using non-orthogonal multiple access. IEEE Commun Lett 19(11):1949–1952
8. Tabassum H, Ali MS, Hossain E, Hossain MJ, Kim DI (2016) Non-orthogonal multiple access (NOMA) in cellular uplink and downlink: challenges and enabling techniques. https://arxiv.org/abs/1608.05783, pp 1–8
9. Tabassum H et al (2017) Modeling and analysis of uplink non-orthogonal multiple access in large-scale cellular networks using poisson cluster processes. IEEE Trans Commun 65 (8):3555–3570

10. Diamantoulakis PD et al (2016) Wireless-powered communications with non-orthogonal multiple access. IEEE Trans Wireless Commun 15(12):8422–8436
11. Zhang N, Wang J, Kang G, Liu Y (2016) Uplink nonorthogonal multiple access in 5G systems. IEEE Commun Lett 20(3):458–461
12. Choi J (2016) On the power allocation for a practical multiuser superposition scheme in NOMA systems. IEEE Commun Lett 20(3):438–441
13. Hanif MF, Ding Z, Ratnarajah T, Karagiannidis GK (2016) A minorization-maximization method for optimizing sum rate in the downlink of non-orthogonal multiple access systems. IEEE Trans Signal Process 64(1):76–88
14. Marshoud H et al (2016) Non-orthogonal multiple access for visible light communications. IEEE Photonics Technol Lett 28(1):51–54
15. Kim JB, Lee IH (2015) Non-orthogonal multiple access in coordinated direct and relay transmission. IEEE Commun Lett 19(11):2037–2040
16. Men J, Ge J (2015) Non-orthogonal multiple access for multiple-antenna relaying networks. IEEE Commun Lett 19(10):1686–1689
17. Ding Z, Peng M, Poor HV (2015) Cooperative non-orthogonal multiple access in 5G systems. IEEE Commun Lett 19(8):1462–1465
18. Timotheou S, Krikidis I (2015) Fairness for non-orthogonal multiple access in 5G systems. IEEE Signal Process Lett 22(10):1647–1651
19. Wu Z, Lu K, Jiang C, Shao X (2018) Comprehensive Study and Comparison on 5G NOMA Schemes, Received 26 January 2018, accepted 8 March 2018, date of publication 19 March 2018, date of current version 23 April 2018
20. Wu Y, Wang C, Chen Y, Bayesteh A (2018) Sparse code multiple access for 5G radio transmission. In: 2017 IEEE 86th Vehicular Technology Conference (VTC-Fall), 12 February 2018
21. Rahmati A, Yapici Y, Rupasinghe N, Guvenc I, Dai H, Bhuyan A (2019) Energy efficiency of RSMA and NOMA in cellular-connected mmWave UAV networks. In: 2019 IEEE International Conference on Communications Workshops (ICC Workshops), 11 July 2019
22. Zeng J, Li B, Su X, Rong L, Xing R (2015) Pattern division multiple access (PDMA) for cellular future radio access. In: International Conference on Wireless Communications & Signal Processing (WCSP), China
23. Kumar S, Kumar R, Vishwakarma RK, Srivastava K (2018) An improved compact MIMO antenna for wireless applications with band notched characteristics. Int J Electron Commun (AEÜ) 90:20–29

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Documentation on Smart Home Monitoring Using Internet of Things

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Abstract Internet of things is eventually a connection of many things and appending them into a real-world environment by interconnecting them. These days, we get to come across a frequent subjective regarding home automation system which has bagged enormous popularity in the last few decades using the internet of things (IoT). In this tremendous growth of technology, IOT marks its own identity by making life easier in this busiest world. It mainly focuses on the safe and secure quality of life. In this era, the internet of things (IoT) plays a crucial role by handling a plethora of connections with billions and trillions of things with devices and also with people. We people starting from the day to the end of the day we need to manage many things around us and sometimes there is no time for us to take better care towards home automation. IOT specifically interrelates a set of things in a single base and controls them over. It not only controls and takes care of the devices but also keeps informing the users. Homes are very reliable places where people crave for more security and care in the current world. So, IOT deserves its place by giving a satisfactory outcome in better home automation. In this paper we are going to see how I build a huge network of connection and how it controls and handles plenty of home appliances using different types of communication, and the better and cheaper types of connections for a safe home and how

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_103

user can control his home effectively by staying far away by sending a single text and also it will get to know what are the pros and cons and different types of applications providing by IoT.

Keywords IoT · Home automation · Architecture · IoT challenges

1 Introduction

In this digitized world, people got hooked up with smart devices and want their work to be automated. Since 2012, IoT has also emerged as a technology that attained popularity by making smart things too smarter. Earlier, in our homes, we have manually operated smart things like TV, refrigerator, washing machines, AC's, coolers, etc. These smart things have evolved in the 1990s and now these have the most frequent usage in almost every home [1, 2]. After all, people are seeking better and secure living and most preferably for self-automated home monitoring which reduces their work and they can relax for a while by escaping from doing home chores. This IoT is the most suitable technology in home automation. It is mostly useful for the elderly and disabled ones. In recent years, the extent of IoT is seen everywhere and the home automation system has been developed enormously through IOT [3–5]. It is majorly an interconnection of various things into a single base and handling over all of them simultaneously [3]. Even the connecting items are of different strategies, they may mobile or may not, and they may sustain or may not, with different categories and various constraints IOT can organize in every possible corner [12]. In this era of developing technology, the application of IoT is found as a boon for users and majorly in home automation for the residents. It is an intelligent network which brings forth different types of communication between human to human and human to machine and machine to machine [8–10]. The home mechanization system can be planned and executed within a particular organizer which monitors different interconnected home appliances like bulbs, thermostats, home security systems, temperature and detective sensors, etc. [14]. In this paper, we are going to discuss about the smart home monitoring system which is wireless communication using the Internet of things (IoT).

2 Literature Review

The internet has been evolved a few decades ago by connecting massive gadgets in a unique base by giving enormous information [1]. The initiation of the internet became the most privileged development all over the world. There were many changes and developments have been noticed in the technological world after the evolution of the internet [6]. When we see from the past few years, people got acquainted with technology and desires for the technical world. In that case, smart

home automation is one of the most craving technologies. By the Internet of things (IoT), we can deal with home monitoring where we can connect numerous things in a single infrastructure [1]. In-home automation, the things are equipped in such a way that they are remotely accessed and we can handle them whenever and wherever we are. Also, for homes, we need special security systems to keep our property and things safe from burglars and intruders [9]. IoT transforms intelligence into the interconnected objects and there the information will subject to every interrelated thing [7]. Here, the communication and exchanging the information between objects will be done. We can see a lot of information will be shared by them and there will be amazing results and services finally. Internet of things (IoT) is the crucial factor in the fruitful success of home security and monitoring.

In a single system, there are many complex layers, extremely numerous varieties of devices, communication, exploration, information transferring, frequent decisions and final results are involved. The applications of IoT are majorly seen in the added-value services and which supports the most forwarded communication technologies [13]. If we see, there are many technologies available readily in the market. These available technologies completely based on the internet or Bluetooth. Sometimes, when we are far from home, we cannot be able to access or remotely control our homes even it is technically equipped because of some communication channel issues and Bluetooth communication is not available when we are far from home. So IoT is ready to sort out all such issues and it also authorizes the communication between any channel without any consequences [9]. In this paper, we can also have a glance over different wireless communication technologies like Zigbee, one of the most prevailing wireless communication channel with which we can remotely access the home appliances when we are outside.

3 Methodology

Internet of things (IoT), the basic system has divided into five layers. Let us see the brief description of these layers in detail

- **Perception layer:**

This layer is most frequently called a Device layer, and it is having sensors and physical things. The sensors are RFID (radio frequency identification), 2D-Barcode devices or some Infrared sensors [14]. It passes the information whether it is about temperature, location, atmospheric changes, humidity whatever it may be, it will collect the information and it passes on to the successive layer called network layer [14].

- **Network layer:**

The network layer is a system information processing layer. This network layer passes the information from the above layer to the information analyzing layer. So that it is also called a Transmission layer. It may be either a wired or a wireless one.

It will be 3G, Wi-Fi, Bluetooth, Zigbee, etc. [14, 15]. This network layer is here to transmit the acquired information from the perception layer and then to the sequential middleware layer.

- **Middleware layer or software layer:**

Here, this intermediate middleware layer actually gathers information from the network layer and it performs the processing of information after the information has been linked to the data base [14]. It receives the gathered info in the network layer and keeps it in the database. It is able to take automatic decisions and performs the task. This is specifically meant to be a service layer [16].

- **Application layer:**

The information from the above layer is processed in the middleware layer and that is sent to the application layer. Here, the database is enrooted to perform the tasks on a particular region like in home automation, agriculture, farming, smart city development, transportation, waste management, pollution monitoring, etc. [15]. This layer is in charge of the management of services.

- **Business layer:**

This layer is the most crucial layer in the overall application of this IoT network. The design and management of the Internet of things (IoT), is completely supervised by this layer [14]. Based on the information provided by the above layers, it exhibits the related flowcharts and graphs and everything. The success of IoT business strategies is completely depended upon the business layer [16]. These is the basic network layers in the functioning of the Internet of things (IoT) (Fig. 1).

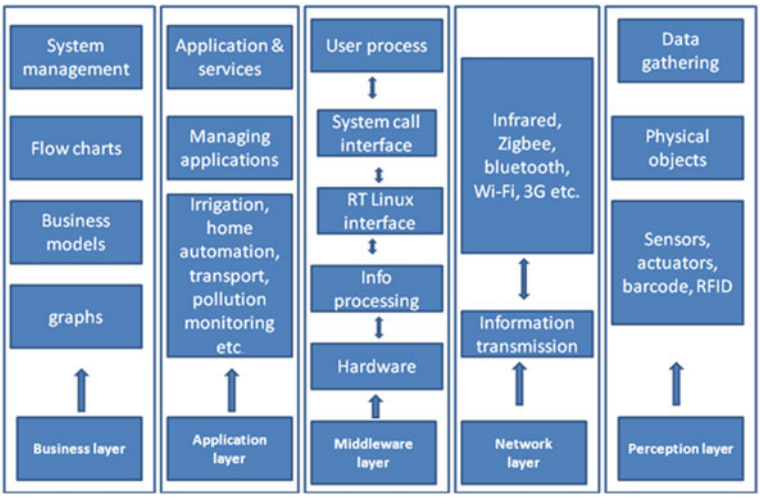

Fig. 1 Architectural layers of IoT

This IoT communication technology deals majorly with home monitoring systems which are mainly useful in these following areas:

Smart Home Management

Smart home management or monitoring is nothing but getting things done with a secured and simple user interface. It helps in accessing things remotely whenever and wherever we are.

It is helping the elderly and disabled as it is usually accessed by the senses and. It can be operated by two modes by voice command mode or by touch mode [17]. It is opened by a smartphone as it acts as an interface between the user and the device (Fig. 2).

Fire Security System

Sometimes, unfortunately, fire accidents will happen and at the same time, we are not able to put off the fire. Because of this problem, the burglar security system helps in the case of accidental calamities. There is an Arduino board connected with the sensor. When there is flame then the sensor detects whether there is fire or not and then it sends information. As the logic level is 1 then there is fire, if logic is 0, then there is no fire [18, 19]. Depending on the logic levels, it gathers the information and proceeds for the successive task (Fig. 3).

Burglar Security System

When we are outside of the home, there is a chance of burglary sometimes. To be secured in case of burglary, a burglar security system using IoT is worth helping. This system is also called a laser beam system. It has a point light source if a burglar tries to enter the house, a bell will ring as a danger signal so that to inform the host [20, 21] (Fig. 4).

Fig. 2 Home automation system

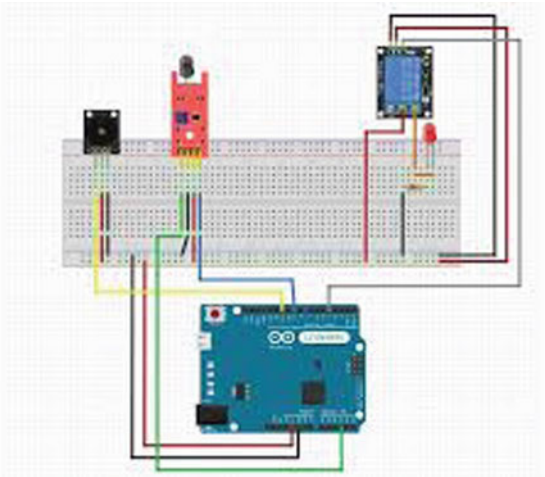

Fig. 3 Fire security system

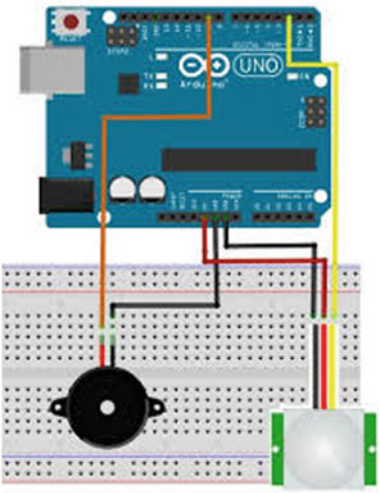

Fig. 4 Burglar security system

4 Applications

Smart Home Automation: The smart home supervising using the Internet of things (IoT), having sensors and actuators which provides comfort to the human lives. We can preferably control the room temperatures according to the weather. We can switch on/off the lights, fans, and any electronic gadgets automatically. People can access home automation remotely when we are far from home. As safety is the first and foremost need of any user, it provides security from intruders by providing alarm systems. It is cheap and available for home automation so that everyone can access it [21, 24].

Medical Technology and Health Care: IoT is having many crucial factors in the medical sector, as with the help of sensors like RFID, Zigbee, Bluetooth, etc. It is easily helpful in communication for the individual living. These sensors also allow monitoring methods for patients by measuring blood pressure, cholesterol levels, body temperature, etc. [23]. Implantable wireless devices are into storing the health issues of a patient and measuring the key factors like their increasing and decreasing levels from time to time. This is used to save a patient life by detecting their body condition with the sensor in case of an emergency when he/she got accidentally affected with ill, heart strokes, diabetes, and other disorders. In this way, IoT helps save people from accidental attacks in medical technology also.

Agriculture and Farming: No matter how many technologies arrive, there is always a possibility of being fraud sometimes. The identification of fraud is also one of the big challenges. With the better usage of identification systems [22], make the product in many ways. So usage of IoT in agriculture for identification purposes helps farmers a lot.

5 Results and Discussions

Table 1, shows that how the IoT sweeps over the vast technology under its control and provides its services to the users effectively in mass quantity. The above mentioned sensors and equipment are the mostly used areas in home automation using IoT, where the radio frequency recognition takes over the intelligent processing and center communication network handles in various fields of use of IoT [11]. Light sensors are extremely used for detecting the light rays and in turn they protect the data in them [22]. PIR sensing is also an important sensor which deliberately involved in capturing wide range of objects in any position [25]. The smart monitoring involves lacking of specific standardization, thus in turn results in a major drawback. Visualization and efficient data monitoring results in overcoming the drawbacks of some home monitoring techniques.

6 Applications

Due to the vast use of the internet, one is always seeking for the scope of more implementation in technology. As we see the applications of IoT in many areas, we are still expecting many. These may occupy various areas of emerging technologies but we can say in the future, it connects with all communication, sensing, and many other processes. It is somewhat difficult and complex.

Table 1 Comparative analysis of published paper

Sensors	Category	Description	Applications
RFID & NFC [15]	Identification	This system represents a similar or identity of another IoT system, relates with the corresponding things. The frequently used are RFID & NFC tags and their readers	Smart home management, burglary system
Temperature [19]	Ambient	It gathers data from the surroundings, environment and the space	Fire alarm systems, smart city management systems
Humidity [11]	Ambient	It relates the data of humidity in the sensor	Smart agricultural systems, soil verification, farming
Light sensor [11, 22]	Ambient	Light sensor detects the light rays and stores the data in the sensor	Home automation, Smart traffic system in urban areas
Gyroscope [23]	Motion	It identifies the motion of things and people	Disaster management, information sensing, captures motion
GPS [15]	Position	It is particularly for the identification of a person or thing in global scale or local scale	Location identifier, smart vehicle sensing and tracking management
PIR sensing [25]	Presence	This PIR sensor is relevant to capture anything in a prescribed position or however it will be	Smart home automation, location and smart position sensing techniques
Current &Energy consumption [25]	Electric	In this, sensor holds only the things which are applied to electricity	Smart electrical home automation system

7 Conclusion

The use of the internet has been tremendously increased the life cycle of a person has been changed from live conversations to social media conversations. This has made a good platform for the surveillance of emerging technologies in the market. As we can say IoT is also one of the prevailing and remarkable technologies which gained its identity in the home automation. It sorts the distraction of communication and let the information pass among objects anytime and anywhere, whether they are movable or immovable with the help of wired or wireless communication. Here we show the applications and key challenges where the Internet of things (IoT) came out ahead.

References

1. Ransing RS, Rajput M (2015) Smart home for elderly care, based on wireless sensor network. In: International conference on nascent technologies in the engineering field (ICNTE), Navi, Mumbai, pp 1–5
2. Jamil MMA, Ahmad MS (2015) A pilot study: development of home automation system via Raspberry Pi. In: 2nd international conference on biomedical engineering (ICoBE), Penang, pp 1–4
3. Mekki T, Jabri I, Rachedi A, ben Jemaa M (2016) Vehicular cloud networks: challenges, architectures, and future directions. Veh Commut 9:268–280
4. Stankovic JA (2014) Research directions for the Internet of Things. IEEE IoT J 1(1):3–9
5. Kushiro N et al (2007) Practical solution for constructing ubiquitous network in building and home control system. IEEE Trans Consum Electron 53(4):1387–1392
6. Hong S et al (2010) SNAIL: an IP-based wireless sensor network approach to the Internet of Things. IEEE Wirel Commun 17(6):34–42
7. Bui N, Castellani AP, Casari P, Zorzi M (2012) The internet of energy: a web-enabled smart grid system. IEEE Netw 26(4):39–45
8. Surie D, Laguionie O, Pederson T (2008) Wireless sensor networking of everyday objects in a smart home environment. In: International conference on intelligent sensors, sensor networks and information processing, Sydney, Australia, pp 189–194
9. Sundmaeker H, Guillemin P, Friess P, Woelffle S (2010) Vision and challenges for realizing the Internet of Things. European Union, Luxembourg, ISBN 9789279150883
10. Dorigo M, Stutzle T (2004) Ant colony optimization. A Bradford Book MIT Press, Cambridge
11. Rawat S, Gupta P, Kumar P (2014) Digital life assistant using automated speech recognition. In: International conference on innovative applications of computational intelligence on power, energy and controls with their impact on humanity (CIPECH 2014), India
12. Dey S, Chakraborty A, Naskar S, Misra P (2012) Smart city surveillance: leveraging benefits of cloud data stores. In: IEEE 37th Conference on Local Computer Network Workshops (LCN Workshops), Clearwater, FL, USA, pp 868–876
13. Eisenhauer M, Rosengren P, Antolin P (2009) A development platform for integrating wireless devices and sensors into ambient intelligence systems. In: IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks Workshops, June 2009, pp 1–3
14. Zheng J, Simplot-Ryl D, Bisdikian C, Mouftah H (2011) The Internet of Things. IEEE Commun Mag 49(11):30–31
15. Huang Y, Li G (2010) Descriptive models for Internet of Things. In: IEEE international conference on intelligent control and information processing (ICICIP), China
16. Fan T, Chen Y (2010) A scheme of data management in the Internet of Things. In: 2nd IEEE international conference on network infrastructure and digital content, China
17. Humphries LS, Rasmussen G, Voita DL, Pritchett JD (1997) Home automation system. U.S. Patent 5,621,662, issued 15 April 1997
18. Matoba K (1986) Fire alarm system. U.S. Patent 4,594,581, issued 10 June 1986
19. Bin MdS et al (2013) Development of fire alarm system using Raspberry Pi and Arduino Uno. In: International conference on electrical, electronics and system engineering (ICEESE), Malaysia
20. Krueger A (1952) Burglar alarm system. U.S. Patent 2,615,083, issued 21 October 1952
21. Richard S (1970) Burglar alarm system. U.S. Patent 3,531,793, issued 29 September 1970
22. Sushanth G, Sujatha S (2018) IOT based smart agriculture system. In: International conference on wireless communications, signal processing and networking (WiSPNET), India

23. Baker SB et al (2017) Internet of Things for smart healthcare: technologies, challenges, and opportunities. IEEE Access 5:26521–26544
24. Fewtrell P (1998) A review of high-cost chemical/petrochemical accidents since flixborough. In: 1974 Loss Prevention Bulletin, April, Nr. 140. http://www.hse.gov.uk/comah/lossprev.pdf
25. Morais CM, Sadok D, Kelner J (2019) An IoT sensor and scenario survey for data researchers. J Braz. Comput. Soc. 25(4):1–17

Implementation of Cloud Based Traffic Control and Vehicle Accident Prevention System

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Abstract Road accidents are the most undesirable thing to happen to a road client, however, they happen regularly. Road accidents cost many nations 3% of their GDP. The greater part of all street traffic passing is among unprotected road costumers. This problem can be reduced by traffic sensors on streets interfacing with drivers through a 4G scheme. Not all roads are fitted with such sensors. We speak about various methods in this article. We examine in particular an open GTS and MongoDB IoT Cloud Framework for traffic surveillance and alert notification. In addition, we use H2O and WEKA mining tools as another operation. We can predict the age, gender and mishap of drivers. VCC traffic management system is another scheme. It scrutinizes VCC's role in the management of highway traffic.

Keywords MongoDB · Open GTS · H2O · WEKA · VCC

1 Introduction

In the Internet of Things or IoT, interrelated processing gadgets, mechanical and computerized machines, items and people have specific identifiers and can move information through a scheme without expecting interaction between human beings [1]. In particular, we will use the traffic collection and vehicle accident anticipation

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_104

IoT cloud structure in this document. The IoT can assist to reconcile correspondence, control and information management through various transport frameworks across the board. The use of the IoT extends to any part of the transport. The dynamic collaboration between the vehicle framework components provides buries and vehicle correspondence, smart traffic control, shrewd leaving, frameworks for electronic toll recovery, board and armada arrangements, vehicle control, wellbeing and road assistance. For example, when the board is exempted from the situation and the state of the storage and the resources can be constantly screened and armada by remote sensors and the executives can send explicit cautions once the board is exemption happens (slowdown, damages, robberies…). The IoT and its continuous accessibility among gadgets must be conceivable. Sensors such as GPS, humidity, and temperature send information to IoT and then the information is examined and forwarded to customers. In this respect, customers can follow the vehicle's ongoing status and make suitable choices. The vehicle-to-all communication (V2X) framework consists of three main sections: vehicle-to-vehicle (V2V), vehicle to infrastructure (V2I) and pedestrian communication (V2P). V2X is the start of self-regulation and related roads framework. Vehicles that allow riders to enhance their driving skills are combined with Sensor innovation. This provides a system of roadside units with alarm and precautionary measures. Such information is especially important to drivers in remote areas wherever traffic sensors cannot be equipped on roads [2, 3, 5, 6].

One of the main factors for crashes in cars is the unexpected delay in traffic, particularly when you look over roads and roads, defined by a rare perception. It tends to be caused by various incidents, progressive roads, traffic pinnacles, etc. The drivers' lack of perceptibility results from entirely different factors, combined with narrow angles, nebulae, unusual light burrows, etc. Google maps for example, which collect traffic information from road-based detectors and send re-sent messages to client mobile applications via the 4G scheme, can normally moderate this problem, but not all of the roads have traffic sensors of this kind. In this distinctive circumstance, the excellent progress made by innovations makes the ITS administrations even more exciting [4].

2 Literature Review

The abrupt traffic slowdown is because of rare perceive ability. It is the real reason for accident sensors introduced on streets that collaborate with drivers through the portable application by the 4G network. These sensors are straightforwardly introduced in private and open transportation. Specifically, we talk about an IoT cloud framework for checking and ready warning dependent on open GTS and Mongo DB with the goal that drivers can get ready messages to keep away from the danger of potential accidents. Right now, not all spots are furnished with traffic sensors so we utilize a different strategy i.e., Traffic observation and alert notification IoT cloud framework. The GPRS/GSM/GPS TK103 tracker-based

framework implemented in vehicles restricts geo-location and speed data. The data on geo-location is transferred to a GeoJSON micro service4 that is integrated into a distributed Mongo DB database. Another microservice is utilized to know the places of vehicles in a given territory near drives to tell them with ready messages utilizing the 4G network. Both open GTS administration and microservices were conveyed by methods for Docker compartments. In the future job, the impact of safety on our system will be broken down. Beamforming is a method used to know distance frameworks to distinguish reliable, extensive hurdles. If this is possible, it may allow the description of the obstacle form, correctly related to DOA (Difference of arrival). For testing of separating running systems, it is possible to separate vehicles from snags and to estimate the laser and ultrasound circumstances that are shady and foggy. The main difficulty in the sensor array signal processing is the evaluation of the coordination of the source using acoustic filtering. The range, the azimuthal and the elevation are three parameters [5]. Array processing aims to collect details from propagation ratio wave signals as there course of the exhibit. Standard beam-forming algorithms go flat where the proportions origin are not within the Rayleigh objectives, which is the capacity of the number of sensors and the array component. In contrast to beam-based techniques, a multiple signal classification (MUSIC) with a larger outstanding objective, but with a possibility that the sources are near and the noise ratio level is small, the objectives are small as well.

The most significant problem in the processing of antenna sensor arrays is the condition of sources that transmit a signal or target of an external signal [6]. The exceptional advance of technologies allows ITS to flawlessly access the internet through a cloud-based Gateway model, i.e., GaaS. Their purpose is to manage gateways. In particular, vehicles need on-board equipment sustaining the invention to implement the GaaS Framework [7]. H_20 and WEKA mining devices are proposed to locate the most significant indicators. It has 5 classifiers Naïve Bayes, C4.5, random forest, Adaboost M1, Bagging [8]. An expansion in the number of vehicles can build the figure of accidents. For this, we utilize a vehicular cloud system to keep up communication among vehicles and roadside units. Vehicular cloud conditions by giving different cloud services, for example, an administration utilizing traffic test systems [9].

IoT is a different kind of scattered structure consisting of a wide variety of key gadgets linked to remote cloud facilities, a platform or web-based programming that is prepared for IoT as a service [10]. Cloud computing for vehicles is increasing innovation. The under-used resources of the Vehicle can be imparted to various vehicles via TMSs, based on the VANET and the VCC, in order to prove the reasons for the located scale of the vehicular clouds and their use in control of traffic. The fog-based crowdsensing scheme is a growing infrastructure for transportation management. It is used to reduce inactivity and enhance service nature [11, 12]. Fog computing is used by STS to enhance cost-effective wrongdoing by means of intelligent video surveillance by the fog System for clever public safety in a vehicle situation structure [13].

3 Methodology

In this paper, in order to provide information other then infrastructure as a service [iaaS], platform as a service (paaS) and technology, we will look at Iot cloud's strategies for storing and processing data from internet of things (IoT) [14, 15]. In this IoT cloud framework, portable sensors are introduced out in open or private transportation vehicles and gather information about their position. So it is conceivable to gather information about their position and figure speed, acceleration, and other related information. It needs the machine to machine work for collecting vehicle data and informing drivers of unaware traffic slowdown alerts. Vehicle-collected geo-location data is gradually sent to a GTS server that stores it in SQL. This is transmitted in a distributed database to the GeoJSON parsing micro-service. In a particular area close drivers from best locations, a different microservice will observe the shift of car condition in order to communicate alerts to identifiable traffic jams. It is carried out using 4G network connection techniques.

From Fig. 1 the beginning stage of the information transmission is the vehicles. These are outfitted with commercial satellite tracker gadgets such a GSM/GPRS/GPS TK 103 tracker. This geo-location correlates like latitude, longitude, speed. It promotes location, emergencies, alerts, and geosite. It is tiny and easy to manage because it is easy to trace vehicles. For the transmission of data, TK 103 supports GPRS and SMS. The data is sent via a 4G connection to open the GTS server. This framework is now used for tracking government vehicles. Open GTS is an open-source tracing license that allows for online tracing of vehicles under the apache software license. The communication between open GTS and tracker is a soothing methodology. It enables us to utilize a satellite tracing framework and it is a decent decision for broadly useful vehicles. It consists of two distinctive types of servers which are implemented through Docker containers in all parts. One for the collection and control of data and one for storage of data. The social data occurrence is double. GTS promotes the understanding of one hand of the open road map of Geolocated information. This provides an image of traffic in real-time and reduces the high risk. Then again, the road map is opened again and in relation to our traffic notification scheme, GeoJSON requires an unstructured human and machine-readable JSON setup to encode geographical data. In SQL information is stored by Open GTS. So every time SQL-GeoJSON interpretation is performed. The approaching data must be removed from our SQL database for a GeoJSON parsing job and storage in the MongoDB database in order to keep a calculated distance from this. The formless data is very adaptable. These are intended as a microservice to a container on Docker. The GeoJSON produced is sent to another microservice to coordinate the MongoDB. This framework aims to monitor the presence of other vehicles at a similar road nearby, informing the driver's mobile app on a steep slowdown in traffic with a 4G.

Data mining and blocking counteractive measures are another mechanism. Data mining is the way to investigate and condense information from other points of perspective and Traditional machine learning devices such as H2O and WEKA are

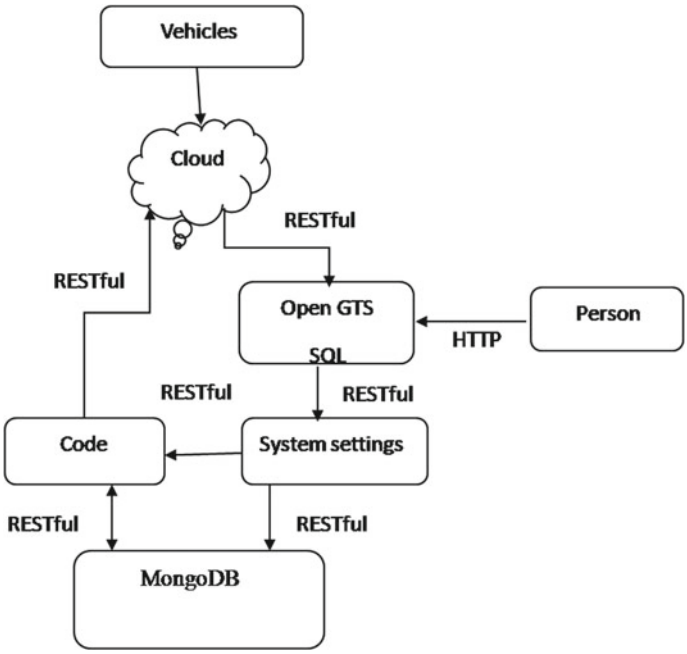

Fig. 1 Traffic tracking and alert notification IoT cloud system

available [16, 17]. In this work, we utilize the two. It gives the bit by bit manual for structure a classifier model utilizing on information and after that, the model is tried utilizing the test information and aides in making forecasted. With the headways in computing facilities given by software engineering innovation, it is currently conceivable to foresee traffic more precisely. Using WEKA and H2O mining devices, we found that the figuring classifier here was the decision tree classifier C4.5 and Naive Bayes on the grounds that they gave the best outcomes.

The VANET is the real segment of ITS which changes the technique for driving all over the place. Today, driving all over the places is progressively secure, ensured and congenial. Numerous endeavors are made to arrive at these targets, in any case, VANET's limitation, for instance, high versatility of the vehicle and security issue don't enable analysts to meet these objectives [18]. That continuous upgrades in software, hardware, and communication advancements engage the structure and improvement in cloud computing innovation. The ability of cloud computing to concatenate and serve aggressive materials assumes a significant role in improving rising TMSs. Improved data and vehicle asset sharing lead to VCC. VCC offers access to progressively can be programmed and coordinated underutilized vehicle assets. Communications in VANET are normally organized into vehicle-to-vehicle and vehicle-to-Infrastructure communication. The automobile communicates with different vehicles and Road Side Units (RSU). Automobile cloud computing assistance of a specific cloud is subject to the reason for which this cloud is framed.

Vehicles can subscribe to the cloud give benefits on interest. By interfacing OBUs through remote systems, for example, Wi-Fi and 3G/4G-LTE frameworks, clients can procure practically unrestricted computing force and cloud based storage. It improves the accumulation, handling, and dissipating of traffic-related data. It incorporates and facilitates available vehicular assets and empowers road traffic management in a superior manner. The overall assessment of VCC and VANET based TMSs is provided and the explanation of the degree of arranged vehicular clouds and their use in road traffic management is demonstrated.

From the Fig. 2, we can claim that vehicle clouds are divided into two categories called V2I clouds and V2V clouds. Classification focuses on applications to be built for cloud, technology to be used, and third-party cloud participation (internet and other profitable clouds). By leveraging the communication network type V2V (DSRC), V2V clouds are developed. For the typical service required by the underlying TMS, dynamic clouds are formed by vehicles on the roads or on the parking lot. Like vehicles on the road, the cloud is built to know the status of each other and make an intelligent route planning decision. The static cloud provides storage and processing services. Vehicular sensors are created for traffic monitoring. V2I clouds make use of roadside infrastructure communication networks like Wi-Fi, DSRC, 3G/LTE. If vehicles depend on RSU's for control information they are called V2R clouds. And if they depend on 3G/LTE network they are called V2 cellular clouds. For smaller areas V2R clouds and for larger areas V2 cellular clouds are used. If the sensors work together to create a database and share information with vehicles, they are called road side sensors.

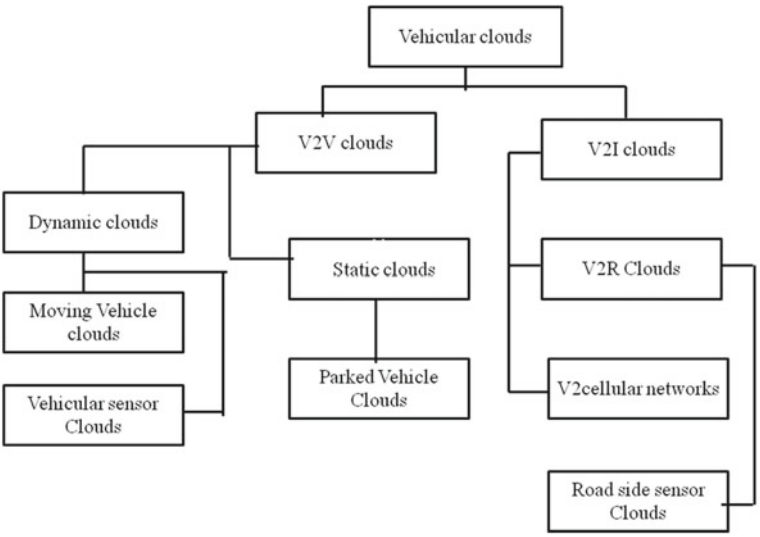

Fig. 2 Taxonomy of vehicular cloud

Table 1 Statistics data report of road accidents, number of persons died and injured

Year	Total number of road accidents (in numbers)	% change	Total number of persons died (in numbers)	% change	Total number of persons injured (in numbers)	% change
2014	4,89,400		1,39,671		4,93,474	
2015	5,01,423	2.46	1,46,133	4.63	5,00,279	1.38
2016	4,80,652	−4.14	1,50,785	3.18	4,94,624	−1.13
2017	4,64,910	−3.28	1,47,913	−1.90	4,70,975	−4.78
2018	4,67,044	0.46	1,51,417	2.37	4,69,418	−0.33

4 Result

Table 1 shows the data received from the police department and published by the ministry. As per global status report on road safety 2018 of World Health Organization (WHO) India is one of the leading countries where the number of road accidents is higher. As we can see, the number of accidents had been reduced from the year 2015–2017. Even though accidents were reduced the reduced number is not remarkable achievement. The highest number of accidents took place in the year 2015 and least in the year 2017. The highest number of deaths is due to accidents were highest in the year 2018 leading to the death of nearly 5 lakh people. So by observing the statistics, we can conclude that better traffic regulating systems are required. So we use IoT cloud system for monitoring the traffic to reduce the accidents. In this article, we use different methodologies like open GTS and MONGO DB for alert notification and other methodology is H2O and WEKA mining tools. And also we discussed the VCC traffic management system which is used for the management of heavy traffic.

5 Conclusion

Numerous individuals are biting the dust because of street accidents. Almost 1.25 million individuals bite the dust in road crashes every year. Furthermore, more individuals are harmed each hour. Right now, not all streets are outfitted with firm traffic sensors. So in this paper, we discussed various arrangements. IoT cloud structure for checking traffic and send alert notification. GSM/GPRS/GPS TK 103 Tracker accumulates geolocation and speed data and forwards to an open GTS server and it is stored in the SQL database. This approaching information is sent to the GeoJSON parsing microservice and it is embedded in MongoDB. Another microservice questions the situation of the vehicles and advise their mobile applications with alert messages identified with traffic slowdown. This is performed by a 4G network. We perform both data inclusion and recovery in MongoDB. To

upgrade this road security and decreasing car accidents we use mining tools such as H2O and WEKA. This upgrades the transportation framework wisely and grow new runs the show. The VCC additionally deals with traffic during congestion close to an examination of VANET and VCC based TMSs are given to exhibit the explanation arranged possibility of vehicular cloud and their utilize in road traffic administration.

References

1. Karunkuzhali D, Madhubala D, Nisha Y, Rajeswari S (2019) Accident detection and monitoring system using IoT. Int Res J Eng Technol (IRJET) 06(03):6766–6770
2. Lewis, G, Echeverria S, Simanta S, Bradshaw B, Root J (2014) Tactical cloudlets: moving cloud computing to the edge. In: 2014 IEEE military communications conference, Baltimore, MD, pp 1440–1446
3. Salman O, Elhajj I, Kayssi A, Chehab A (2015) Edge computing enabling the Internet of Things. In: 2015 IEEE 2nd world forum on Internet of Things (WF-IoT), Milan, pp 603–608
4. Celesti A, Galletta A, Carnevale L, Fazio M, Ekuakille AL, Villari M (2018) An IoT cloud system for traffic monitoring and vehicular accidents prevention based on mobile sensor data processing. IEEE Sens J, 1558–1748
5. Ekuakille AL, Vergallo P, Saracino D, Trotta A (2012) Optimizing and post processing of a smart beamformer for obstacle retrieval. IEEE Sens J 12(5):1294–1299
6. Vergallo P, Ekuakille AL, Caratelli D (2013) Sparsity of the field signal-based method for improving spatial resolution in antenna sensor array processing. Progr Electromagnet Res 142:369–388
7. Lin YW, Shen JM, Weng HC (2013) Cloud-supported seamless internet access in intelligent transportation systems. Wirel Pers Commun 72(4). https://doi.org/10.1007/s11277-013-1137-5
8. Al Najada H, Mahgoub I (2016) Big vehicular traffic data mining: towards accident and congestion prevention. In: International wireless communications and mobile computing conference (IWCMC), Paphos, Cyprus, pp 256–261
9. Abhale AB, Khandelwal SA (2016) Intelligence transportation service using vehicular cloud network. In: IEEE international conference on advances in electronics, communication and computer technology (ICAECCT), Pune, India, pp 277–282
10. Celesti A et al (2016) Characterizing cloud federation in IoT. In: IEEE 30th international conference on advanced information networking and applications workshops (WAINA), Crans-Montana, Switzerland, pp 93–98. https://doi.org/10.1109/waina.2016.152
11. Ahmad I et al (2017) The role of vehicular cloud computing road traffic management: a survey. In: International conference on future intelligent vehicular technologies, pp 123–131. Springer, Cham
12. Wei J et al (2018) A privacy-preserving fog computing framework for vehicular crowdsensing networks. IEEE Access 6:43776–43784
13. Neto AJV et al (2018) Fog-based crime-assistance in smart IoT transportation system, vol 6, pp 11101–11111
14. Celesti A, Mulfari D, Fazio M, Villari M, Puliafito A (2016) Exploring container virtualization in IoT clouds. In: IEEE international conference on smart computing (SMARTCOMP), St. Louis, USA, pp 1–6
15. Celesti A, Fazio M, Giacobbe M, Puliafito A, Villari M (2016) Characterizing cloud federation in IoT. In: 30th international conference on advanced information networking and applications workshops (WAINA), Crans-Montana, Switzerland, pp 93–98

16. Witten IH, Frank E (2005) Data mining: practical machine learning tools and techniques, 2nd edn. Morgan Kaufmann Publication
17. Shah SAA et al (2018) Adaptive beaconing approaches for vehicular ad hoc networks: a survey. IEEE Syst J 12(2):1263–1277
18. Alazawi Z et al (2014) A smart disaster management system for future cities. In: Proceedings of the 2014 ACM international workshop on wireless and mobile technologies for smart cities, USA. ACM, pp 1–10

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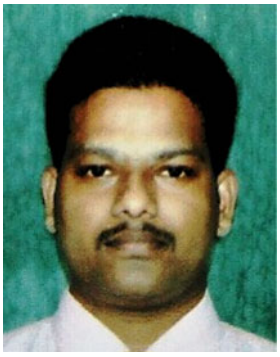

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Modern Health Monitoring System Using IoT

Satish Nimmakayala, Bhargav Mummidi, Parvateesam Kunda, and Sanjeev Kumar

Abstract In the Present world Health Monitoring of patients becomes very difficult for all the doctors and family members some people are died in their sleep because of the lack of monitoring of patients. So many technologies are used by physicians and doctors by linking their equipment to the Internet using IoT and cloud technologies to monitor patient Health condition every minute and every second. This paper is mainly focusing on applications which are related to health monitoring of patients based on Internet of Things. IoT provides many benefits to improvement of eHealth.

Keywords Arduino · Raspberry Pi 3 · Sensors · GPS · ESP8266 · Cloud computing

1 Introduction

Nowadays IoT takes part ins a very important role in every field. Internet of things is a concept of where things can talk to other things. By using IoT we can interlink system to our devices like smart phones, pc etc., so that we can control the systems

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_105

from anywhere by using sensors, fog computing etc., now by using this IoT technology in the medical field, we can make our work easy, time-saving. IoT becomes a trend in the next generation and all is automated using IoT. All the Appliances in our home also automatically work in next few years through the internet and mobile these can be interlinked through sensors and IoT is also implemented in present technologies like AWS (Amazon Web Services), AI (Artificial Intelligence), etc., the present world running on the platform called IoT. IoT includes programming through Python, C, etc., IoT includes Wireless technologies and Smart home and also security purposes all are using the IoT in many ways no one using the IoT in Medical field by using IoT in the medical field we can make wonders and save many lives through internet and by using simple sensors. The health care proposal is focused on the measurement and monitoring a variety of biological constraints of patient's body such as heart rate, oxygen saturation level in blood associated temperature employing a net server and humanoid application wherever doctor will unendingly monitor the patient's condition on his smartphone mistreatment an humanoid application, the patient history are going to be hold on the web server and doctor will access the data whenever required from anyplace and want not physically gift. While this implies, it simultaneously improves the standard of consideration through consistent consideration and brings down the cost of compensation by dispensing with the need for a parental figure to effectively have communication in information grouping and investigation [1]. One audit evaluates that concerning twenty-fifth of the grown-up populace don't take their endorsed prescription, which can bring about weakness results and misrepresented mortality Technology improvements in consideration offices and administrations. Inside the in the interim, Internet-of-Things (IoT) has been perceived as unrest, since it began toward the beginning of the twenty-first century [2].

2 Literature Review

In 2011 Vandana Milind Rohokale and her team Neeli Rashmi Prasad, Ramji Prasad proposed a concept of Cooperative Internet of Things (IoT) for pastoral Health concern Monitoring and Control. The aim of this article is to reduce the death rate through effective monitoring. The Rural Healthcare Center (RHC) enlisted individual will wear one wakeful RFID sensor. Although the individual's wearings this sensor are uneducated, any adjustments in the typical rules or alarms after go past specific qualities will be educated to patients just as RHC specialist. At that point, the RHC staff will have the option to arrive at the therapeutic office to the crisis patients. In each town, one RHC should be dynamic. The organized PC in the RHC will contain information concerning the medical problems of the enlisted patients. The RHC checking individual will refresh the knowledge forever concerning their portions and set up the remodel report [3]. Liane Margarida Rockenbach Tarouco and his team proposed a concept for IoT in healthcare Interoperability and Security Issues and it is described a project called

REMOA, which aims home solutions for care/telemonitoring of patients with chronic illness [4]. Emmanuel et al. proposed a system called Smartphone as a Medical Device in 2013. In today's generation smartphones are been carried by people wherever they go. Late investigations have demonstrated that cell phones are in a similar room as their proprietors more than 90% of the time. This infers at whatever point Smartphone proprietors pick, and they can without much of a stretch distinguish their issue with therapeutic gadget applications, sharp stand out from current wellbeing rehearses in which patients need to build arrangements to see their primary care physicians and hold up days or weeks before being taken care of [5]. The way that a lot of senior voters tormented by subjective state frequently neglect to require the endorsed medications on schedule. Endorsing clinicians of times don't usually notice or rise concerning disobedience and don't appear to be everlastingly reasonable at perceiving once patients quit taking their drug. On the off chance that feasible, it's indispensable to keep up repetitive connection with the specialist to discuss, surrounded by various effects, consistency problems. Be that as it may, this is frequently not as straightforward because it sounds. Besides, the abuse and maltreatment of physician-recommended medicine will cause an assortment of unfavourable medication responses, commonly notwithstanding bringing about death. To unravel the medication misuse downside, Geng rule and his team improved the pharmaceutical insubordination scenario, and create the daily task as simple and good as doable; Associate in nursing iMedpack is projected utilizing 2 crucial technologies: RFID tools and controlled delamination materials (CDM). Associate in Nursing intelligent drugs box (iMedbox) is a home health care entree. IoT gadgets [e.g., wearable sensors and shrewd medications are pressing (iMedpack) zone unit consistently associated with the iMedbox utilizing a heterogeneous system that is good with various existing remote benchmarks. The body-tatty Bio-fix will see and transfer the client's profile sign in the direction of the iMedBox in period. The iMed pack is associated per the iMedBox by means of Associate in Nursing RFID connection to assist the clients with their recommended drug. All the gathered information is taken, put away, and showed territorially on the iMed Box. The arranged data can in like manner be sent to the Health-IoT compose for scientific finding or advance assessment [6]. In 2015, Das et al. utilized IoT in recognizing wellbeing dangers because of flashing counterfeit lights [7]. In 2016, Zviad et al. started Tele Derma mission and teledermoscopy service at Batumi Maritime Hospital with the help of Dr. Gogitidze had proficient extraordinary dermoscopy guidance in December 2014 and mutually dermoscopy and teledermoscopy services had become accessible at BMH since 2015 [8]. In 2017 Niket et al. have proposed a health monitoring systems for soldiers by using IoT. This device is used to tracking and monitoring the health and position using some basic sensors and GPS of Soldiers. This data is transmitted to the main center via interconnection of transmission modules and sensors to the cloud. This system is used to save the human in the battlefield [9]. In 2018, Fekadu et al. have proposed a health care services, which is based on cloud systems and the main use of this system is to storing, retrieving and updating patients health database from the cloud database. Generally, Hospitals store the patients' data into cloud server by using

Middleware platforms within Hospitals for this they also developed a site for accessing they give access only to the authorized users [10].

In 2018 Anam Bhatti and his team had published a paper based on the overview of the design a Health Monitoring System. The term Health Monitoring System is derived from the development of Information Communication Technology. They simply motioned that none of them has fully succeeded in fully up to date and reliable Tele Monitoring Framework in all aspects like cost and time. The present technologies also used in developing the system but they are time-consuming and very expensive. They also developed a system that is used to monitor the patients and sends the physiological parameters of patients when he is in abnormal condition and it helps a person for real-time monitoring of patients [11]. In 2003 Mitsuhiro Ogawa and Tatsuo has proposed a new concept of Health Monitoring system that is used to monitor the physical parameters of the person daily without disturbing that person as monitoring during sleep and also via bathroom seat by using some sensors and finally they concluded that for this project they require large scale of analysis of data and objective evolution and also computational analysis is also required for this analysis [12]. In 2005, Neeraj Kushwaha and Minkoo Kim have developed a project that is mainly focusing on monitoring every healthy person anywhere and is also used to promote health awareness. In present days Heart attack is the biggest health hazard all over the world. Nearly 60–70% of people are dying due to heart attack, although they experience the symptoms regarding to heart attack, with the help of these symptoms they designed a system that uses Bayesian Network systems interface and Microsoft agent as human-computer interface [13]. In 2009 Yu-Chi Wu et al. proposed a long-distance home health monitoring system is developed by using the ring-type pulse sensor through RFID. The working of the sensor fully depends on the Smartphone and some other sensors like RFID, GPS and other connectivity modules like Bluetooth and Wi-Fi. This sensor monitors the person's heartbeat and pulse rate these are transmitted to the remote server via mobile phone and it is also used to track the position of the person using built-in GPS which is present in the ring sensor [14]. In 2010 Zimu li et al. proposed a structure for the Health Monitoring of patients who are suffering from a disease called Apnea. Apnea is a sleeping health disorder. This is very dangerous may people who are affected by this disease have mostly died in their sleep. According to this disorder, Zimu Li proposed a Health Monitoring system for monitoring the Health condition of the patients [15]. In 2012 Vittorio Miori ad Dario Russo proposed 3 types of specific ontologies for Home automation. In this project they use some technologies like Internet of Things, Machine Learning (ML) and Artificial intelligence (AI) with the use of these technologies the humans can adopt occupational intelligent ecosystem and with the use of the ML and AI humans can increase the preventive measures for their health issues. The main important thing in their work is they also provide some information for the future work of their project [16].

3 Methodology

In 2017 Veena used a methodology which uses IoT sensors and cloud-based technologies to monitor the patient health condition by using moments of the patients or a person by motion sensors attached to his/her body, these sensors send the information to the cloud and these can be monitored from cell phone or home (Fig. 1 and Table 1).

In case of any emergency, the cloud sensor sends an emergency message to home and hospital and also shares the location of the patient by using the GPS sensor attached to his/her body [1]. The above figure shows how the sensors link up to the cell phone and remote area (cloud) to the Hospital and again to the home just through the communication through Raspberry pi 3. Using the Arduino for the project makes the device to work with the connecting several sensors like ESP8266,

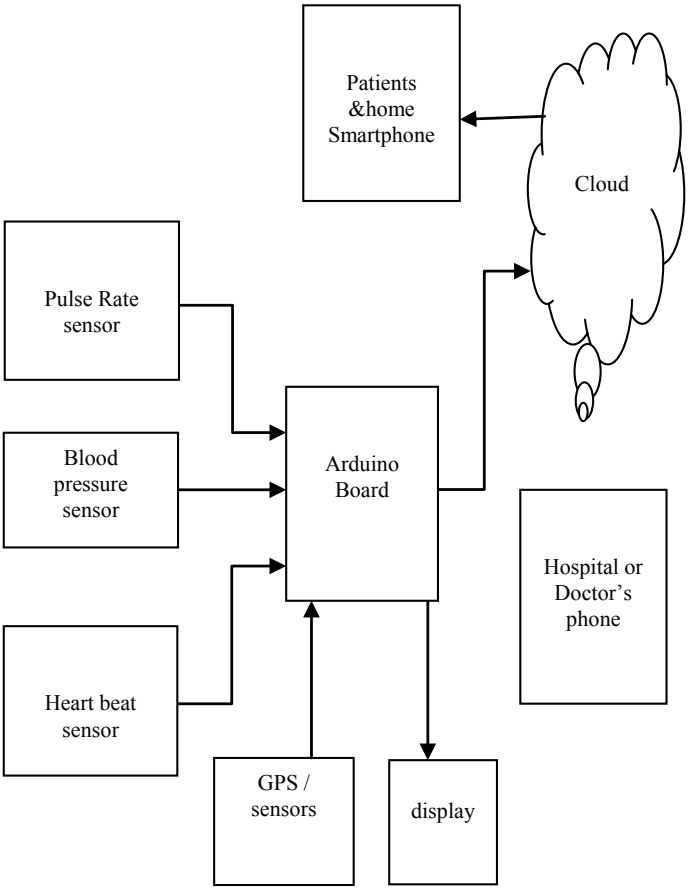

Fig. 1 Block diagram of health monitoring system

Table 1 Threshold values assigned to the health monitoring system

Parameters	Proposed system	Pathological value	% error
ECG HR	67 63 76	65 65 77	3.07 3.07 1.29
Sphygmomanometer	98/75 99/100 96/62	99/71 98/82 96/65	1.01/5.63 1.02/2.43 0.00/4.61
Blood pressure	124/86 117/86 129/92	122/85 117/81 127/93	1.60/1.17 0.00/1.23 1.57/1.07
Body temperature	96.7 99.8 100.1	99.2 100.2 100.9	2.52 0.39 0.79

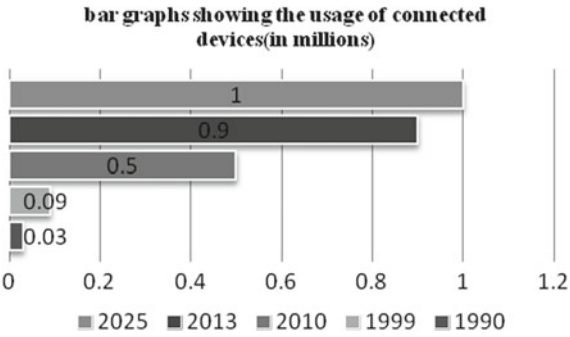

Fig. 2 No of connected devices

node MCU, GPS all are externally connected to this Arduino board with connecting wires and all these circuit is works with the help of Arduino program which is written using Arduino software and dumped into the Arduino board with the help of data cable and also we monitor the changes and outputs coming from the sensor through serial monitor which is present in the Arduino.

4 Result

According to the Gartner report, gadgets will reach up to 20.6 billion by 2020 and this is a huge number of gadgets (Fig. 2 and Table 2).

These gadgets will remove any issues between the physical and computerized world to improve the value and profitability of being, civilization and business enterprises. With IoT making up for lost time smart houses is the mainly anticipated component, with variety previously getting into the challenge with brilliant

Table 2 No of connected devices

Year	Number of connected devices
1990	0.3 millions
1999	90.0 millions
2010	5.0 billion
2013	9.0 billion
2025	1.0 trillion

appliances. Wearables are another component floating second on the web. With the send off of Apple watch and additional devices to stream in, these related contraptions are going to keep us trapped with the between related world.

5 Conclusion

So many users prefer Arduino for the health monitoring system with externally connected WiFi module. This leads the circuit looks like bulky, to avoid this Raspberry Pi 3 can be used because it contains inbuilt Wi-Fi. This helps us to connect the things more accurately and Raspberry pi 3 has more specifications like HDMI port, USB port up to 2.5 A output and this board is having a 1 GB RAM. It has 1.2 GHz quad-core 64-bit processor using of Raspberry pi 3 is better as compared to the Arduino.

References

1. Tripathi V, Shakeel F (2017) Monitoring health care system using the internet of things - an immaculate pairing. In: IEEE international conference on next generation computing and information systems (ICNGCIS), Jammu, India. https://doi.org/10.1109/icngcis.2017.26
2. Lavanya S, Lavanya G, Divyabharathi J (2017) Remote prescription and in-home healthcare based on IoT. In: International conference on innovations in green energy and healthcare technologies (IGEHT), Coimbatore, India. https://doi.org/10.1109/igeht.2017.8094069
3. Rohokale VM, Prasad NR, Prasad R (2011) A cooperative Internet of Things (IoT) for rural healthcare monitoring and control. In: 2nd international conference on wireless communication, vehicular technology, information theory and aerospace & electronic systems technology (Wireless VITAE), Chennai, India. https://doi.org/10.1109/wirelessvitae.2011.5940920
4. Tarouco LMR, Bertholdo LM, Granville LZ (2012) Internet of Things in healthcare: interoperability and security issues. IEEE international conference on communications (ICC), Ottawa, ON, Canada. https://doi.org/10.1109/icc.2012.6364830
5. Agu E, Pedersen P, Strong D, Tulu B, He Q, Wang L (2013) The smartphone as a medical device. IEEE international conference on sensing, communications and networking, New Orleans, LA, USA. https://doi.org/10.1109/sahcn.2013.6644964

6. Yang G, Xie L, Mantysalo M, Zhou X (2014) A Health-IoT platform based on the integration of intelligent packaging, unobtrusive bio-sensor, and intelligent medicine box. Trans Ind Inf 4 (4):2180–2191. https://doi.org/10.1109/TII.2014.2307795
7. Das S, Ballav M, Karfa S (2015) Application of IoT in detecting health risks due to flickering artificial lights. In: International Conference on Advances in Computing, Communications and Informatics (ICACCI), Kochi, India
8. Kirtaval Z, Shulaia T, Kiladze N, Korsantia N, Gogitidze T, Jorjoliani D (2016) e-Health/m-Health services for dermatology outpatients screening for skin cancer and follow-up. In: IEEE 18th international conference on e-health networking, applications and services (Healthcom), Munich, Germany. https://doi.org/10.1109/healthcom.2016.7749427
9. Patil N, Iyer B (2017) Health monitoring and tracking system for soldiers using the internet of things (IoT). In: International Conference on Computing, Communication and Automation (ICCCA), Greater Noida, India. https://doi.org/10.1109/ccaa.2017.8230007
10. Workneh F, Adem A, Pradhan R (2018) Understanding cloud-based health care service with its benefits. In: International conference on inventive communication and computational technologies (ICICCT), Coimbatore, India. https://doi.org/10.1109/icicct.2018.8473243
11. Bhatti Anam, Siyal AA, Mehdi A (2018) Development of cost-effective tele-monitoring system for remote area patients. In: International Conference on Engineering and Emerging Technologies (ICEET), Lahore, Pakistan. https://doi.org/10.1109/iceet1.2018.8338646
12. Ogawa M, Togawa T (2003) The concept of the home health monitoring. In: Proceedings 5th international workshop on enterprise networking and computing in healthcare industry (HealthCom), Santa Monica, CA, USA. https://doi.org/10.1109/health.2003.1218721
13. Kushwaha N, Kim M (2005) Microsoft agent-based health care alert system for smart home. In: Proceedings of 7th international workshop on enterprise networking and computing in healthcare industry, HEALTHCOM, Busan, South Korea. https://doi.org/10.1109/health.2005.1500453
14. Wu Y-C, Chen P-F, Hu Z-H, Chang C-H, Lee G-C, Yu W-C (2009) A mobile health monitoring system using RFID ring-type pulse sensor. In: IEEE international conference on dependable, autonomic and secure computing, Chengdu, China. https://doi.org/10.1109/DASC.2009.136
15. Li Z, Feng G, Liu F, Dong JQ, Kamoua R, Tang W (2010) Wireless health monitoring system. In: IEEE long island systems, applications and technology conference, Farmingdale, NY, USA. https://doi.org/10.1109/LISAT.2010.5478274
16. Miori V, Russo D (2012) Anticipating health hazards through an ontology-based, IoT domotic environment. In: IEEE international conference on innovative mobile and internet services in ubiquitous computing, Palermo, Italy. https://doi.org/10.1109/imis.2012.109

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An Improved Method for Face Recognition with Incremental Approach in Illumination Invariant Conditions

Riyazoddin Siddiqui, Feiroz Shaikh, P. Sammulal, and A. Lakshmi

Abstract In this paper we propose an enhanced method with an acceptable level of accuracy for face recognition with an incremental approach in invariant conditions like illumination, pose, expressions and occlusions. The proposed method hold the class-separation criterion for maximizing the input samples as well as the asymmetrical characteristics for training data distributions. This enhanced approach helps the learning model to get adjusted the weak features inline with enhanced or boosted feature classifier for online samples. This enhanced model also helps in calculating feature loses during the training process of offline samples. For representing the illumination invariant face features local binary pattern (LBP) are extracted from the input samples and IFLDA is used for representation and classification. This modified algorithm with incremental approach gives the acceptable results by detecting and recognizing the faces in extreme illuminations varying conditions.

Keywords Face detection · Incremental online and offline learning · LBP · IFLDA · Illumination invariant, etc.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_106

1 Introduction

During the past decade, the biometric security systems based on face recognition have attracted the research community due to its significant usage in different applications [1–4]. In general, the face problem for recognition is defined and be formulated like [5] i.e. from a given set of stored databases, localizing and extracting the equivalent face images. There are various challenges in face recognition such as varying lighting conditions, pose, overfitting etc. We find that the problem of illumination is big challenge in face recognition especially for single image based recognition system. This problem can be addressed effectively by extracting illumination invariant features [3, 4, 6]. However, the conventional methods found be very difficult in extracting the multi-scale and multi-directional geometric features simultaneously and are very much essential for accurate face recognition and extracting the important intrinsic required face features. Intrinsic features extracted shows a significant variations captured due to uncontrolled environment surrounded by varying wide spectral changes [3, 4, 6, 7].

In a controlled environment, the face identification and recognition is very simple since in this case, the human faces of all the participants are acquired in a fully synchronized environment with uniform background and frontal pose only. But in maximum cases, in real time scenario we come across varying environmental conditions, poses, scaling, beards, makeup, turbans, colors, occlusions etc. affecting the accuracy of the face recognition. In all these challenges, for a face recognition algorithms the varying lighting conditions are considered as the most trivial challenge. It is very difficult task and found to be very impractical to recognize the faces in an illumination invariant appearance conditions due to complex model of recovery and accurate recognition. Oftenly, we find the larger magnitude difference between the same face samples due to varying illumination. This leads the biometric recognition system towards the poor performance. But today there is need of real world application supporting systems which must be efficient in localizing and recognizing or matching algorithms with dynamic constraints [6]. The problem of face recognition associated with the challenging constraints have attracted researchers from the different discipline like psychology, computer vision, Data Science, Security, pattern recognition, neural networks, computer graphics, AI and Machine Learning [8, 9]. The major challenge which affects the performance of the face recognition system includes the following factors:

- **Illumination**: The face images found to be varied due to the position of light source.
- **Pose**: The face images may found in varying poses due to the relative camera positions or face poses.
- **Structural component Existence**: The given face images sometimes may possess the facial features like makeup, beards, mustaches, and glasses and these components create more challenges due to their varying shape, color and size.
- **The Perceptual Face Features**: Face expressions and emotions of a human face directly affects the appearance of faces.

- **Occlusion**: Due to overlapping faces of group of peoples may partially get occluded or by other Objects
- **Intensity**: There are three types of face images intensities which includes color, gray and binary.
- **Image Quality**: The varying Image intensities leads the face images in poor-quality with noise producing blurred or distorted images.

Based on the face image representation [9] face recognition algorithms are classified into two types given as follows:

- Appearance-based where the holistic texture features are extracted from the selective areas of the given face image or from the complete image.
- Geometric Feature based method in which geometric relationships of the facial components like mouth, eyes, brows, cheeks etc. are compared.

In Holistic feature based approach, complete face is given as a input to the face recognition system. Then These high-dimensional training input face images are projected into a lower dimensional subspace by using subspace analysis technique. Finally by calculating the distance between the feature vectors of training and test samples. Finding the required sufficient subspace area is the major challenge for such type of systems. There exists many well known algorithms used for face recognition. Some of such algorithms includes Principal Component Analysis (PCA), Independent Component Analysis (ICA), Linear Discriminant Analysis (LDA) [18], Since the amount of data samples in an online recognition or video based face recognition system is not static hence incremental LDA is used and considered most adaptive and efficient algorithm to the new data sets. By using this concept when batchLDA is used for face recognition the results obtained found to be significant with acceptable very low time and space complexities.

But still there is huge scope in this area and found that since late 1980s many face computational models are been proposed in active reach domain; but very few work is done on incremental learning using sparse LDA. The research community not only contributed theoretically their insights but in many practical applications like criminal detection, security support systems, image and film processing, and machine-human interaction, etc.

But designing an incremental solution based on sparse LDA is a very difficult task since sparse LDA problems are non-convex and NP-hard. This increases the computation cost and memory requirements for training data. Viola and Jones proposed the first AdaBoost detector where he utilized the 6060 low quality features from 4916 set of face sets. Later AdaBoost method along with forward feature selection (FFS) is used for fast training of training and test samples. Further the LDA based algorithms can be used for online face recognition also called incremental LDA in an illumination invariant condition by incorporating a classic semi-supervised learning framework in many applications. However, due to complex, dynamic and multidimensional face features, developing a computational process model for face recognition becomes very difficult task.

2 Illumination Invariance

In face recognition systems, contour or edges [4] are used inorder to extract the illumination invariant features and overcome the illumination challenges since contour-tracking algorithms found to be prone to invariant illumination effects. But since few decades, the research community from the computer vision have come out with many significant solutions to overcome challenges caused due to illumination invariance and witnessed with several excellent methodologies.

These methodologies are based on two important parameters such as photometric parameters and Shadow compensation method. The photometric parameters includes the illumination dependent variables such as color, texture and pixel intensity where as Shadow compensation method which compensates the illumination variation of the face image and query image.

The human faces are naturally includes the basic face components like a forehead, two eyes, a nose and a mouth with two lips. The reflections of lights form a shadow of these basic components on a face, showing distinctive characteristics. These illuminated invariant characteristics generated due to the shadow on a face image can be neutralized and used to obtain a equivalent image in a face recognition system. There are two basic approaches of face recognition under illumination invariant conditions: by proper representation of highly nonlinear face features illumination variances and transforming into a simple face matching algorithm. The illumination invariance can be overcome by proper representation of facial features and these elevated features are utmost insensitive to illumination invariance like a tightly controlled face database. For the representing the image features edge maps, Gabor filters, 1st and 2nd derivatives of gray-level image or logarithmic transformations of the intensity are can be used. Figure 1 shows the common challenges caused due to illumination invariance under controlled conditions.

Looking into all these challenges, the work is focused on improving the recognition accuracy using statistical method by reducing the noise and variances identified in the face recognition process. The experimental work with this approach has shown a significant improvement with acceptable outcomes for real-world image sequences.

Fig. 1 Illumination-invariant conditions *Source* YALE-B

2.1 Illumination Specifications at a Glance

Face recognition in an uncontrolled environment is one of the toughest challenges in real time practical situations. This problem is addressed by normalizing the illumination effects with proper representations of texture features and consequently using [10] the distance transform based matching algorithms. In this particular case, it follows three major steps: (i) First using efficient preprocessing techniques utmost varying illumination effects are eliminated preserving the essential appearance details required for recognition; (ii) then Local Binary Patterns i.e. LBP are generalized also known as Local Ternary Patterns (LTP) descriptors which are more discriminative and very less sensitive to noise in uniform regions; and (iii) Finally local histogram equalization technique is used to improve the performance of the recognition system in a illumination invariance environment. Further with help of incremental approach in face recognition, uneven effect of illumination is elevated by normalizing the [8] LBP facial features. Apart from the illumination challenge the hybrid algorithm is also articulated to overcome the problem of pose variation using view-based approach like eigen-space along with neural networks.

Liu et al. (2005) have used the Gabor wavelet and PCA technique for recognizing the faces where as R. Gross proposed the concept of characterizing the images in varying light field with pose spaces. However, maximum methods used for face recognition in 2D image face space area either can deal with illumination issue or pose variation, and hence very difficult to apply directly when both the challenges are present i.e. illumination and pose variations.

2.2 Face Recognition with Small Illumination Invariant and High Dirt

Human beings has an ability to identify and recognize the human faces very easily but at the same time the performance of the automated system may get affected due to the various parameters such as high noise in the face images due to the poor quality of the camera artifacts and other is the surrounding environment in which the image is been captured. Although there are many advanced recognition technologies already exists with good accuracy but most of them unable to perform in a complex environment due to poor illumination and high dirt [4]. In contrast to the other biometrics like fingerprint, iris, etc. face is the most natural source of identification and communication as such Low illumination and high dirt identity recognition technologies still a worry for the many security agencies and industries that are using facial features based support systems for personal identification.

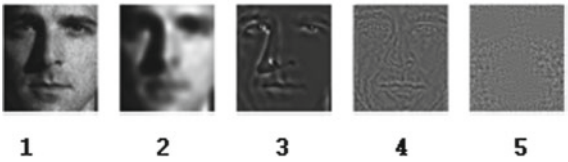

Fig. 2 Sample image classification based on illumination (1) Bluer noisy image, (2) low-pass/sub-band, (3&4) strong edges and weak-edges and (5) Noisy

2.3 Normalizing the Illumination Invariance Using SRA

Now a days the representation of facial features with the high noise due to illuminations issues and artifacts of the input devices is a major challenge for face recognition. To mitigate these challenges posed due to illumination and high dirt the computer vision and statistical signal processing community have actively involved to provide the best solution; for which optimal representation techniques like sparse matrix for calculating the sparse features (SRA) [18], EVD and SVD can be used for facial features representation efficiently by convex optimization even though the problem may be very complex. We explore and modify the sparse representation [4] for robust visual identification of facial features using sparse representation with fractional LDA giving the significant improvement in recognition accuracy in which we have applied a appearance based approach object detection technique (Fig. 2).

While devising a strong visual identification and recognition algorithm the presence of noise, occlusion, background clutter, and illumination variance poses lot of challenges. We propose an improved framework using Fractional LDA along with sparse approximation in a template subspace. Sparse Bayesian learning algorithms [7] are used for multiple instance learning to meet the good accuracy even if there are occluded, illumination variations or other corruptions. The bootstrapping binary classifiers can be used to suppress such issues and the results have seems to be reliable.

3 Face Recognition with Incremental Method

Before discussing the improved method for face recognition in this section we have highlighted some analogues incremental methods which can be applied on the gray scale face images for recognition. These includes

- Computing and updating the facial features in sequential manner.
- Successively updating previous version as new observations

In face recognition, LDA technique is the most frequently used approach; already there exists different forms of LDA with incremental approach [8] with a single new data point in each time step. These approaches are usually used for on-line learning tasks. Because of single step approach, the recognition task become very complex when $\Re$ i.e. the number of classes becomes very large since this method applies an eigen-decomposition of $\Re \times \Re$ sized scatter matrices. There are two forms of Incremental linear discriminant analysis (ILDA) i.e. sequential ILDA and a Chunk ILDA. In experiments we calculate;

- S_W - within-class scatter matrix
- S_B - Between-class scatter matrix and
- S_T - Sparse total scatter matrix

These three components are adjusted inorder to boost each training samples incrementally;

$$S_w = \sum_{i=1}^{\Re} \sum_{x \in \Re_i} (x - m_i)(x - m_i)^T \tag{1}$$

$$S_B = \sum_{i=1}^{\Re} n_i (m_i - \mu)(m_i - \mu)^T \tag{2}$$

$$S_T = \sum_{allx} (x - \mu)(x - \mu_i)^T \tag{3}$$

Where

$\Re$ - Total number of classes,
n_i - No. of samples in class i,
m_i - Mean and
M - indicates Global mean.

The total scatter matrix is given by;

$$\mathrm{ST} = \mathrm{SB} + \mathrm{SW} \tag{4}$$

Incremental PCA has the drawback of feature retention while projecting in sub space area thus incremental LDA is used for feature extraction and PCA is used only for data compression and eigenbases are used to get the reduced set of basis vectors from the spanning space caused due to large data variation [11, 12]. The Eigen sub-space method uses the cubic computational approach for respective

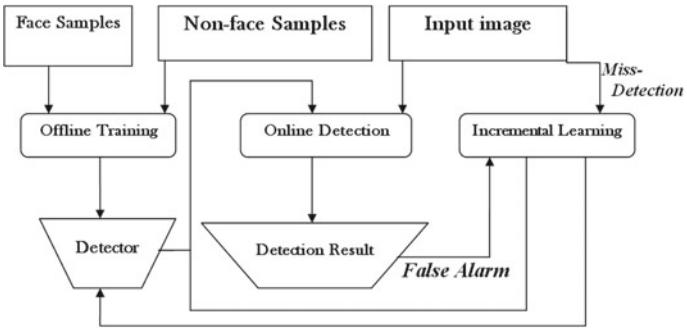

Fig. 3 Incremental learning approach for offline and online detection and recognition

scatter matrix. The block diagram for proposed methods is as shown figure in which the algorithm is adaptive to eigen-space and updated online (Fig. 3).

As discussed earlier due to varying properties of surrounding environments, poses, size the appearance of a target objects get changed drastically affecting the recognition accuracy. In this LDA based improved method, for feature extraction first incremental PCA is used and then updates the Fractional LDA bases. This modified method takes a single new data point as input and uses the intermediate representation technique before classification/recognition. In this modified scheme FLDA is used get adjusted the scatter matrices of between-class and within-class features that linearly combines producing the optimal stronger classifier,

$$\mathrm{S}(\mathrm{x}) = sign \sum_{i.j=o}^{T} Xm_i \, \mu m_i \tag{5}$$

In-order to improve the feature quality of the represented features by driving X_{m_i} and μ_{m_i} AdaBoost learning algorithm is used minimizing the upper error bound. This approach can be applied on both i.e. Online as well as offline data.

4 Working Framework for Improved Method

This improved method for face recognition uses the Incremental sparse approximation method as key technique explored with PCA and Fractional LDA. The major significances of sparse approximation includes

- Reducing the high dimension data to Low dimensional Samples.
- Matrix based Eigen value Decomposer.
- Comparable same as that of PCA, ICA, LDA, etc.

Unlike other conventional methods, most of them uses the online boosting approach. This modified version uses the SLDA based feature selection and maximizes the class-separation criterion. The Sparse ILDA (SILDA) reduces the quotient of generalized Eigen-values into a cardinality-constrained subspace. SILDA helps in computing the discriminating features instead of regular LDA methods which follows the Branch-and –Bound problem solving approach since getting the global optimal solutions for high dimensional data is computationally infeasible. The modified SILDA uses the Greedy approach to find optimal solution [1, 2] to address the issue of invariance generating the exact formulation of sparse feature representation. Following figure shows the process flow of the modified version of recognition in illumination and pose variant conditions.

Input: training data *D*(*person; illumination,Pose*),
filtered data *F*(*person; illumination,Pose*),
sparse function *S*, Filter *F*.
Output: estimate S (X, μ)
1: Initialization
p (Xμ)= 0
2: Simulated matching iteration
for all illuminations *i; j* **and**
for all Pose *i; j;*
persons p
3: Initial separation
$S_B \geq S_T \leq S_W = \{S, F\}$;
Then *Sparse function equities of illumination filter*
4: Iteration
for all $p = S_T$
5: Separation given
{S, M}= {p (X, μ)}
6: Update incremental density estimate
$D_{ij} \geq S, F, p (X, \mu)$
7: Smooth the output
$S \equiv F \equiv D$
8. **Intermediate Representation using SRA**
9. **Classification using IFLDA**

Our modified algorithm not gives the good results for planar tracking like experiment but also performs effectively giving the promising recognition accuracy in an illumination and pose appearance variant conditions. However, it is giving poor performance if the target object experience a large out-of-plane rotation or video is recording is done with large illumination changes like sunlight etc. (Fig. 4 and Table 1).

Table 1 Eigenvalues for representing sparse features with YALE-B

By using Liu's experimentation	Eigenvalues determined by our experiment
1.00000000e+00	3.31404754e+04
1.00000000e+00	2.39150276e+04
1.00000000e+00	1.670974851e+04
1.00000000e+00	1.01371472e+04
1.00000000e+00	6.88317848e+03
1.00000000e+00	7.41278626e+03
1.00000000e+00	2.70246188e+03
1.00000000e+00	5.53315254e+03

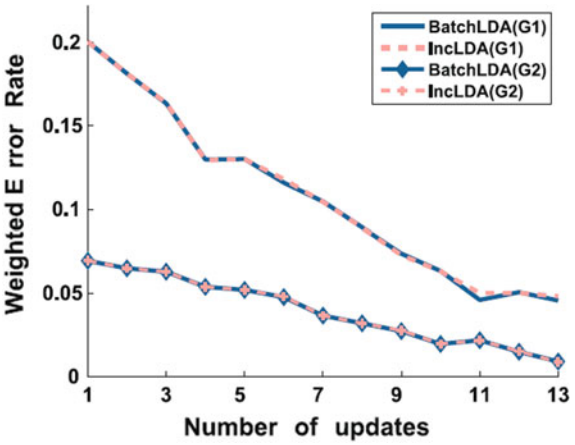

Fig. 4 Weighted error for different LDA under illumination variant conditions

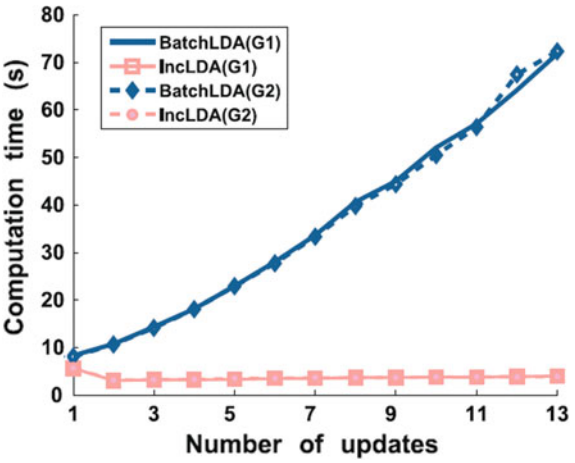

Fig. 5 Online computational complexities performance under illumination and pose variant conditions

Table 2 Complexity factor of Fig. 5

Parameter	Batch LDA	Incremental LDA	Sparse incremental LDA
Time	O(N2 + min(N, M3)3)	O(dT, 1)3 + dB, 1 + N dT, 3 + 3 dB, 3	O(dT, 1)3 + dB, 1 + N dT, 3 + 3 dB, 3
Space	O(NM3 + NC3)	O(NdT, 3 + NdB, 3)	O(NdT, 3 + NdB, 3)

Initially the training of online and offline ILDA found to be same but with different time complexities. Table 2 shows the time complexities for different ILDA methods for the weak samples. Let N be the number of training samples with a greedy approach it needs $O(N \log N)$ time to calculate the optimal threshold for each feature. Thus the time complexity for feature sets of size M is given as $O(M * N \log N)$.

5 Conclusion

In this paper we have done a detailed analysis of the different sub-space based face recognition techniques and identified the parameters which affects the recognition accuracy in different environmental conditions as well as due to artifacts of the face acquisition devices. The major ideas was to focus on how to normalize the illumination and pose variation effects and incrementally change the quality of the discriminating features using AdaBoost to improve the recognition accuracy using PCA and IFLDA. This improved method will be used in next version of the paper on video images captured in illumination invariant conditions.

References

1. Tan X, Deng L, Yang Y, Qu Q, Wen L (2018) Optimized regularized linear discriminant analysis for feature extraction in face recognition. © Springer-Verlag GmbH Germany, part of Springer Nature. https://doi.org/10.1007/s12065-018-0190-0
2. Liu X, Lu L, Shen Z, Lu K (2016) A novel face recognition algorithm via weighted kernel sparse representation. Future Gener Comput Syst. https://doi.org/10.1016/j.future.2016.07.007
3. De Marsico M, Nappi M, Riccio D, Wechsler H (2013) Robust face recognition for uncontrolled pose and illumination changes. IEEE Trans Syst Man Cybern Syst 43(1):149–163
4. Wagner J, Ganesh A, Zhou Z, Mobahi H, Ma Y (2012) Toward a practical face recognition system: robust alignment and illumination by sparse representation. IEEE Trans Pattern Anal Mach Intell 34(2):372–386
5. Paisitkriangkrai S, Shen C, Zhang J (2010) Incremental training of a detector using online sparse Eigen-decomposition. IEEE Trans Image Process 20(1):213–226
6. Wu H (2011) Offline and online adaboost for detecting anatomic structures. MS thesis, Arizona State University, August 2011

7. Zhang C, Zhang Z (2010) A survey of recent advances in face detection. Microsoft Technical Report, MSR-TR-2010-66, June 2010
8. Yang M-H, Kriegman DJ, Ahuja N (2002) Detecting faces in images: a survey. IEEE Trans Pattern Anal Mach Intell 24(1):34–58
9. Rashid E, Ansari MD, Gunjan VK, Ahmed M (2020) Improvement in extended object tracking with the vision-based algorithm. In: Gunjan V, Zurada J, Raman B, Gangadharan G (eds) Modern approaches in machine learning and cognitive science: a walkthrough. Springer, Cham, pp 237–245
10. Viola P, Jones MJ (2004) Robust real-time face detection. Int. J. Comput. Vis. 57(2):137–154
11. Wang L, Peng J, Wang F, Li B (2015) Linear discriminant analysis using sparse matrix transform for face recognition. In: MMSP 2015, Xiamen, China, 19–21 October 2015. 978-1-4673-7478-1/15/$31.00 © 2015 IEEE
12. Kim T, Stenger B, Kittler J, Cipolla R (2011) Incremental linear discriminant analysis using sufficient spanning sets and its applications. Int J Comput Vis 91:216–232. https://doi.org/10.1007/s11263-010-0381-3
13. Li SZ, Chu R, Liao S, Zhang L (2007) Illumination invariant face recognition using near-infrared images. IEEE Trans Pattern Anal Mach Intell 29(4)

A Robust Image Security System for Cloud-Based Smart Campus Using LBP and PCA

Mohd Ahmed Abdul Mannan and Gulabchand K. Gupta

Abstract Most of the educational institutes now days because of increased threat to the campus security have started installing the biometric security support system for personal identification. In real time situation, a large number of biometric data get accumulated which could be an unbearable burden for the biometric security system of a digital smart campus. This had attracted the research community in the field of computer vision and security to use the convenience of cloud computing and store their large data set to cloud servers. During the transform of the bulky data to the cloud source there is necessity of reducing the computational burden and storage burden on the intelligent biometric security system. In this paper a enhanced method for personal identification using biometric system in cloud environment is proposed in which first biometric images are encrypted using either block encryption technique or pixel encryption technique. Out of these encrypted images local binary pattern (LBP) features are extracted for identification or classifications due to which privacy can be preserved. Further PCA is applied on LBP which helps to reduce the computational time and data transfer time to cloud. These extracted features using LBP and PCA are used for equivalent image retrieval using histogram equalization technique for personal identification.

Keywords Biometric security · Cloud computing · Local binary pattern · Smart campus · LBP · PCA · Histogram equalization, etc.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_107

1 Introduction

In present era of digital systems is seeing the exponential growth in the uses of information technology. This idea of implementing the ICT transforms a new model of education system can also be called as smart educations system. The usage of this smart system is not limited to spreading knowledge and education but also monitoring the smart campuses. Millions of digital data either textual or image gets produced because of the day today activities performed in the campuses. We can have a robust mechanism for continuous monitoring and analyzing the student information with respect to the properties or the characteristics of the data produced. However, this leads to an unattainable storage and calculation problem [1–3]. These problems can be mediated with the use of cloud based systems which provides data owners with a large amount of storage and computing resources. However, this creates a big threat to the privacy and integrity to the system due the unprotected multimedia data stored on cloud server. To protect privacy, images must be encrypted before subcontracting. Encryption is a common way to protect information. During the survey of such work we found there are many biometric systems already exists [4–6] for privacy protection based on cloud computing and LBP features [7, 8] are most widely used for image retrieval or personal identification using biometrics.

In this paper a enhanced method for smart campus monitoring is proposed based on LBP and PCA in the cloud environment. For dimensionality reduction Principal Component analysis (PCA) is used, after the extracting the LBP features which further will reduce the computation time and increase the speed of data transfer to the cloud. The specially designed encryption can support the direct extraction of LBP functions even from images encrypted in the cloud. In addition, you can make the extracted feature also encrypted but that supports the similarity calculation.

The organization of the rest of the paper is as follows: In Sect. 2, we explore the state of art for the extraction of image features that preserves privacy. In Sect. 3 we discuss the we present the system model, LBP feature extraction, PCA for dimensionality reduction and finally pixel based encryption model. In Sect. 3.4 describes the proposed process model for secured biometric personal identification using PCA and LBP. Section 4 discusses about the analysis of the proposed scheme. Finally, Sect. 5 conclusion is given.

2 Related Work

In [9] Lowe has proposed a safe SIFT feature extraction method for the input image and used s Paillier's homomorphic encryption technique which is based on addition and multiplication operations to the encrypted text further which is used to solve convolution operations in the SIFT calculation, but cannot resolve the comparison operation. Wang et al. [10] proposed two schemes for extracting encrypted features

based on forms, one is more practical and easier to implement but lacks safety tests, while the other has proven security. However, the analysis of the experimental results discussed is too brief and not in convincing approach. Apart from this we found many methods encryption methods using for SIFT [11] but in all these cases schemes require huge storage and computing costs and still they could not address the issues for reducing size of the directional characteristics due to modified SIFT extraction technique. To mitigate this challenge we propose a secured data outsourcing technique for feature extraction using LBP and PCA that can be widely used in many applications [12–14].

3 System Overview

3.1 System Taxonomy

Figure 1 shows the structural model for the protection of privacy preservation of the end users in the feature extraction process and the intermediate representation of the features.

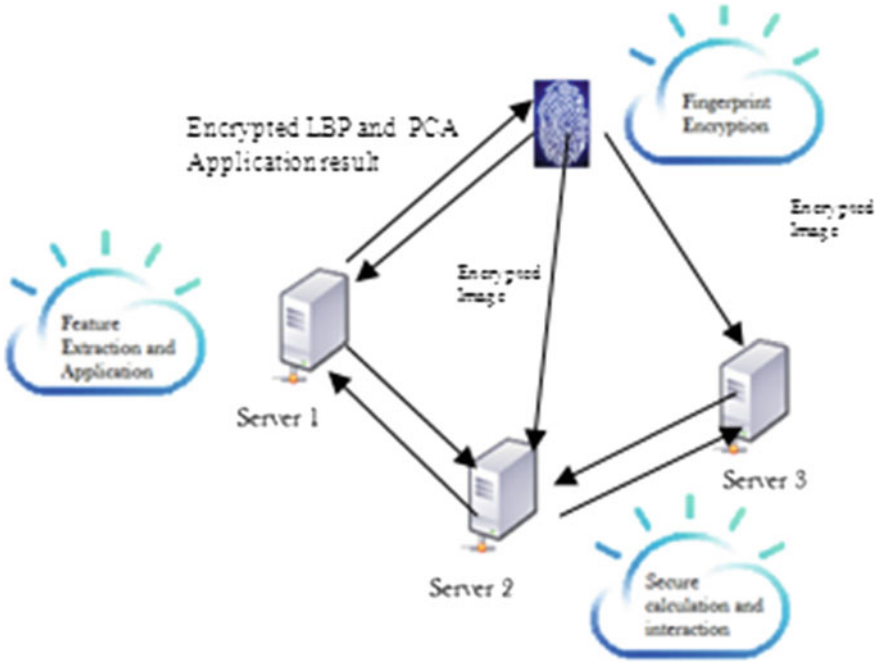

Fig. 1 System models

Let's consider that $\tau = \{I_i\}_{i=1}^{n}$ be the voluminous image database of a database owner which supposed to be outsourced to the third party server for reducing the costs and its efficient use. But inorder to protect the privacy of the database it is need to be encrypted before uploading, Lets consider two sets of encrypted images $e_1 = \{C_{1i}\}_{i=1}^{n}$ *and* $e_2 = \{C_{2i}\}_{i=1}^{n}$ are generated. In whole process, the database owner intents to utilize as much as possible the cloud services by out sourcing data for other operation like feature extraction and storing [14] except encryption for protecting the privacy of the data. In addition, database owner ask the cloud servers very frequently for its application services. In our proposed system we have considered LBP features of the image database for privacy preservation and classification and the results of the application are discussed using LBP feature. The per the building blocks of the system architecture, there are three independent cloud servers S-1, S-2 and S-3 respectively. The roles and functions of these servers are discussed as follows.

As shown in figure, the encrypted images are received by S-1, S-2 independently and preprocessing is done at both the servers and later whole data is accumulated at S-1. At server one later LBP features are extracted by using the feature extraction processes and transferred to S-3 for intermediate representation for reducing the processing time where PCA is applied for data compression.

In addition, the cloud server of our solution also provides LBP application services. In-order to protect the privacy the cloud servers do not try to understand the outcome of the requests posed by the database owner and provides only extracted features from the images or the corresponding operational results to database owner i.e. the cloud servers are capable to complete the requested task without compromising the data privacy. The propose model, a copy of the encrypted images is considered as input to the server for further processing of classification and identification using LBP features generated by the server using secure multiparty computing framework without compromising the user's privacy.

3.2 Privacy Preservation

In cloud environment, security of data is the major challenge so in this model a measure is taken inorder to protect the privacy of the image data stored in cloud and simultaneously LBP algorithm is run on the encrypted biometric data. In biometrics, pixel values of the image and the descriptive information are usually considered as the Local binary patterns or the individuals personal information. The cloud server of the proposed system is considered to be "independent and curious" i.e. the accurate implementation of LBP security algorithm on transferred personal owner data. However, the cloud server need to put take lot of efforts to obtain additional information from the encrypted data and simultaneously performing all the operations on the data. In our proposed model, the data owner uploads the encrypted images to the cloud server, where all preprocessing all operations are

performed on encrypted images. However, the cloud server possesses only LBP encrypted features and does not hold any other information other than LBP features and hence the image features are preserved from the cloud server. Thus S1, S2 and S3 would become explicitly non-collusion and try to work independently.

3.3 *Local Binary Model*

In 2002 first time [9, 11] the idea of local binary pattern (LBP) was used for the texture representation. To calculate the LBP features, the image is sliced into overlapping blocks of fixed size of 3 × 3. Later, the gray values of the median block and the surrounding 8 neighbors in each block are compared and the positions are marked as '1' when the central pixel value is less than corresponding gray value otherwise the position is marked as '0'. Then LBP value is obtained from the 8-bit binary number produced from 8 points in the 3 × 3 block. This process of extracting the LBP features is as shown in Fig. 2 and the image data is represented with help of LBP histograms.

Following equations shows the formal LBP operation

$$LBP(x_c, y_c) = \sum_{p=0}^{p-1} 2^p s(i_p - i_c), \tag{1}$$

where (x_c, y_c) gives the central pixel position, ic and ip is adjacent pixel brightness and s (.) is a symbolic function:

$$s(x) = \begin{cases} 1 & if \ldots x >= 0 \\ 0 & else. \end{cases} \tag{2}$$

Using this approach the researcher can capture the detailed information of the image as well which can be used for advanced level textural feature classification since LBP characteristics are enough capable to represent the local texture properties of the image. These properties are widely used in various types of applications such as image retrieval and face detection and recognition.

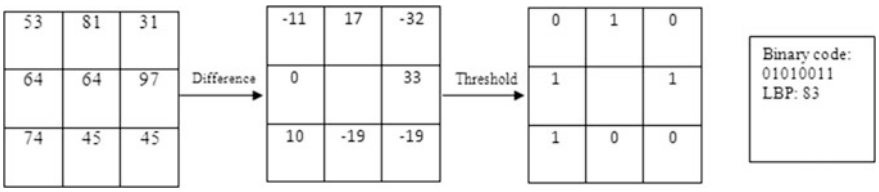

Fig. 2 Basic method for LBP feature extraction

3.4 Dimensionality Reduction Using PCA

While analyzing larger data sets usually the time complexity of data transfer and processing get increases. In-order to overcome this challenge the size of the data is reduced with the help of well known statistical approach PCA and utmost care is taken to retain variance of the data set. Following steps are taken into consideration to represent while representing the reduced smaller size of data. Step-1- Subtract the mean of the data to find the covariance matrix

$$\sum = E\left[(x - \overline{x})(x - \overline{x})^T\right] \tag{3}$$

Where x is the original data set and $\overline{x}$ represent the mean of the original data. Symbol Σ- represents covariance matrix and mostly used uppercase of s. But at the same time a care need to be taken to distinguish the symbol used for summation series.

Step-2- Calculate the eigenvalues and eigenvectors of matrix Σ.

Step-3- Arrange the eigenvectors in descending order with respect the eigenvalues.

Step-4- Here first eigenvectors are chosen since they possesses higher variance while forming the feature vector. Step-5- Now a new data set is derived by using the formula

$$S = X \cdot V \,(\mathrm{Z} = \mathrm{S}) \tag{4}$$

Where V represents eigenvectors. While extracting the data features and its dimensionality reduction using PCA a assumption is made to consider the feature vectors from the m principal axes contained in the subspace where m < p for a p-dimensional data space.

Step-6- Thus each original data vector is represented with its principal component vector of dimension m.

Step-7- In this work the training and test samples are projected using the principal components,

$$\begin{aligned} \hat{S}_{train} &= X^T_{train} \cdot V \\ \hat{S}_{test} &= X^T_{test} \cdot V \end{aligned} \tag{5}$$

Where, X^T- training set of size 1024×1 pixels V- Orthogonal matrix $1024 \times k$ which shows the principal components and k represents no. of selected principal components.

4 The Proposed Scheme

There are two aspects taken into consideration while designing this process model i.e. cloud side processes and client side process. In cloud side processes three entities are involved i.e. server S1, S2 and server S3 for intermediate representation. The data owner always transforms the original data using encryption technique for protecting the privacy before transferring to the cloud. In our proposed method two sets of encrypted images are generated are received by the two servers s S-1 and S-2. Then the cloud servers S-1 and S-2 performs the same calculation operations in the sets of encrypted images received and this data is transferred to S3 for intermediate representation where PCA is applied and finally the features are extracted from the data on S-3 by applying LBP function.

Input: training data B(Finger Biometric Scan; illumination),
Prepossessed data F(Finger Biometric Scan; illumination),
Statistical Features S(Finger Biometric Scan)
Classification function C, statistical Features S.
Output: evaluate S (C, S)

1: Initialization
s (Xμ) = 0
2: Preprocessing
{Image Filtering, Contrast Enhancement by Histogram Equalization}
for all illuminations i; j and Scan s
3: Unwanted Objects Removal
The objects having values greater than threshold are eliminated.

4. Data Encryption
//The image database τ is encrypted using the secret key K and considered as inputs of the data classes C1 and C2.

3: Feature Selection Dimensionality Reduction
Dimensionality Reduction
//Apply Principal Component Analysis Technique- PCA is Applied
{Scan data contains redundant and irrelevant information which reduce the performance of classification; which is used as feature selection technique
Feature Selection

$$LBP(x_c, y_c) = \sum_{p=0}^{p-1} 2^p s(i_p - i_c) = \{S, F\};$$

{It involves the linear combination of variables which explain the data to predict the category of pattern}

4: Iteration
for all B = ST

5: Classification
$\{S, M\} = \{s\ (X, \mu)\}$
Result Analysis
The proposed system is analyzed with FCV 2006 finger print data bases in which we have take 21 class samples for training the system and five samples as a query (Fig. 3, 4, 5).

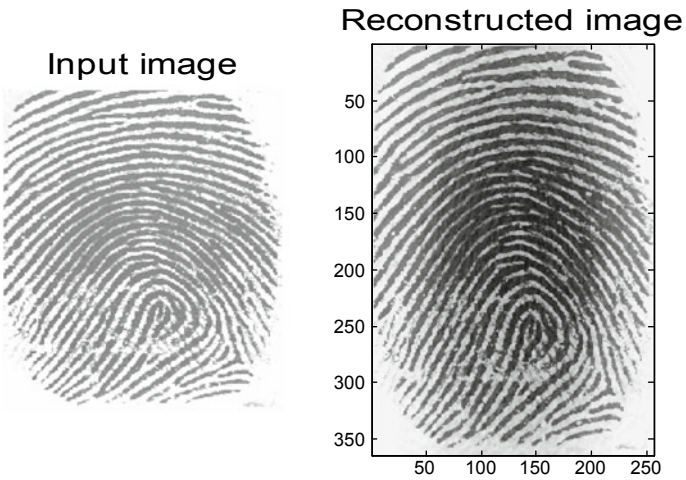

Fig. 3 Reconstructed or recognized fingerprint image

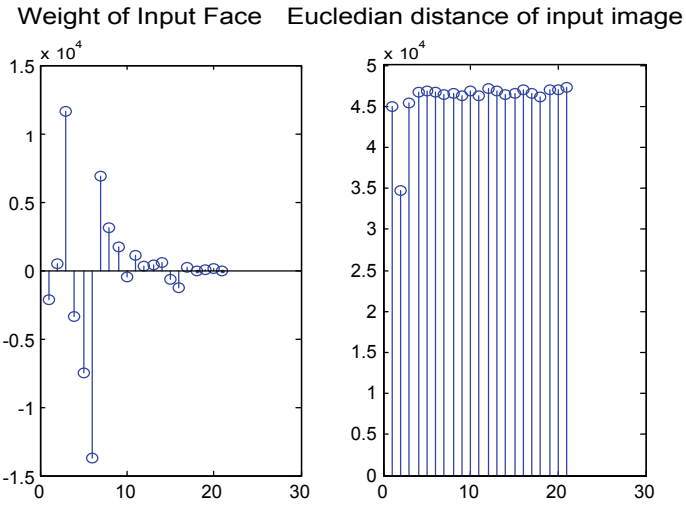

Fig. 4 Histogram equalization

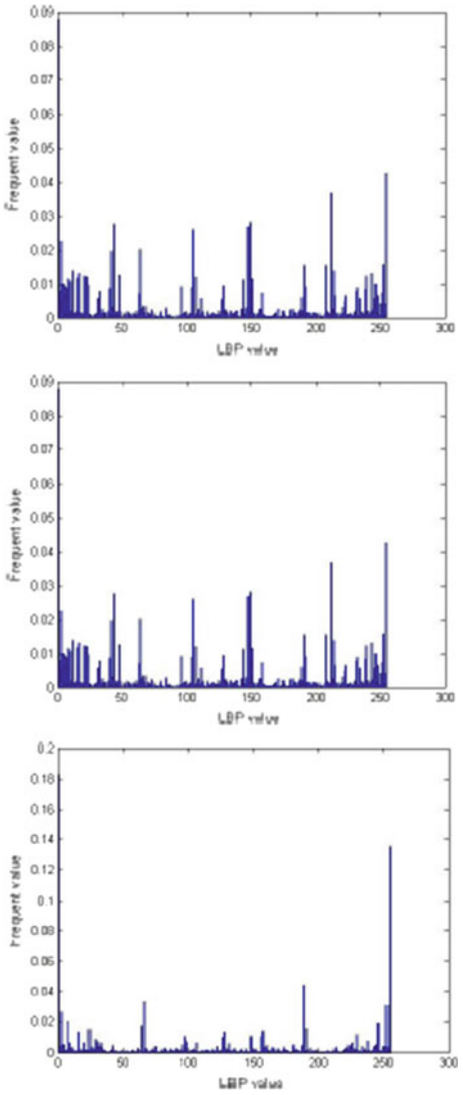

Fig. 5 LBP histogram for Fig. 2 (**a**) original LBP. (**b**) LBP without pixel permutation. (**c**) Histogram with LBP and PCA

Method	Training samples	Test samples	True classification	False classification	Accuracy (%)
LBP	50	31	25	6	80.64
PCA + LBP	50	31	28	3	90.32

Method	Training samples	Test samples	True classification	False classification	Accuracy (%)
LBP	50	31	25	6	80.64
PCA + LBP	50	31	29	2	93.54

5 Conclusion

The smart campus can be monitored effectively by using the cloud computing resources. In this work we have outsources the extracted features to the cloud computing platforms. In the cloud domain utmost measures are taken to protect the data by using standard data encryption technique. For which we have used the permutation pixels and the segmentation of images to protect the privacy of sub-contracted images. LBP features are extracted for the data classification and identification. Where as PCA is used for dimensionality reduction and reduce the computational time and data transfer time. The experimental results shows how LBP is the safest scheme for image recovery of fingerprint biometrics for personal identification. Further we had a plan to improve the performance of system with good accuracy and coming out with good solution for the Data Security.

References

1. Xia Z, Ma X, Shen Z, Sun X, Xiong NN, Jeon B (2018) Secure image LBP feature extraction in cloud-based smart campus. IEEE Access 6:30392–30401
2. Mell P, Grances T (2011) The NIST definition of cloud computing. Nat Institute Stand Technology 53(6):50
3. Punithavathi P, Geetha S, Shanmugam S (2017) Cloud-based framework for cancelable biometric system. In: IEEE international conference (CCEM), pp 35–38
4. Elmehdwi Y, Samanthula B, Jiang W (2014) Secure k-nearest neighbor query over encrypted data in outsourced environments. In: Proceedings of the IEEE 30th international conference data engineering (ICDE), Maril/April 2014, pp 664–675
5. Hsu C-Y, Lu C-S, Pei S-C (2011) Homomorphic encryption-based secure SIFT for privacy-preserving feature extraction. In: Proceedings of the SPIE, vol 7880, p 788005, February 2011
6. Park U, Pankanti S, Jain AK (2008) Fingerprint verification using SIFT features. In: SPIE defense and security symposium, Orlando, Florida
7. Lowe DG (2004) Distinctive image features from scale-invariant keypoints. Int J Comput Vis 60(2):91–110
8. Ojala T, Pietikäinen M, Mäenpää T (2002) Multiresolution gray-scale and rotation invariant texture classification with local binary patterns. IEEE Trans Pattern Anal Mach Intell 24 (7):971–987
9. Dandan L, Shen J, Xia Z, Sun X (2017) A content-based image retrieval scheme using an encrypted difference histogram in cloud computing. In: MDPI, pp 1–13

10. Wang S, Nassar M, Atallah M, Malluhi Q (2013) Secure and private outsourcing of shape-based feature extraction In: Information and Communications Security, vol. 8233. Springer, Cham, pp 90–99
11. Chang BR, Tsai H, Chen C, Huang C (2011) Access control of cloud computing using rapid face and fingerprint identification. In: Second international conference on innovations in bio-inspired computing and applications. IEEE, pp 179–182
12. Ansari MD, Ghrera SP (2018) Intuitionistic fuzzy local binary pattern for features extraction. Int J Inf Commun Technol 13(1):83–98
13. Ansari MD, Ghrera SP (2016) Feature extraction method for digital images based on intuitionistic fuzzy local binary pattern. In 2016 international conference system modeling & advancement in research trends (SMART), pp. 345–349. IEEE, November 2016
14. Ansari MD, Koppula VK, Ghrera SP (2019) Fuzzy and entropy based approach for feature extraction from digital image. Pertanika J Sci Technol 27(2):829–849

Colour Image De-noising Analysis Based on Improved Non-local Mean Filter

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Abstract In a non-linear filter, open resources filter is a particular scenario that is used to reduce the Gaussian noise in our paper and it performs well to reduce it. The major advantage of non-local means filter is to preserve the limits and particulars of a unique image. In this paper, combined both open means filter and mutual filter to recommend an enhanced filter for colour picture de-noising. Novel influence significance is computed by addition consistency in sequence into the weight to evaluate the parallel of the patch. At the final stage of this paper deals that the proposed method of NLM and BILF is a suitable method to reduce the Gaussian sound and combination of sound.

Keywords Non-local means filter (NLM) · Colour image de-noising · Bilateral filter (BlLF) · Impulse noise · Gaussian noise

1 Introduction

There will be a chance of the addition of noise during image acquisitiveness, transmission or storage of color images. Gaussian, impulse and mixed noises are the types of noises available in the literature. The famous non-linear filters for removing impulse sound are Vector average filter (VFM) [1], directional distance filter (DDF) [2], vector directional filter (VDF) [2]. But due to a spatially invariant

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_108

property of these filters noise-free and noisy pixels are not distinguished properly. And also, these filters are not useful to remove the Gaussian sound in color similes.

NLM be a well-known filter for removing Gaussian noise proposed by Buades et al. [13]. Several algorithms are used to reduce the noise [14–19] like Gaussian, impulse and mixture noise. From these NLM has been proposed to preserve the edges during noise reduction. The resultant of NLM removes Gaussian noise effectively but suffers from computational time and also introduces blurring and blocking artifacts. Moreover, Wang et al. [20] proposed a fuzzy-based algorithm and Quaternion representation of color images based on the NLM filter is discussed by Liu et al. [21]. Faster NLM filter which removes noise effectively for clinical images in papers [22, 23]. Sparse and redundant representations algorithms proposed in [25, 26] can produce a better performance of Gaussian noise. Tomasi et al. [27] proposed a bilateral filter (BILF) for de-noising with the preservation of edges. A vigorous mutual and sequential filter based on the spatial and chronological development of sequence proposed by Pinto et al. in [28]. The reduction of speckle noise, an adaptive fast bilateral filter is proposed by Shao et al. in [29]. But most of the available algorithms are reducing only impulse or Gaussian noise. Here, a novel algorithm is proposed taking the compensation of both BILF and NLM. Fine details and edges are retained more effectively using the proposed filter which can take away both desire sound and Gaussian sound.

In this paper color image, de-noising should be improved by using illustrious non-linear filters (NLM, BILF) in Sect. 1. The brief information of non-linear filters is explained and noise removing techniques in color images are discussed in Sect. 2. An innovative improved filter is introduced that is proposed filter in Sect. 3, Sect. 4 explores the comparison of outcome and weights are also calculated further. Finally, we concluded the proposed method is the best method for image de-noising.

2 Review Criteria

The two major types of noises like impulse noise and Gaussian to are extra to similes during acquisition, transmission or storage. Directional distance filter (DDF) [3], vector directional filter (VDF) [2], Vector filter median (VFM) [1] are the types of open-classical filters which are used to remove impulse noise. The main disadvantage of these filters is unable to distinguish between noisy and noisy free pixels because they are spatially invariant operators. To avoid approximation vector middle filter (AVMF) [4, 5], quick examine grouping filter (QEGF) [6, 7] and vector upper-lower middle filter (VULM) [8] be which works on switching schemes. Due to the success of switching filter schemes many types of research have been done sufficiently to eliminate the random appreciated desired noise [9–12], these are every one used to remove only impulse noise and these methods not applicable to Gaussian noise [30].

To remove the Gaussian noise of non-local means filter (NLM) is introduced which operates under non-local area utilizing dissimilarity between patches. All NLM algorithms are used to remove noises as well as preserve the details of images. In the paper proposed by Li and Suen [14], a weight function is calculated by observing the configuration relationship using gray next of kin of coefficient. Base on contented conscious purpose during perceptive picture inside an open collection system of regularization restriction is introduced by Zheng et al. [15]. A suitable Kernel as influence purpose is selected based on converting incorporating circulates parallel keen on a prejudiced standard filter is introduced by Chen et al. [16]. To preserve edge pixels similarities between intensity, edging patch and edging map be taken from neighbourhoods is introduced by Bhujle and Chaudhuri [17]. By conducting statistical tests between distributions Torres et al. [18], selected functions of the't' values of the test are the weights of location variant linear filter and also certain standardized pixels in the filter region. A general non-local denoising model is explained by Sun et al. [19] base on the multi Kernel induced method (GNLMKLM). The drawbacks of NLM are computed moment is larger, the charge is high, there is a possibility of blurring and also blocking artefacts are present. By combining the NLM advantages as well as fuzzy decision filter (FDF) to reduce the noise and to preserve the edges a new filter (FDNLM) is proposed by Wang et al. [20]. Based on the quaternion representation of colour images an NLM filter is introduced by Liu et al. [21]. To remove noise effectively in the clinical image a faster NLM is proposed in papers [22, 23]. To avoid inadequate noise removal based on qualities of the search region an optimum size of the search window which varies from region to region taken by Verma et al. [24]. Sparse and redundant representation is also applicable for effective noise reduction [25, 26]. All the above-represented algorithms are used to remove Gaussian noise effectively.

Bilateral filter (BILF) [27] is a type of nonlinear filter which is used to smooth the images during the preservation of edges. A vigorous two-sided and chronological filter (VTCF) based on spatial and chronological evolution is described by Pinto et al. [28]. The main function of BILF is producing an enhanced description of the Gaussian filter which is the combination of spatial and intensity similarities. Since both NLM and BILF are used to remove Gaussian noise more effectively hence we combine the advantages of these two filters are proposed in this paper for removing the Gaussian and impulse noise.

3 Existing Methodology

In the filters contain advantages as well as disadvantages. Among all techniques of BILF filters switching bilateral filter is used to dismiss both Gaussian and impulse noise. With the use of the above existing bilateral techniques, the eminence of the denoised picture is enhanced. In this broadsheet, a superior version NLM filter is proposed. The grouping of desire noise and Gaussian sound is the mixture noise. In this article, the projected method exhibits good performances of removing these complicated mixture noises (Tables 1 and 2).

Table 1 Comparison of existing filters for Gaussian noise removal in image de-noising: Non-Local Means Filter (NLM)

Existing NLM Filters	Advantages	Disadvantages	Approach	Algorithm	Factors Effects detection and extraction
A non-local algorithm for image denoising	Because of the combination of both the Gaussian sound elimination filter and NLM, the neighborhood pixels can be treated exactly and also accuracy improved slowly	It is more complex than an ancient technique. It has derived by a more and more mathematical equation	Image denoising is done through non-local means filter	Zernike moments and NLM Filter	Time taking is more
Rapid picture and videotape De-noising Via open resources of comparable Neighbourhoods	NLM is used to denoise the image effectively	Lack of accuracy efficiency gets reduced	Reduction of noise from an image is done in addition to pixel relation substitution	NLM approach with neighborhood pixel classification	At a time cannot apply for two or more images
Nonlocal Similarity Image Filtering	Denoising uses the SIFT technique, hence it has high efficiency. It also has high accuracy and high robustness	SIFT is used for the removal of Gaussian noise completely and circular estimation. However, the noise level performance is found them 3D-RGB images and it cannot be used on behalf of diagnosing all noise levels	Image denoising	NLM approach with neighborhood pixel classification	Following the algorithm for 3D RGB image can't be followed
Open consistency filter through proficient hierarchy structure with Invariant piece relationship method	Clusters use the semi-local technique. Hence it has high redundancy. Robustness is high due to variant/invariant transformations	Brightness variance/ invariance of a specific image can be done and may not be done for all images in a long purpose. Due to clustering characteristics, the Gaussian noise is added but not denoised back perfectly	Texture denoising	Brightness variance and invariance level analysis using NLM	Complexity is more

Table 2 Comparison of existing filters for Gaussian noise removal in image de-noising: Bilateral Filter (BILF)

Existing bilateral filters	Advantages	Disadvantages
Bilateral Filter	It preserves the edges, reduces blurriness and it is simple to work	It is unable to reduce impulse or mixed noise and also not able to sharpens the image
Adaptive bilateral filter	It sharpens the images and improves the quality of the denoised image	It is not applicable for impulse noises and it is not worn for corners of images
Modified Double Bilateral Filter	It is used to remove high noise density in less time	It does not apply to mixed noise. The blurring of images and poor noise level occurs
Switch two-sided Filter	Mutually Gaussian and inclination sound is eliminated. In this filter, a noise detector is present for classifying noise pixels correctly	The main disadvantage is color blurriness
Joint Bilateral Filter	It provides better quality when compared to other Gaussian removal techniques	

NLM proposes a novel quantify to appraise the efficiency of the de-noising method. NLM, base on an open meaning of every one pixel in the picture. Non-local means of similar neighbourhood's algorithm brings in filters that eliminate irrelevant neighbourhoods.

Switching Bilateral Filter (SBF) is a new filtering scheme it is based upon the "detect and replace" methodology. SBF technique gives satisfactory results as an image obtained is blurred. These algorithms and techniques participate in a very important position in de-noising.

Types of Noises and Their Reducing Techniques

This proposed method is the combination of advantages of both NLM filters and BILF filters. In NLM filters, weights are calculated by using only pixel information and in the case of BILF filters, weights are calculated by using spatial and pixel similarity. The NLM filter is superior for removing the Gaussian noise. If the Gaussian noise level is increased, then we prefer the NLM filter compared to the BILF filter (Fig. 1).

Figures and Tables:

Stuck between the performance of the projected de-noising algorithm and erst-while breathing method, a contrast comparison was perform.

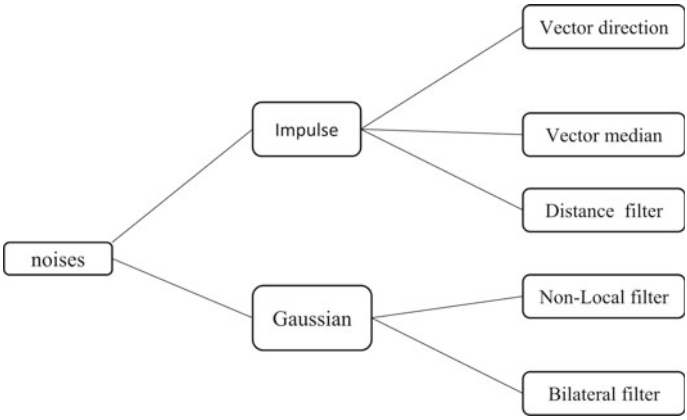
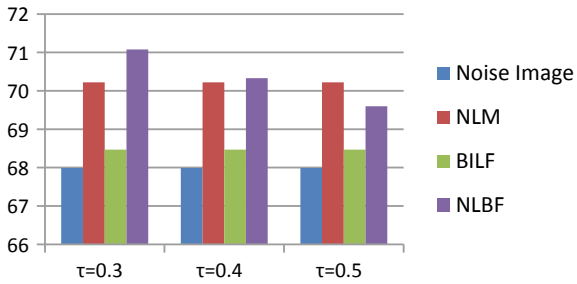


Fig. 1 Classification of noises

Table 3 Analysis of PSNR

Image/ filter	Noise image	NLM	BLF	NLBF $\tau = 0.3$	NLBF $\tau = 0.4$	NLBF $\tau = 0.5$
Mountain	67.99	70.22	68.47	71.08	70.33	69.60

Fig. 2 Graph of PSNR



4 Result and Discussions

Regarding [31], it can be observed from Table 3 that PSNR of NLM and BILF are high compared to the PSNR of a noisy image. The NLBF improves the PSNR with a change in weight τ. Figure 2 shows that NLBF removes Gaussian noise more effectively than NLM and BILF. The proposed algorithm is the combination of both filters such as NLM and the BILF. Therefore, accuracy can be improved by NLM and BILF filters and the blurriness is reduced in color images and also the overall quality of denoised image is enhanced. And finally, the noise is separated from color images.

5 Conclusion

In this paper, we mainly focus on colour image denoising. To separate the colour images from noises like impulse noise, Gaussian noise, and mixture noise. And we intend an enhanced non- local mean filter (ENLMF) for picture de-noising. The methodology combines the benefit of the BILF and NLM. By measure the pixel similarity, the spatial similarity and the mean of differences we can find new weight using NLM filters and BILF filters. Noises like an impulse, Gaussian and the mixture of impulse and Gaussian which are added to the innovative similes can be eliminated. Finally, we concluded that to remove the Gaussian noise and the combination sound the proposed method is the superlative method.

References

1. Astola J, Haavisto P, Neuvo Y (1990) Vector median filters. Proc IEEE 78:678–689
2. Kang CC, Wang WJ (2009) Fuzzy reasoning-based directional median filter design. Sig Process 89:344–351
3. Jin L, Li D (2007) A switching vector median filter based on the CIELAB colour space for colour image restoration. Sig Process 87:1345–1354
4. Wang G, Li D, Pan W, Zang Z (2010) Modified switching median filter for impulse noise removal. Sig Process 90:3213–3218
5. Lukac R, Plataniotis KN, Venetsanopoulos AN, Smolka B (2005) A Statistically Switched Adaptive Vector Median Filter. J. Intell. Robot. Syst. 42:361–391
6. Morillas S, Gregori V, Hervás A (2009) Fuzzy peer groups for reducing mixed Gaussian-impulse noise from color images. IEEE Trans Image Process 18:1452–1466
7. Wang G, Li D, Zhao T (2012) Adaptive iteration filter for suppression of impulse noise in color images. Appl Mech Mater 203(2012):116–121
8. Miloslavskiand M, Choi TS (1998) Application of LUM filters with automatic parameter selection to edge detection. In: Tescher AG (ed) SPIE's international symposium optical science engineering instrumentation. International Society for Optics and Photonics, pp 865–871
9. Liu L, Chen CLP, Zhou Y, You X (2015) A new weighted mean filter with a two-phase detector for removing impulse noise. Inf. Sci. (NY) 315:1–16
10. Chou HH, Hsu LY (2015) A noise-ranking switching filter for images with general fixed-value impulse noises. Sig Process 106:198–208
11. Zhang C, Wang K (2015) A switching median–mean filter for removal of high-density impulse noise from digital images. opt. Int J Light Electron Opt 126:956–961
12. Wang G, Liu Y, Zhao T (2014) A quaternion-based switching filter for color image denoising. Sig Process 102:216–225
13. Buades A, Coll B, Morel J (2005) A review of image denoising algorithms, with a new one, multiscale model. Simulation 4:490–530
14. Li H, Suen CY (2016) A novel Non-local means image denoising method based on grey theory. Pattern Recognit 49:237–248
15. Zheng Y et al (2015) Adaptively determining regularisation parameters in non-local total variation regularisation for image denoising. Electron Lett 51(2):144–145
16. Chen F, Zeng X, Wang M (2014) Image denoising via local and nonlocal circulant similarity. J Vis Commun Image Represent 30:117–124

17. Bhujle HV, Chaudhuri S (2013) Laplacian-based non-local means denoising of MR images with Rician noise. Magn Reson Imaging 31:1599–1610
18. Torres L, Sant'Anna SJS, da Costa Freitas C, Frery AC (2014) Speckle reduction in polarimetric SAR imagery with stochastic distances and nonlocal means. Pattern Recognit 47:141–157
19. Sun Z, Chen S, Qiao L (2014) A general non-local denoising model using multi-kernel-induced measures. Pattern Recognit 47:1751–1763
20. Wang G, Zhu H, Wang Y (2015) Fuzzy decision filter for color images denoising. Opt Int J Light Electron 126:2428–2432
21. Liu Q, Shu H, Sun B, Chen B et al (2014) Removing Gaussian noise for color images by quaternion representation and optimization of weights in non-local means filter. IET Image Process 8(10):591–600
22. Shim J, Yoon M, Lee Y (2018) Feasibility of newly designed fast non-local means (FNLM)-based noise reduction filter for X-ray imaging: a simulation study". Optik 160:124–130
23. Jomaa H et al (2018) Denoising of dynamic PET images using a multi-scale transform and non-local means filter". Biomed Signal Process Control 41:69–80
24. Verma R, Pandey R (2017) Adaptive selection of the search region for NLM based image denoising. Optik 147:151–162
25. Elad M, Aharon M (2006) Image denoising via sparse and redundant representations over learned dictionaries. IEEE Trans Image Process 15(12):3736–3745
26. Labov K et al (2007) Image denoising by sparse 3-D transform-domain collaborative filtering. IEEE Trans Image Process 16(8):2080–2095
27. Tomasi C, Manduchi R (1998) Bilateral filtering for gray and color images. In: Sixth International Conference Computing Vision (IEEE Cat. No. 98CH36271). Narosa Publishing House, pp 839–846
28. Maykol Pinto A, Costa PG, Correia MV, Paulo Moreira A (2004) Enhancing dynamic videos for surveillance and robotic applications: the robust bilateral and temporal filter. Signal Process. Image Commun 29:80–95
29. Shao D, Liu P, Liu DC (2013) Characteristic matching-based adaptive fast bilateral filter for ultrasound speckle reduction. Pattern Recognit Lett 34:463–469
30. Nandan D, Kanungo J, Mahajan A (2018) An error-efficient gaussian filter for image processing by using the expanded operand decomposition logarithm multiplication.J Ambient Intell Humanized Comput:1–8
31. Anh DN (2014) Image Denoising by Adaptive non-local bilateral filter. Int J Comput Appl:4–10

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Effective Data Acquisition with Sensors Through IoT Application: A Succinct Study

P. Lakshmi Mounika, A. Konda Babu, and Durgesh Nandan

Abstract Today the Internet of Things is increasing day-by-day due to its wide applications in many aspects. Internet of Things is identified as one of the emerging techniques in the coming years as technology is turning towards the world of the internet and in smart living. The concept of IoT leaves us in a place of computer networks because it has a wide range of applications from our home to the entire world. In the future, for the increase in demand IoT requires a large necessity from sensors. In this paper we are going to know about WSN usage which is acting as a long-term environment data acquisition this application as a wider use because of its accuracy, collection of data in an efficient way and other method is Zigbee and BLE which also serves the same purpose like WSN these techniques are mostly used because of their flexibility, low cost. Even when sensors fail in the collection of data, through IoT application we can get information easily because IoT works with the physical environment too. Recently these type of sensors with IoT application is utilized in many ways such as in industrial development, smart home, smart irrigation purposes. At the end of this paper, we came to know how data acquisition plays a major role in everyone's life.

Keywords IoT (Internet of Things) · WSN (Wireless Sensors) · Zigbee · BLE · Data acquisition · Sensors · Long-term environment data acquisition

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_109

1 Introduction

Data acquisition is the process of collecting data that is in analog or digital form contains some sampling points that measure real-world physical conditions and converting them into digital signals which are controlled by a computer. Data acquisition plays a key role in the research field. Now - a - days smart environment is present everywhere. Our technology is changing day by day which connects people with smart technology. In future sensors play a key role in effective data acquisition. By doing lots of research on IoT researchers found innovative ideas that help in finding a better solution, this IoT makes our work easy. By connecting this to different sensors data can be easily collected [1]. For these wireless sensors play a key role in the past we just use sensors that may or may not give accurate value but now we have different sensors with more accuracy. Not only has that it helped in healthcare monitoring also in which doctors can assess the patient's condition [2]. However, by monitoring from time to time we need different data acquisition sensors especially in countries like India hospitals are very less so by using sensors we can save more people. The usage of internet is increasing every day. This field creates more opportunities for a better life with this advancement in technology wireless sensors serve an IoT [3]. This paper helps to know us about different types of sensors like temperature sensors, moisture sensors with the help wireless sensors Zigbee and BLE methods come into action the objective of this kind of sensors is to get a data in different fields this collected data can be used to improve efficiency [4] (Fig 1).

There are some papers which tell that collecting data by capturing through cameras but this paper suggest you a different sensors for better acquisition. Many people are accessing data with the help of sensors in this there is another technology called M2M (machine to machine) with the help of cloud computing and sensors this technology serves a great work [5]. Once upon a time we use WiFi and Zigbee sensors for counting people based on strength of signals but now we use radar sensors [6].

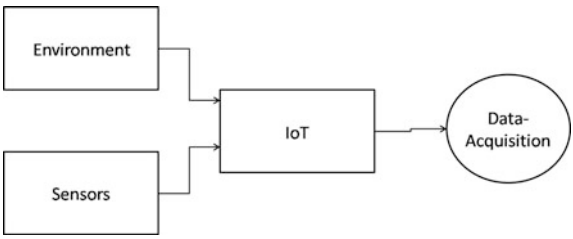

Fig. 1 Passage of data

2 Literature Review

The widespread availability of an increase in technology collection of data through sensors made our work easy. In this paper, we came to know us different types of sensors used for the collection of data [26]. Among them the first method used for data acquisition is Bluetooth. As it has a lot of disadvantages different sensors are coming into action WSN (wireless sensor networks) is one of the technologies which collects data from different nodes and sends it to the one location it measures temperature, humidity, soil moisture and so on [7]. Wireless sensors collect data about the physical environment [8]. The emerging compressing technique with WSN may reduce the sampling points because the compressing ratio plays a key role [9]. After this GPS (global position system) which tells us the place of the information where we want to get the data it mainly used in disaster management, in navy. IoT has sensing facility when connected through cloud computing technologies. Internet of things is nothing but taking all systems connecting and operating with a single device that is under the control of the internet [10]. IoT now is acting as a platform for machine learning also such that we can get real-time data acquisition for sensing networks this technique is based on an RFID (Reconfigurable sensing networks) [11] (Fig 2).

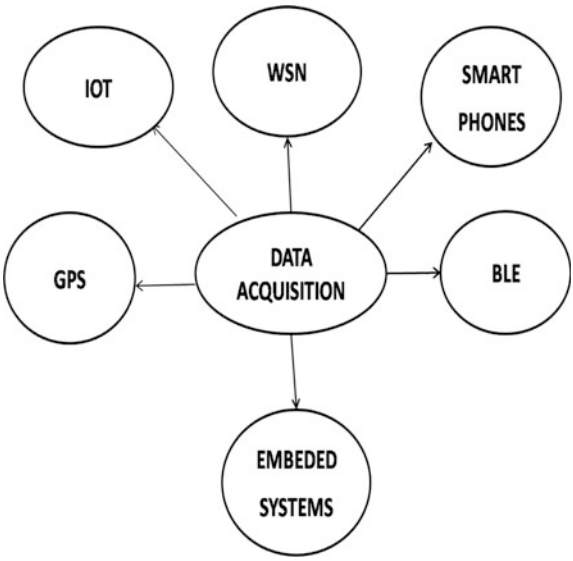

Fig. 2 Data acquisition through different devices

3 Emerging Techniques

WSN: This is one type of network which collects data through sensors without the help of the connection of wires. This can be operated through the internet. WSN collects data from various sensors and sends it to one node which nothing but a computer. Depending upon the type of information we need to collect WSN categorized to various types [12]. When we want to acquire data in huge packets this method is more efficient. The collection of data through the WSN platform is challenging. Usually, this method is considered to be a group of sensors applied when the heterogeneous quantity of data needs to be collected. For this purpose, researchers developed a WSNAP [13].

Zigbee: This is another type of wireless network used when we want to send data to a long distance and is mostly used because it requires low power [14]. It is considered a protocol for WSN implementation [15].

This is a two-way communication system between sensors and controllers. Zigbee network consists of three devices.

1. A coordinator to store the data (it should include at least one).
2. A router to transmit data from one device to another device.
3. And an end device that is used to show the data (maybe cameras, computers, video recorders).
4. Overall its advantages and disadvantages Zigbee supports low data rate so more works are done on it and combine Zigbee with Wifi [16]. Wireless sensors with Zigbee technology collect data from different nodes and send them to one monitoring area with the help of wi-fi controllers [17].

Embedded System: Embedded systems are nothing but a combination of hardware and software consists of mainly microcontrollers and microprocessors. These are mainly designed for doing a specific task. Embedded combined with two software platforms are mostly used:

I. Arduino system: This is an open-source platform to operate the hardware. This has different types of pins to read and write the values among all those Arduino UNO is mostly used source [18].
II. Raspberry pi: This another platform operates by Linux. It has GPIO (General Input and Output Pins) to connect directly with the physical world and to get data by connecting through IoT application.

4 Results

In this paper, we came to know about the proposed method for data acquisition. First of all, we evaluate the proposed technique and then we make analyze of how the method works. The techniques used in this paper are WSN and Zigbee. The

above-discussed methods require a systematic procedure and then by following a sequence of steps make us work easy. Every method as its feature in acquiring data. Most importantly in this paper, we need to select a platform that collects better data especially in the case of health monitoring because we have to analyze the patient's condition from time to time [19]. Insecurity areas also IoT is facing a big challenge through IoT we can simply secure our data. Not only in that, but nowadays more research is also being carried on agriculture too as the technology is leading us in an environment with full of resources such that with the help of sensing devices in farming will help us to know about soil nutrients, soil fertility, moisture level, humidity, temperature [20]. When coming to security purposes with the development of technology we are in smart living. IoT provides data privacy where there is a huge amount of data transformation [21].

5 Applications

(1) **Weather reporting:** we can't predict how environmental conditions changes, but with IoT it is possible and we can make an analysis of how temperature or humidity varies and how does its effects environment [22, 23].
(2) **Health-monitoring:** IoT is also used for monitoring the patient's condition with the use of multiple sensors connected. With this, we can make a record of patient condition from time to time [24]. By this, we can take action immediately when patient condition changes suddenly like a sudden increase in blood pressure, body temperature.
(3) **Agriculture:** agriculture is mostly done by the people in Countries like India.so we need to work on this to make agriculture output more efficiently. With the increase on technology and in the internet, connectivity farming becomes easy [25].

6 Conclusions and Furure Scope

From the above paper, we can simply say that IoT is stepping towards a different sensing network. The main objective of this paper is to come out with a solution in different areas like agriculture, health and in many ways where there exists an emerging technology. The process of selecting the number of sensors play a key role in data acquisition and future developments. Growth in wireless technology with the help of sensors is acting as a basement for data acquisition. The application of sensors in a wide range will help us to measure different environmental phenomena. With effective data, the acquisition gives us a better solution for our smart living. For better performance, the selection of sensors and internet platforms is very important. Finally, we can say that IoT with sensors together gives us better output.

References

1. Bellavista P, Cardone G, Corradi A, Foschini L (2013) Convergence of MANET and WSN in IoT urban scenarios. IEEE Sens J 13(10):3558–3567
2. Deneault LG, Lewis CM, Debons A, Stein KL, Dewolf AM (1990) An integrative display for patient monitoring. In: IEEE international conference on systems man and cybernetics conference proceedings, pp 515–517
3. Chen Y-S, Chen Y-R (2012) Context-oriented data acquisition and integration platform for internet of things, In: Conference technologies and applications of artificial intelligence (TAAI), pp 103–108
4. Chen A, Gil-de-Castro A, Palacios-Garcia EJ, Flores-Arias JM, Bellido-Outeirino FJ (2015) In-home data acquisition and control system based on BLE. In: International symposium on consumer electronics, pp 1–2
5. Chien S-Y, Cheng T-Y, Ou S-H, Chiu C-C, Lee C-H, Somayazulu V, Chen Y-K (2013) Power consumption analysis for distributed video sensors in machine-to-machine networks. IEEE J Emerg Sel Topics Circuits Syst 3(1):55–64
6. Choi JW, Yim DH, Cho SH (2017) People counting based on an IR-UWB radar sensor. IEEE Sens J 17:5717–5727
7. Hsu CH, Lin CT, Tsemg HP, Han JY (2014) An implementation of light-weight compression algorithm for wireless sensor network technology in structure health monitoring. In: IEEE world forum on internet of things (WF-IoT). Seoul, Korea, pp 548–552
8. Kazi R, Tiwari G (2015) IoT based interactive industrial home wireless system energy management system and embedded data acquisition system to display on web page using GPRS SMS & E-mail alert. In: Energy systems and applications 2015 international conference, pp 290–295
9. Li S, Xu L, Wang X (2013) Compressed sensing signal and data acquisition in wireless sensor networks and internet of things. IEEE Trans Ind Informat 9(4):2177–2186
10. Kelly SDT, Suryadevara N, Mukhopadhyay SC (2013) Towards the Implementation of IoT for environmental condition monitoring in homes. IEEE Sensors J. 13(10):3846–3853
11. Khan MS, Islam MS, Deng H (2014) Design of a reconfigurable RFID sensing tag as a generic sensing platform toward the future Internet of Things. IEEE Internet Things J. 1 (4):300–310
12. Harrop P, Das R (2010) Wireless sensor networks 2010–2020. IDTechEx Ltd, Cambridge, U.K
13. Corra M, Zuech L, Torghele C, Pivato P, Macii D, Petri D (2009) WSNAP: a flexible platform for wireless sensor networks data collection and management, Environ. Energy Struct Monitor Syst, pp 1–7
14. Nugroho FE, Sahroni A (2014) ZigBee and WiFi network interface on wireless sensor networks. In: Proceedings of the makassar international conference on electrical engineering and informatics (MICEEI), pp 26–30
15. Pan G, He J, Wu Q, Fang R, Cao J, Liao D (2018) Automatic stabilization of Zigbee network. In: International conference on artificial intelligence and big data (ICAIBD), pp 224–227
16. Zhang Y, Li Q (2014) Exploiting ZigBee in reducing WiFi power consumption for mobile devices. IEEE Trans Mob Comput 1(13):2806–2819
17. Helmy F, Susanto M, Ahmad S. Arifin, D,. Mausa, A, Trisanto. Z (2017) Bee based wireless sensor networks and performance analysis in various environments, Quality in Research (QiR): international symposium on electrical and computer engineering 2017 15th international conference, pp 272–275
18. https://www.arduino.cc/en/Guide/Introduction
19. Gómez J, Oviedo B, Zhuma E (2016) Patient monitoring system based on internet of things. Procedia Comput Sci 83:90–97
20. Bhawarkar NB, Pande DP, Sonone RS, Aaquib M, Pandit PA, Patil PD (2014) Literature review for automated water supply with monitoring the performance system. Int J Current Eng Technol 4(5):3328–3331

21. Perera C, Ranjan R, Wang L (2015) End-to-end privacy for open big data markets. IEEE Cloud Comput. 2(4):44–53
22. Simoes N, de Souza G (2016) A low cost automated data acquisition system for urban sites temperature and humidity monitoring based in internet of things. In: 1st international symposium on instrumentation systems circuits and transducers (INSCIT), pp 107–112
23. Saha HN, et al (2017) Disaster management using internet of things. In: Proceedings of the 8th annual industrial automation and electromechanical engineering conference (IEMECON), pp 81–85
24. Kawarada A (2000) Fully automated monitoring system of health status in daily life. In: Proceedings of the 22nd annual EMBS intertational conference, pp 531–533
25. Rane et al (2014) Review paper based on automatic irrigation system based on rf module. IJAICT 1(19):736–738
26. Perera C et al (2014) Sensor search techniques for sensing as a service architecture for the internet of things. IEEE Sensors J. 14(2):406–420

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Design of Dynamic Comparator for Low-Power and High-Speed Applications

G. Murali Krishna, G. Karthick, and N. Umapathi

Abstract Most of the real world signals have analog behavior. In order to convert these analog signals to digital, we need an analog to digital converter (ADC). In the architecture of ADC's, comparators are the fundamental blocks. The usage of these dynamic comparators are maximized because of demand for low-power, area efficient and high-speed ADC's. The dynamic comparator performance depends on technology that we used. This paper presents the design and analysis of dynamic comparators. Based on the analysis, designer can obtain a new design to trade-off between speed and power. In this paper, a p-MOS latch is present along with a pre-amplifier. p-MOS transistors were used as inputs in pre-amplifier and latch. The circuit operates by specific clock pattern. At reset phase, the circuit undergoes discharge state. During evaluation phase, after achieving enough pre-amplification gain, the latch is activated. The cross coupled connection in the circuit enhances the amplification gain and reduces the delay. This design has optimum delay and reduces the excess power consumption. The circuit simulations are done by using mentor graphics tool having 250 nm CMOS technology. Index Terms: Analog to digital converter (ADC), static comparator, dynamic comparator, two-stage comparator, low-power, high-speed.

Index Terms Analog to digital converter (ADC) · Static comparator · Dynamic comparator · Two-stage comparator · Low-power · High-speed

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_110

1 Introduction

Low-power, high-speed ADC's are the part of different types of applications. Such applications are digital signal processing, digital storage oscilloscopes, cell phones, scientific instruments etc. The comparators are the essential building blocks of various kinds of ADC's, for example, flash type ADC, pipelined ADC, SAR ADC's [1–5]. These ADC's required low-power, high-speed comparators with a less amount of chip area. Since, now-a-days the demand for portable devices is increasing. These devices requires less weight and small size which lead to low-voltage circuits. So, the low-power, high-speed comparators are necessary in ADC's. The performance of comparators are limited by various factors such as supply voltage, offset voltage, input referred noise, power and delay. The comparator should have less offset voltage for a given supply voltage, less power, optimum delay, kickback noise and high speed for desired performance.

In olden days, CMOS amplifiers were implemented as static comparators, however they experiences high power consumption because they are always active and also have low-speed, since no positive feedback and stabilization [2]. Also, designing of static comparators using deep submicron technology i.e., 180 nm, 90 nm, 65 nm is more difficult because of short channel effects, small intrinsic gain of transistor. Dynamic comparators are introduced to overcome the drawbacks of static comparators. Since, dynamic comparators have positive feedback and power consumption is less [6]. One-stage dynamic comparators were discovered in which latch circuit directly connected with pre-amplifier. High-speed and low-power consumption was achieved by these single stage dynamic comparators. Although, they are more immune to noise which is referred as kickback noise. The noise was more due to the capacitive path from the output node to input node. Also, the trade-off between the power and speed is limited. Two stage dynamic comparators were invented to reduce the kickback noise by decreasing the capacitive path. It consists of pre-amplifier stage and latch stage. At pre-amplifier stage, it amplifies the input differential signal, later in latch stage, again it amplifies its differential signal until Vdd reaches to Gnd [1–8]. The capacitive path is a series combination of gate-drain capacitors which reduces the kickback noise. The stages are independent on each other. So, that it is easier to construct the two stages.

The paper organized as follows. A review is presented on different comparators in Sect. 2. Section 3 explains about conventional comparator, proposed comparator was explained in Sect. 4. In Sect. 5 simulations and comparisons are done. Followed by conclusion in Sect. 6.

2 Litterature Review

Different types of two stage dynamic comparators have been analyzed in this section. In [5] presents a comparator with PMOS latch and amplifier which enhances the speed and power. The power was reduced by a special clock signal generated by delay line based controller. However, it effects the dynamic behavior of the circuit i.e., offset voltage. The comparator reported in [9] increases the speed and decreases the area. It has two phases, amplification phase and regeneration phase. During the amplification phase, the static power consumption is more. It means, it is not suitable for low-power applications at low frequencies. This comparator suits very good for high-speed applications. In [10], high-speed low-power insensitive dynamic comparator is presented. It has a combination of simple latch and amplifier. It reduces the power consumption, since the latch activated after some delay. Although, it has large offset voltage, suffers from large kickback noise and more area than conventional method. The structure presented in [11] offers a low-offset and low-power consumption using delayed clock signals. Depends on the clock signal values, it has 3 phases. At first, pre-charge phase, during this the transistors discharge the outputs to ground. After that amplification phase begins, in which the differential signal becomes amplified. In the final phase, comparison was made. The delayed clock signal improves the offset voltage but decreasing the speed. However, low-offset voltage cause large parasitic capacitors at output which required more power consumption.

The comparator presented in [13] is a low-voltage low-power double tail comparator. In this design two tail transistors are added to achieve the low-power consumption. It suffers from large kickback noise. Although, the proposed comparator has less delay and energy per conversion. In [14], comparator is proposed to avoid the excess power consumption. In this design the outputs are connected to the input transistors through buffers. Due to this structure the excess power was eliminated but series connection of transistors at input side decreases the speed. However, it does not affect the dynamic behavior of the comparator. In [12], low-power comparator was proposed. In which the outputs of pre-amplifier are connected to inverters and outputs of inverter connected to latch. So, that offset of comparator is more. The transistor count is more compare to conventional design.

In all the above explained research, they follows two methods to reduce offset voltage and power consumption. First method is bulk-tuned calibration which is used for low-offset voltage results in low-power and smaller transistors. The design procedure is complex and increases the area. Second method is delayed comparator with large transistors size. It sometimes increases the power consumption and decreases the speed of comparator. In this paper, we are using a particular controller to achieve low-power and high-speed. The design includes p-MOS latch and p-MOS pre-amplifier which results in an optimal delay. Hence it is useful for low-power applications.

3 Conventional Comparator

Two stage conventional comparator is shown in Fig. 1. This comparator constructed by a pre-amplifier and latch. It has two phases, reset phase and evaluation phase. During reset phase, the clk is set to logic '1' and $\overline{clk}$ is set to logic '0'. It resets the first and second stages of comparator to Gnd and Vdd respectively. When clk is set to logic '0' and $\overline{clk}$ is set to logic '1', the evaluation phase begins. Based on the input differential signal i.e., V+ – V- , the parasitic capacitors of output nodes are charged. If the voltage at the pre-amplifier output is greater than threshold voltage of n-MOS transistor in latch i.e., M_{10} & $M_{11,}$ the latch is activated and differential signal was amplified. In order to gain more amplification, the latch provides the positive feedback. The pre-amplifier output voltages are charged to Vdd simultaneously.

To achieve enough pre-amplification gain, we need the size of the input transistors ($M_{3,}M_4$) should be high and a better transistor matching occurs by large input transistors. Here, the effect of offset voltage is negligible. As earlier stated that the pre-amplifier outputs are charged to Vdd. Due to this reason, a large input transistors are considered at OP + and OP- nodes. A large parasitic capacitors are created at these nodes which needs more power consumption. Also, the speed of the comparator is depends on the speed of latch. The output voltages at pre-amplifier are large enough to activate the latch. It means, the output voltages of pre-amplifier should be greater than the threshold voltage of n-MOS transistors. To complete this total process, a larger time is required. This delay is cannot be controllable and depends on the input common mode voltage of comparator.

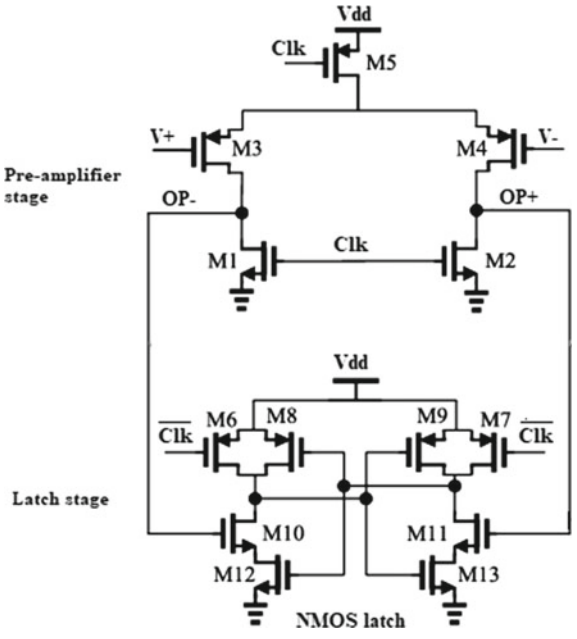

Fig. 1 Circuit diagram of conventional comparator

A differential voltage is appears at input of the latch after some delay. This signal must be large enough to reduce the input referred offset voltage and to turn on the latch stage. After comparison, the pre-amplifier still is in ON stage. It means the pre-amplifier output voltages are charged towards Vdd. Since, after comparison pre-amplifier can turn off to save the excess power but it is charged to Vdd. A large amount of power was consumed by pre-amplifier by charging process. The power consumption cannot be eliminate simply because comparison delay is unpredictable. It depends on several factors such as, input common mode voltage (V_{cm}), input differential voltage (V_{id}), Vdd and temperature. We need a design to eliminate excess power consumption and to increase the speed of comparator. A practical reliable design was proposed in this paper without effecting other parameters.

4 Proposed Comparator

The proposed design is shown in Fig. 2. Similar to conventional comparator it is also having two stages named as pre-amplifier and latch stages. When compared to conventional comparator the only difference in proposed design is latch. It is having

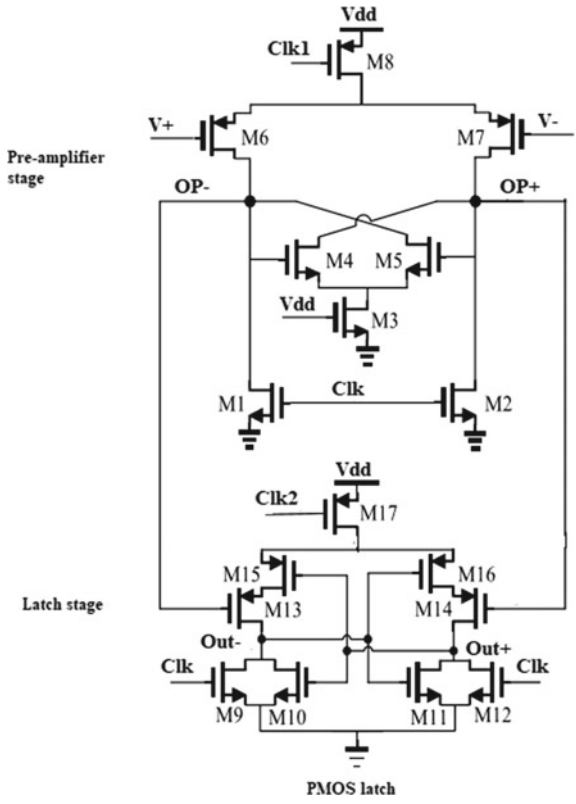

Fig. 2 Proposed comparator design

p-MOS latch i.e., latch with p-MOS input transistors. In conventional comparator the delay was unpredictable and uncontrollable. Proposed design consists of p-MOS latch with predictable delay during the evaluation phase. The reset phase is same as in conventional comparator. Proposed design controlled by a special clock signals. The control circuit is designed carefully which consumes less power.

During reset phase, clk, clk1, and clk2 are set to logic '1' which discharges the pre-amplifier output voltage and latch to Gnd. At evaluation phase, clk, clk1, and clk2 are set to logic '0' which begins the pre-amplification process. The parasitic capacitors are charged differentially. The cross coupled circuit in the design enhances the differential voltage ($V_{idp} = V_{OP+} - V_{OP-}$) and decreases the common mode voltage ($V_{cmp} = 0.5 \times (V_{OP+} - V_{OP-})$) which was given as input to latch. By providing larger pre-amplifier gain the differential voltage increases which eliminates the effect of input referred offset voltage on the latch and delay is less. Also, decreases common mode voltage, increases the comparator speed. Now clk2 is set to logic '0', which switch on the latch. At the same time, clk1 shifted to logic '1' which deactivates the source (M_8) of pre-amplifier. So, the excess power consumption is avoided. The cross coupled circuit is independent on the source (M_8), the amplification process is keep on going. The transistors M_{3-5} reduces the input common mode voltage.

In proposed design, the delay present in evaluation phase is sufficient to provide enough pre-amplifier gain. In conventional comparator, this delay is unpredictable and uncontrollable. The delay in proposed design is controllable, which is a major advantage of proposed design. NMOS transistors also can be used to implement the proposed design. It means, the inputs of pre-amplifier and latch are implemented by using NMOS transistors. The speed of comparator increases by using the input NMOS transistors. The size of M_4, M_5 should be taken large to kept the common mode voltage is small and to enhance the differential gain of pre-amplifier.

5 Simulated Results

Basically the performance of the two stage dynamic comparators are mainly depends on technology we used. The proposed comparator designed with 250 nm CMOS technology for the low-power and high-speed applications. In order to make a better comparison with proposed comparator, other comparators also designed with the same technology. Here, the proposed design was implemented using mentor graphics tanner EDA tool with T-spice simulator to obtain simulated results.

In this paper, mainly concentrated on the delay of the comparator and as well as power consumption of comparator. The delay of comparator mainly depends on the input common mode voltage of the latch i.e., OP+ , OP− node voltages. The inputs for the latch are the outputs of pre-amplifier. It means the delay of the comparator automatically depends on input voltages. The parameters which effects the delay of comparator are input common mode voltage, input differential voltage. If input common mode voltage is more the delay is more, as well as if input differential

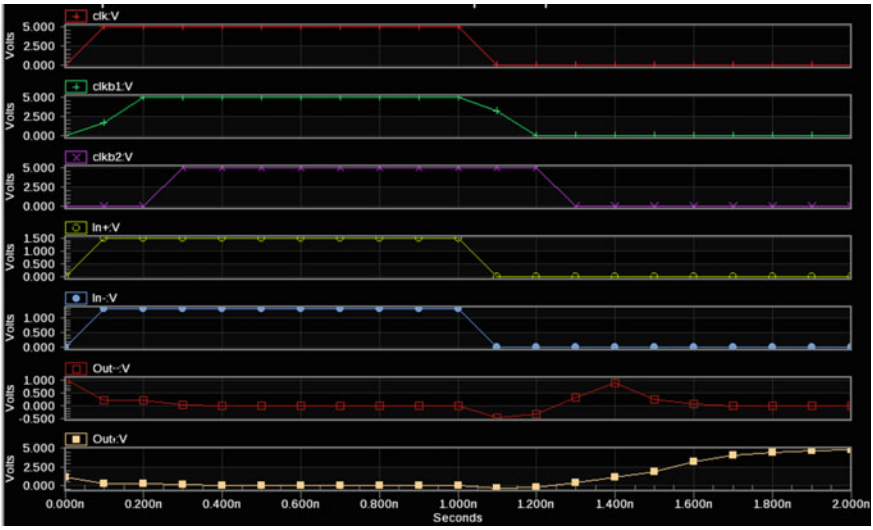

Fig. 3 Simulated input and output waveforms along with clock signals

voltage is more the delay is less. It means a better trade-off should be there between them. The proposed design has a special control circuit for generating clock signals. Figure 3 shows the clock signal with respected input and output waveforms. Here, the control circuit is carefully designed for better performance of comparator. Due to this the power consumption is increases but it is negligible when compared to total power consumption.

The proposed comparator was designed using the 250 nm CMOS technology with operating clock frequency as 500 MHz. The input common mode voltage is 1.4 V with a differential voltage of 200 mV. The offset voltage considered as 2 mV. Since, the offset voltage has an effect on speed of the comparator. It is observed that the delay and power consumption of proposed comparator is less

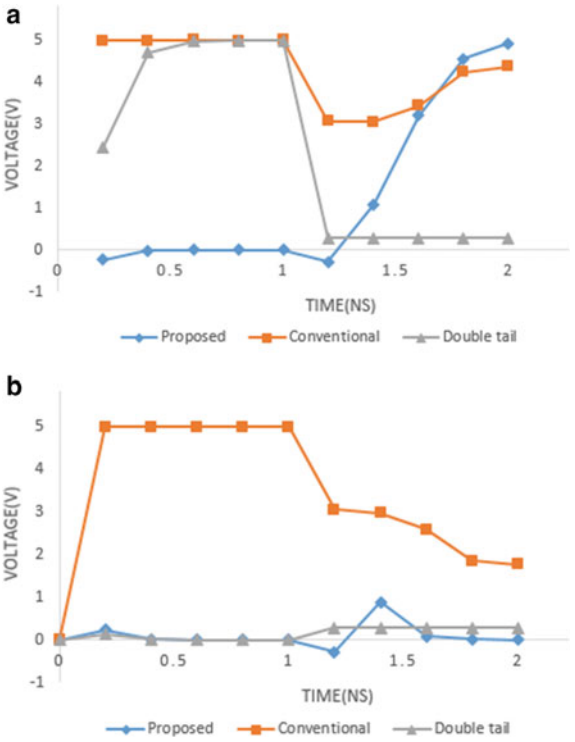

Fig. 4 (a), (b) Out + and Out- waveforms of different comparators

Table 1 Comparison of different dynamic comparators

Parameters	Conventional comp.	Double tail	Proposed comp.
Supply voltage (V)	5	5	5
Technology used	250 nm	250 nm	250 nm
Operating frequency	500 MHz	500 MHz	500 MHz
Delay (pS)	350	500	250
Average power (μW)	1.87	3.78	1.25
Offset(mV)	2	2	2
Maximum power (μW)	154	122	115
Power delay product (μW.pS)	0.65	1.89	0.31

compare to other methods. To make a better comparison the other designs are implemented using the same 250 nm CMOS technology. The output waveforms of all comparators are shown in Fig. 4. The detailed comparisons are shown in Table 1.

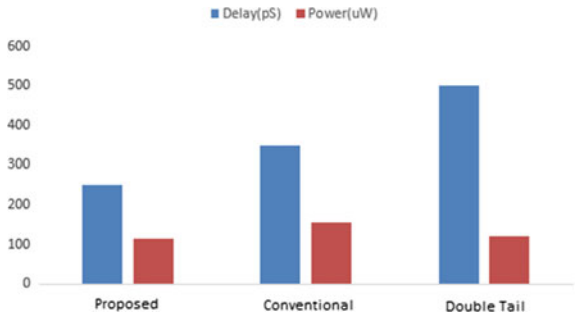

Fig. 5 Power & delay comparison of comparators

From the table it is clear that, the delay and power consumption of proposed comparator is less compare to others. Figure 5 presents a bar-graph to differentiate delay and power consumption of proposed comparator with other comparators. When proposed comparator compared to conventional comparator, the 25% power was saved and 28% reduction in the delay. When it compare with double tail comparator, the power reduced by only 5% whereas the delay reduction is almost 50%. Hence the proposed comparator achieves the low-power and high-speed.

6 Conclusion

The proposed comparator designed with p-MOS pre-amplifier and latch with p-MOS input transistors and with a special control circuit for clock signals. The cross-coupled circuit in the proposed design increases the pre-amplifier gain. Also, it enhances the speed of the comparator by maintaining a low common mode voltage. The proposed design speed improves by 40% compared to conventional comparator and the speed is almost doubled when compare with double tail comparator. It shows that the proposed design suitable for low-power high-speed applications.

References

1. Khorami A, Sharifkhani M (2018) A low-power high-speed comparator for precise applications. IEEE Trans VLSI Syst 26(10):2038–2049
2. Razavi B, Wooley BA (1992) Design techniques for high-speed, high resolution comparators. IEEE J. Solid-State Circ 27(12):1916–1926
3. Hong H-K, et al (2015) A 2.6b/cycle-architecture-based 10b 1 JGS/s 15.4 mW 4 × -time-interleaved SAR ADC with a multistep hardware retirement technique. In: IEEE International Solid-State Circuits Conference (ISSCC) Technical Digital Papers, February 2015, pp 1–3

4. Ragab K, Chen L, Sanyal A, Sun N (2015) Digital background calibration for pipelined ADCs based on comparator decision time quantization. IEEE Trans Circ Syst II Exp Briefs 62 (5):456–460
5. Khorami A, Sharifkhani M (2016) High-speed low-power comparator for analog to digital converters. AEU—Int J Electron Commun 70(7):886–894
6. Cho TB, Gray PR (1995) A 10 b, 20 Msample/s, 35 mW pipeline A/D converter. IEEE J Solid-State Circuits 30(3):166–172
7. Figueiredo PM, Vital JC (2006) Kickback noise reduction techniques for CMOS latched comparators. IEEE Trans Circuits Syst II Exp Briefs 53(7):541–545
8. Khorami A, Sharifkhani M (2016) Low-power technique for dynamic comparators. Electron Lett 52(7):509–511
9. Abbas M, Furukawa Y, Komatsu S, Takahiro JY, Asada K (2010) Clocked comparator for high-speed applications in 65 nm technology. In: Proceedings of IEEE Asian Solid State Circuits Conference (A-SSCC), November 2010, pp 1–4
10. Gao J, Li G, Li Q (2015) High-speed low-power common mode insensitive dynamic comparator. Electron Lett 51(2):134–136
11. Hassanpourghadi M, Zamani M, Sharifkhani M (2014) A low-power low-offset dynamic comparator for analog to digital converters. Microelectron J 45(2):256–262
12. Rabiei A, Najafizadeh A, Khalafi A, Ahmadi SM (2015) A new ultra low power high speed dynamic comparator. In: Proceedings of IEEE 23rd Iranian Conference Electrical Engineering (ICEE), May 2015, pp 1266–1270
13. Babayan-Mashhadi S, Lotfi R (2014) Analysis and design of a low-voltage low-power double-tail comparator. IEEE Trans Very Large Scale Integr (VLSI) Syst 22(2):343–352
14. Khorami A, Sharifkhani M (2017) Excess power elimination in high resolution dynamic comparators. Microelectron J 64:45–52

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Predicting Students' Transformation to Maximum Depressive Disorder and Level of Suicidal Tendency

G. Surya Narayana, Chalumuru Suresh, and Kamakshaiah Kolli

Abstract Suicide is an instance of taking own life intentionally. The second main reason behind the death of young persons aged amid 10 to 24 years is suicide. Depression and unhappiness leads the people to commit suicides. Major Depressive Disorder (MDD) or simply 'depression' can be mild or severe that engages lack of curiosity and joy towards usual activities and low mood. It can be short-lived or chronic. The paradox is that, among the most treatable problems, depression is the one and it can be cured with the help of medication and psychotherapy. Suicides can be prevented by measuring the level of depression. An online questionnaire has been developed to assess the depression level of a person and predicted the suicide tendency by applying two machine learning algorithms LVQ(Learning Vector Quantization) and KNN(K-Nearest Neighbor). The study shows that LVQ, an exceptional case of neural network gives more accuracy than the KNN model.

Keywords Maximum depression disorder · Suicide tendency · Prediction · ANN · LVQ

1 Introduction

In India, the biggest crisis towards personal, family, and societal is Suicide. With respect to the survey report issued by WHO, 8 lakh people are dying by suicide every year which is one person for every 40 s. Across the World, suicide stood as

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_111

the second major reason for the death of young individuals aged amid 15–29 years accounting for 1.4% of deaths worldwide. However, in developing countries like India 75% of deaths happen due to suicide [1, 9].

An estimated 2–15% of persons who have been diagnosed with major depression die by suicide. Today, depression became the most common psychological health disorder [10]. The number of students who are suffering from depression due to stress and failure is exams, career are rapidly increasing [2]. MDD is defined as a mood disorder characterized by the existence of unhappiness, sad and irritable mood, with somatic and cognitive changes that impacts the individual's ability to function negatively. Major depression is responsible for more physical and social dysfunction that leads to suicidal tendency [3]. Survey reports showed that one in every four teenagers went through depression during their college life and it is guesstimated that, at any point of time nearly 10 to 15 percent of adolescents are in depression. Major Depressive Disorder throws a person into a situation where he or she can't take the joy or pleasure in doing activities and makes the person feel hopeless. Depressive cases generally end with hurting events like suicides [8] but, the fact is that MDD is a curable disorder if it is properly diagnosed.

In this study, a dynamic model is developed that will identify the students suffering from different levels of MDD and also predict the students transforming from serious MDD to suicidal tendency. To investigate risk factors an Assessment Questionnaire has been developed that measure the MDD level in students to screen and evaluate their tendency level periodically [6]. This assessment helps the evaluator to take appropriate measures to provide timely and appropriate support to students in need. It aims to improve the mental stability of teenagers with a view of reducing the suicide tendency. The objective of the research is to prevent youth suicide through developing diversified programs on mental health promotion to improve positive thinking in students.

2 Literature Survey

Research on predicting suicides with some traditional methods are summarized below:

Ramasubbu et al. [11] performed classification on FMRI data with fivefold cross validation and achieved performance 59, 72 and 66% with respect to sensitivity, specificity and accuracy with P value 0.012 correspondingly, but the study limits to analyzed data based on brain measurements and they have limited potential in differentiating patients.

Zhang et al. [12] applied Naive Bayes classification to identify the sentences in web pages for assessment according to evidence-based depression treatment guidelines.. The results shows Significant Pearson correlation $p < .001$. The study limits to 3–20 guidelines and the data set is relatively low and used small classifier method.

Hosseinifard et al. [13] proposed methods to uselogistic regression classifiers, k-nearest neighbor and linear discriminate analysis in classifying depression and non-depression patients with feature of EEG signal using.The experimental results showed that correlation dimension and LR classifier achieved 83.3% accurate results.

Zhu et al. [14] used Multi-Site Weighted LASSO Model on brain imaging data to classify Major Depressive Disorder. This technique succeeded in enhancing the classification accuracy MDD by 4.9%. The technique was implemented on large scale data and its proved that it effectively enhanced the classification accuracy by 4.9%.

Wang et al. [15] presented classification technique to MRI Data with Graph-Based Features and Sparse Low-Rank Functional Brain Network and achieved 95% accuracy, 96.77% sensitivity, and 93.10% specificity with the Pearson Correlation.

Khodayari, Rostamabad et al. [16] designed a prediction approach using EEG data and achieved specificity 80.9%, sensitivity is 94.9%, and accuracy of 87.9%.

Yu and et al. [17] proposed an innovative supervised classification technique to diagnose major depressive disorder using support vector machines. The results showed that this technique l provides 90.6% results in terms of sensitivity and specificity.

Walsh et al. [18] proposed a novel technique to predict whether a person will commit suicide or not by analyzing the medical database using machine learning algorithms. The results shows (AUC = 0.84, precision = 0.79, recall = 0.95, Brier score = 0.14). The method enabled the clinicians and doctors to forecast a person will commit suicide or not in the coming two years and succeeded in generating 80% accurate results.

Baca-Garcia et al. [19] used machine learning and NLP (Natural language processing) to predict suicidal ideation Madrid, Spain. They compared NLP-based models using the unstructured question with logistic regression prediction models using structured data. The PPV, sensitivity, and specificity for NLP-based models of suicidal ideation were 0.61, 0.56, and 0.57, respectively, compared to 0.73, 0.76, and 0.62 of structured data-based models.

Singh and Joshi [20] projected that the three major reasons behind committing suicide are stressful life, depression and two dimensions of personality i.e. extraversion and psychoticism. Extraversion, stressful events and depression are identified as the main reasons for committing suicide through a stepwise multiple regression analysis.

Shaheen et al. [21] proposed an innovative technique to predict suicidal ideation by performing hierarchical regression analysis to assess the utility of stress and optimism. These variables accounted for a significant 19.5% ($R2 = .195$, $F = 11.818$, $p < .001$) of the variance in suicidal ideation, gender and percentage of marks in preceding grade examination being the consistent predictor in all the four steps of analysis.

3 Research Methodology

Earlier research shows that higher neuroticism relates to more suicidal thinking [5]. Suicidal rates of young students are being increased due to the lack of sufficient diagnosis and treatment methods for depression in undergraduate college students [7]. Many prediction models are in existence with diverse approaches in predicting the depression levels but there is no conviction that these predictors can accurately determine the depression level. Prediction of outcome will help to take counter-active measures towards the improvement of the mental health of a student at risk [22, 23].

For this intention, Classification algorithms like LVQ (Learning Vector Quantization) and k-Nearest Neighbor (kNN) areadopted to assess the risk among young students and to predict accurately their MDD Level. The performance evaluations of the algorithms are also depicted (Fig. 1).

KNN Algorithm

K-Nearest Neighbor is a wellknown classification algorithm for its low calculation time and ease of use.

Steps:

1. KNN starts with loading the data.
2. K value is initialized in the second step.

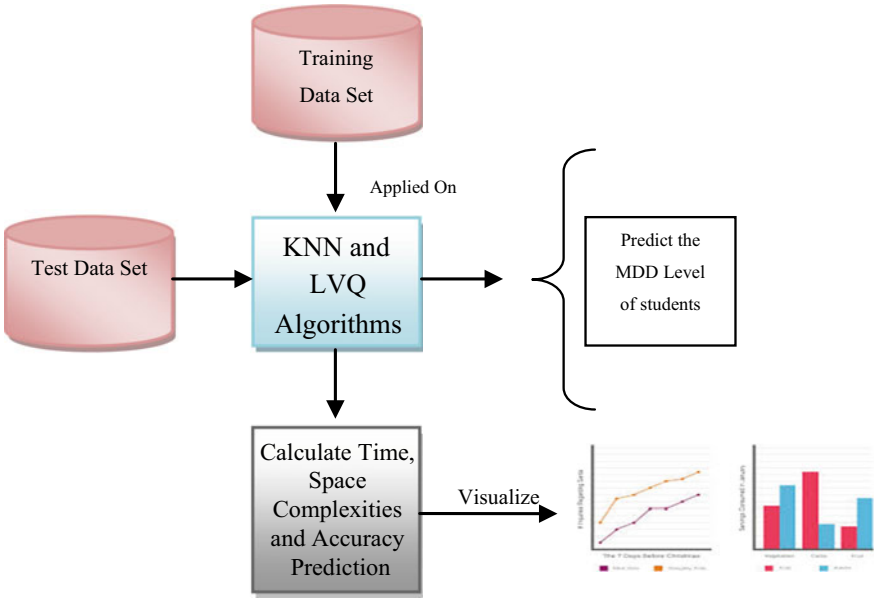

Fig. 1 Architecture of the proposed system

3. Class is predicted by iterating from 1 to n where n represents the number of training data points.
4. Euclidean distance technique is used to find the distance amid each row of training data and test data.
5. Arrange the distance values generated in increasing order.
6. Take the top k rows of the sorted array.
7. Find the most frequent class these rows belong to.
8. Revisit the predicted class.

LVQ Algorithm

Learning Vector Quantization classification algorithm supports binary as well as multi-class classification problems.

LVQ is a collection of codebook vectors.

1. A codebook vector comprises of a set of numbers that have both input and output attributes same as the training data. For instance, if the problem contains length, height and width as attributes, then even a codebook vector also comprises of the same attributes.
2. A set of codebook vectors learned from the training data are clubbed to form the model. They look like training instances, but the values of each attribute have been adapted based on the learning procedure.
3. In neural networks terminology, an individual codebook vector is known as a neuron, every attribute is termed as a weight and a network can be defined as a gathering of codebook vectors.

4 Experimental Results

This system is built and implemented using R Programming. Suicide Assessment Questionnaire has been developed using C#. The dataset is built with 100 records of the students' statistical information obtained through the test. After preprocessing it, KNN and LVQ algorithms are applied.

The model will predict and classify the students who are suffering with different levels of MDD (Low, Moderate, and Strong) by using both k-NN and KNN algorithms and suggest appropriate actions to be taken at each level to mitigate the MDD risk among the students.

Training Dataset has been built considering 100 students with 15 suicidal risk assessment attributes and MDD level as class to assess the accurate MDD levels (low, moderate, strong) of other 100 students in the test dataset.

Attributes, each with three different levels (low, moderate, high) include: Someone's presence, Intervention probability, Precautions, Actions necessary to assist during or after attempt, Preparatory actions for attempt, suicide note, conversations had before attempt, suicide aim, death possibility, attempt seriousness, attitude towards living or dying, rescue ability and degree of premeditation.

The study uses kNN and LVQ that learns the training data set and builds a model on which test data is applied. The model predicts the level of suicide tendency to take appropriate actions as below.

Students with low level of depression are directed to seek advice from Community Mental Health Team or General Practitioner, Students with moderate level of depression are advised to get assessed by Psychiatrist and the same with High level are recommended for immediate Psychiatrist admission. (Tables 1, 2, 3), (Figs. 2, 3, 4)

Table 1 Shows the comparison of time complexity of K-NN and LVQ

Time complexity		
Algorithm	No of records	Time (mSeconds)
K-NN	100	2999
LVQ	100	1320

Table 2 Shows the comparison of space complexity of K-NN and LVQ

SPACE complexity		
Algorithm	No of records	Time (kb)
K-NN	100	3750
LVQ	100	899

Table 3 Shows the correctly and incorrectly classified instances of kNN and LVQ

Algorithm	No of records	Correctly predicted instances	Incorrectly predicted instances	Accuracy
K-NN	100	85	14	0.85859
LVQ	100	93	6	0.93939

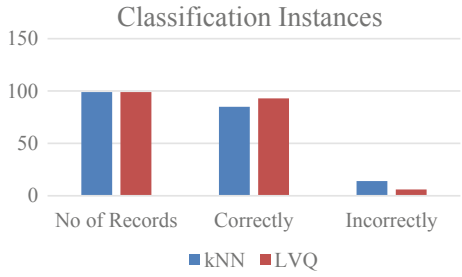

Fig. 2 Shows the correct and incorrect instances of K-NN and LVQ

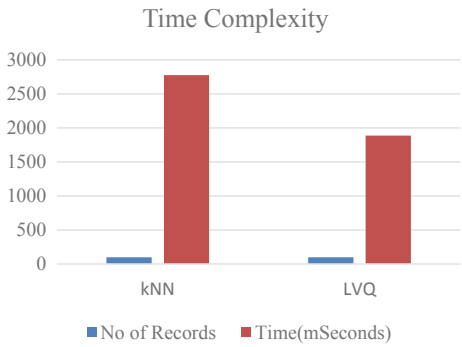

Fig. 3 Comparison graph of K-NN with LVQ in terms of time complexity

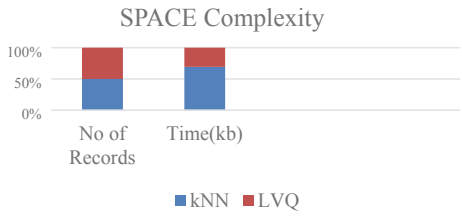

Fig. 4 Comparison graph of kNN with LVQ in terms of space complexity

5 Conclusion

The intensity of Major Depressive Disorder (MDD) can be predicted by evaluating the risk factors associated with Suicidal Thoughts and Behaviors of undergraduates or young students is crucial to potentially prevent suicides and suggest effective treatment [4]. The scope of this study is to explore the prediction accuracy of MDD level and guesstimate the performance of algorithms used in such conditions. Hence, a model is developed in which two machine learning algorithms kNN and LVQ were applied consecutively. From the experimental results it is proved that LVQ is most appropriate for predicting the suicide tendency level. It gives accurate 93% prediction which is relatively higher than kNN with 85%. To bring to a close, it can be assumed that optimum prediction can be obtained by preferring LVQ to kNN. Moreover, this revision is an effort to differentiate the performance of the two algorithms with respect to time and space complexities and accuracy rate to give the accurate predictions of MDD levels for signifying appropriate actions accordingly.

References

1. Shweta K, Jennifer W, Dorian LA (2017) Stress, depressive symptoms, and suicidal ideation in undergraduate women with varying levels of mindfulness. Arch Women's Mental Health 20(1):129–138
2. Bisson KH (2017) The Effect of Anxiety and Depression on College Students' Academic Performance: Exploring Social Support as a Moderator. Spring 5–2-2017, Dissertations, Abilene Christian University
3. Yoder KA (2001) Suicidal ideation among American Indian youth. 2001, Dissertations, Iowa state university
4. Amini P, Ahmadinia H, Poorolajal J, Amiri MM (2016) Evaluating the high risk groups for suicide: a comparison of logistic regression, support vector machine, decision tree and artificial neural network. Iran J Public Health 45(9):1179–1187
5. Kerby DS (2003) CART analysis with unit-weighted regression to predict suicidal ideation from Big Five traits. Pers Individ Diff, 249–261, Elsevier
6. Choi S, Lee W, Yoon J, Won J, Kim W (2017) Risk factors of suicide attempt among people with suicidal ideation in South Korea: a cross-sectional study. BMC Public Health 17:579, https://doi.org/10.1186/s12889-017-4491-5
7. Arria AM, O'Grady KE, Caldeira KM, Vincent KB, Holly MAC, Wilcox EDW (2009) Suicide ideation among college students: a multivariate analysis. NIH Public Access 13 (3):230–246
8. Oquendo MA, Currier D, Mann JJ (2006) Prospective studies of suicidal behavior in major depressive and bipolar disorders: what is the evidence for predictive risk factors? Psychiatr Scand 114:151–158
9. Starlin M, Johann E (2016) Suicide in India: distinct epidemiological patterns and implications. Ind J Psychol Med 38(6)
10. Wasserman D, Cheng QI, Jiang GX (2005) Global suicide rates among young people aged 15-19. World Psychiatry 4(2):114
11. Ramasubbu MDR et al (2016) Accuracy of automated classification of major depressive disorder as a function of symptom severity. Neuro Image Clin, pp 320–331
12. Zhang Y, Cui H, Burkell J, Mercer RE (2014) A machine learning approach for rating the quality of depression treatment web pages. In: iConference
13. Hosseinifarda B, Moradia MH, Rostamib R (2013) Classifying depression patients and normal subjects using machine learning techniques and nonlinear features from EEG signal. Comput Methods Programs Biomed 109(3):339–345. https://doi.org/10.1016/j.cmpb.2012.10.008. Epub 2012 Nov, Elsevier
14. Zhu Z et al (2017) Classification of major depressive disorder via multi-site weighted LASSOModel. In: MICCAI 2017
15. Wang X, Ren Y, Zhang W (2017) Depression disorder classification of fMRI data using sparse low-rank functional brain network and graph-based features. In: Computational and Mathematical Methods in Medicine, vol 2017
16. Khodayari-Rostamabad A, Reilly JP, Hasey GM, de Bruin H, Maccrimmon DJ (2013) A machine learning approach using EEG data to predict response to SSRI treatment for major depressive disorder. Clin Neurophysiol 124(10):1975–1985
17. Yu JS, Xue AY, Redei EE, Bagheri N (2016) A support vector machine model provides an accurate transcript-level-based diagnostic for major depressive disorder. Transl Psychiatry 6 (10):e931
18. Walsh CG, Ribeiro JD, Franklin JC (2017) Predicting risk of suicide attempts over time through machine learning. SAGE J 5(3)
19. Cook BL, Progovac AM, Chen P, Mullin B, Hou S, Baca-Garcia E (2016) Novel use of natural language processing (NLP) to predict suicidal ideation and psychiatric symptoms in a text-based mental health intervention in Madrid. Comput Math Methods Med 2016(2016), 8 p, Article ID 8708434

20. Singh R, Joshi HL (2008) Suicidal ideation in relation to depression, life stress and personality among college students. J Ind Acad Appl Psychol 34(2):259–265
21. Shaheen H, Jahan M, Shaheen S (2014) A study of loneliness in relation to well-being among adolescents. Self 14:2–836
22. Rashid E, Ansari MD, Gunjan VK, Khan M (2020) Enhancement in teaching quality methodology by predicting attendance using machine learning technique. In: Modern Approaches in Machine Learning and Cognitive Science: A Walkthrough, pp 227–235. Springer, Cham
23. Sethi K, Jaiswal V, Ansari MD (2019) Machine learning based support system for students to select stream (subject). Recent Patents on Computer Science 12:1. https://doi.org/10.2174/2213275912666181128120527

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To Identify the Sinkhole Attack Using Zone Based Leader Election Method

Dabbu Murali, P. Sunil Gavaskar, and D. Udaya Suriya Rajkumar

Abstract Wide ranging of research occurs across the world onlooker the significance of Wireless Sensor Network in the present day application world. In the current history, a variety of routing techniques are present to rise life time of WSN. Grouping mechanism is extremely victorious in giving security for network behavior and has turn into promising field for researches. Several unequal algorithms are presented to resolve this intrusion difficulty in wireless sensor network. This paper is used to overcome this as well as to offer lofty security Zone Based Leader Election Method is proposed. ZBLEM is utilized to identify the compromise node in each zone of the network. The proposed algorithm detects the malicious node in the inter or intra zone. The malicious nodes simply communicate with any node in the zone and try to compromise the nodes and in revolve ruin the nature of the network. To decrease the damages be felt on the compromised nodes, it ought to be effectively identified and revoked as earlier as possible. Here, the leader will be chosen region wise based on the energy level to identify the intruder and revoke the compromised node.

Keywords Intrusion · Zone based leader election method · Malicious node · Compromised node · Revoke

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_112

1 Introduction

A wireless networks that consist of low-cost sensors, small tiny device which can sense the surroundings information, then gather and broadcast message. It is spatially scattered to supervise and manage the agreed region with a deterministic or random approach [1]. It has functioning in a bunch of fields such as military application, examine environment and preventing disaster. Thus, a sensor network can be illustrated as a group of sensor nodes that can achieve definite task. Unlike usual wired networks, the sensors correspond with every added and take out the frequent target cooperatively [2].

A dynamic network (DN) is an arbitrary network that shifts changes in overabundance of time. It is disparate from the permanent networks; nodes in lively networks are scattered arbitrarily and have mobility to each way with a concurred rate [3]. For the difficulties in dynamic network, most of the past mechanism receives the considerations from static networks for example elections of leader; associated overlook sets creation, and topology control. A dynamic sensor network (DSN) comprises of mobile hand-held smart devices. These devices are conveyed by people or connected to mobile objects, for example, cars. They can gather the detecting data inside a specific range and report the information to the Internet by WiFi or 2G/3G/4G networks. DSNs additionally have applications in different domains for example transportation, environmental monitoring and social networking [4]. In this manner, a DSN can be portrayed as a unique set of nodes (i.e., sensors), which in part is connected by dynamic undirected communication links. In contrast static networks, nodes in DSNs are powerfully added to the network and are expelled from the network [5].

Leader election is a fundamental issue in distributed computing for breaking symmetry and examining different issues, for example as communicating and data aggregation. Leader election is for every processor in the end of concludes that whether it is a leader or not expose to just a single processor concludes that it is the leader [6]. Right now, study the zone based leader election technique in dynamic sensor networks, the principle reason is that if there exist different leaders in the network, it is advantageous to accomplish and monitor the environment, allocation of resource allocation, collection of data and improving the different parameters. In this article first we split the network and get the numerous of the regions. Next, we elect the leader for each zone to monitor the network. Finally, we design algorithms to solve the compromised node in the network and revocation the node from the network.

The major contributions of this article can be summarizing as behind. For the objective of giving security and furthermore term of network lifetime, we present a zone based leader election technique. The remainder of the article is composed as follows. Section 2 gives an outline of the related work. In Sect. 3, we proposed the

meaning of zone based leader election technique. We give the detailed execution procedure of the planned calculations in Sect. 4. We examine the performance of the algorithms in Sect. 5 finally; we outline our work and finish the paper.

2 Related Works

In [7] author discussed a novel network organization method for energy efficient edge oriented network separation method, to assemble sensor nodes into clusters of same size. It also presented a cluster-based routing method known as zone based routing protocol (ZBRP), for uplifting network lifetime. In [8], author presents two protocols next the leader election method, which have been simulated utilizing OMNET++ and Castalia. The procedure has been executed, moreover additional suggestion MWSN routing protocols, to identify the impact of size of network and performance of node velocity, which has executed the legality of our method. In [9] present approach, an Intelligent Intrusion Detection System (IIDS) technique to identify the intruder in the network, which utilizes a Hybrid method to identify and avoid sinkhole threat, with two methods they are Zone-Based Leader Election technique and Leader Based Monitoring. In the Leader Based Monitoring technique, when a node gets identified as a malicious node, it informs the condition of that node to the various leaders in the WSN. This method can detect the malicious node and develop the effectiveness of the network [10,11].

3 Proposed Work

In proposed work the network model shows that the, nodes are divided into ten sub groups. It can be safely assumed that there are 101 nodes deployed randomly throughout the network. From that one node is considered as a base station, 10 nodes are leader node and other nodes are normal nodes. Each group consists of one leader. The communication among the nodes is bi-directional. In the network BS is the major trusted entities. There is a guess that the BS cannot be compromise by any intruder nodes and all the nodes are under the control of the base station.

Number of nodes N is equally separated and set arbitrarily in the zones and every zone has its own leader. The sensor nodes can interact and communicate with different nodes through their leader. At the point when a node communicates with other nodes in any zone, the zone leader can be observed the surrounding node. The leader node can be act as a server and furthermore it should check all the

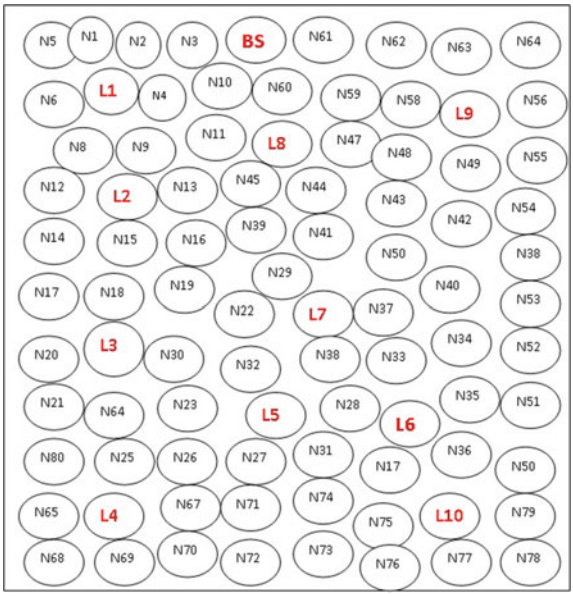

Fig. 1 Network model for zone wise leader election process

communication in the network. In the event that any node tries to make trouble in the network and try to spoil the environment. Leader node confirms the information about that node by utilizing the present technique which prevents nodes compromising in the zone. The network model is appeared in the Fig. 1.

The present method is identifying and preventing malicious nodes. In the first stage, the node information is confirmed by the zone leaders, which ensure the node information. If the information matches with the information table, then it allows the data to be transmitted otherwise blocks the node immediately and diverts to the base station. All the nodes in the network know their location and neighbour node information in the zone. If any node gets compromised and tries to misbehave in the network, this node is instantly diverted to the BS. The BS get rid of and blocks the node instantly. The entire functionality of the ZBLEM is given in following algorithm.

Algorithm for Zone Based Leader Election Method

Step 1: Let us consider the wireless sensor network G.
Step 2: G is divided in to many zones $G = Z_1, Z_2, Z_3 \ldots\ldots Z_n$.
Step 3: Each Zone Z_i has N number of nodes $Z_i = (N_1, N_2, N_3 \ldots\ldots N_n)$.
Step 4: All the nodes in the Zone is bouded with the following initial Configuration settings $\forall$ nodes(N)Energy, $E_i = 1000$ Time, $T_i = 0$
Step 5: At everyΔ time T_i and E_i values are calculated for the nodes.
$\leftarrow$ return $(E(N_1 > N_2 > N_3 > \cdots N_n))$and $\neg E(N_i)$.
Step 7: The leader will update the node ID and location of each node in the network zone to the basestation tmp BaseArr[i] = zoneNode [all nodeInfo] routing table tmpNodeArr[i] = [NodeID(i), X(i), Y(i), zoneID(i)]
Step 9: End loop
Step 10: Compare the location coordinate of nodes in the routing path with source location
Step 11: If$(tmpNodeArr[i].X(i)\&Y(i)) = (tmpBaseArr[i].X(i)\&Y(i)$ AND (tmpBaseArr[i].NodeID(i) = tmpNodeArr[i].NodeID(i)
Step 12: then
Step 13: Node is valid and non malicious
Step 14: else
Step 15: tmpBaseArr[i]discards node i from network or reassigns it by providing new parameter value by provides new NodeID
Step 16: End if
Step 17: End

3.1 Simulation Result of Zone Based Leader Election Method

The simulation is done through Network Simulator with 101 nodes.

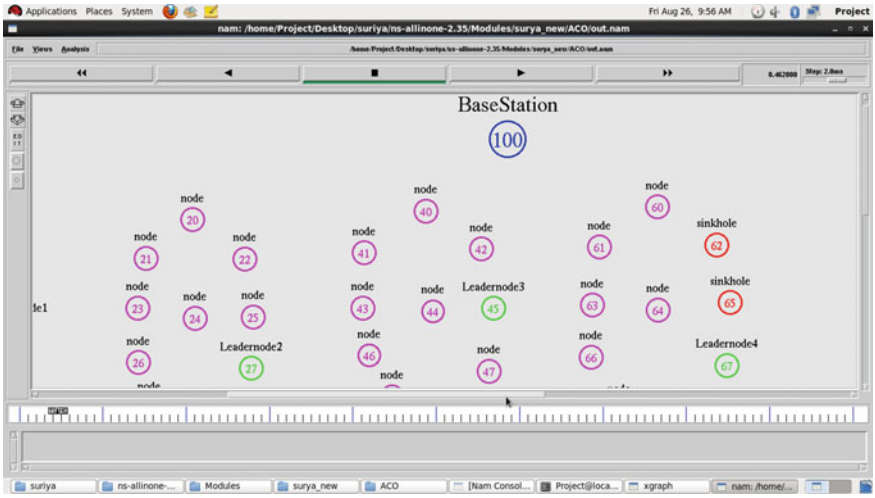

Fig. 2 Screen shot of nodes deployed in the network

Figure 2 shows that the simulation results of ZBLEM. Here, node 100 is assumed as a base station and the leader nodes 27, 45 and 67 are monitoring the surrounding nodes in the zone. The leader will be elected based on the energy as well as performance of the node. If any node tries to misbehave in the network, a node can be identified by the leader node and diverts to the base station and the communication path established through zone leader only.

Figure 3 shows the communication between the source node 29 to the base station through intermediate nodes and is monitored by the leader node. If any node tries to misbehave in the route or in the zone that node is treated as sinkhole node. Here, node 21 and 20 try to misbehave in the network node is assumed as a sinkhole node. When a node was detected as a malicious node, the leader node can inform the status of the base station and the base station eliminates and blocks the node immediately.

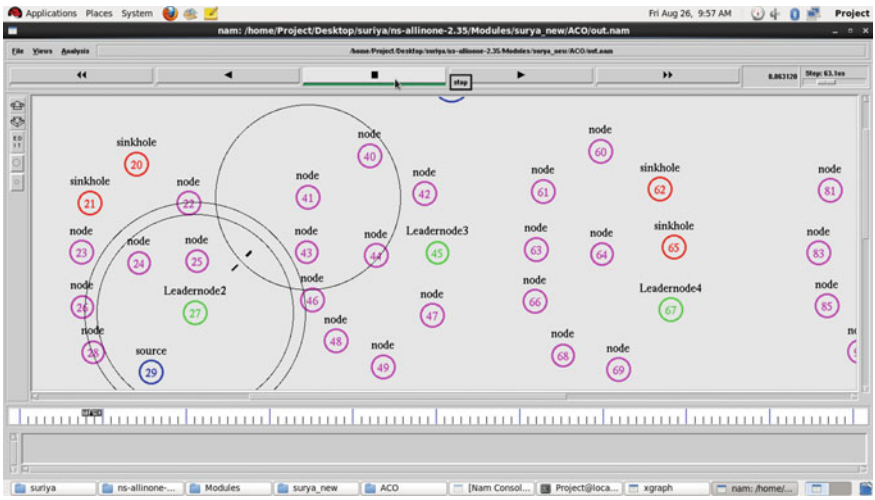

Fig. 3 Communication between the source nodes to the destination node

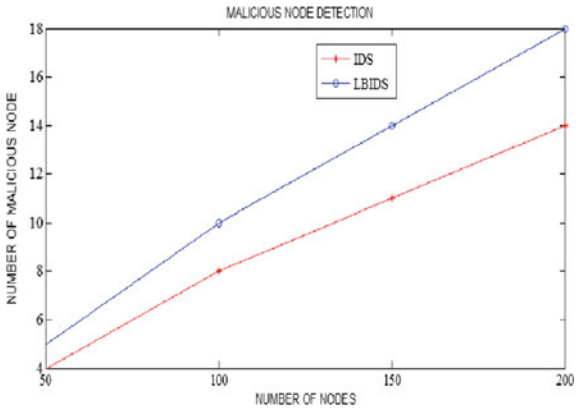

Fig. 4 Comparison of malicious node identification by previous IDS and present LBIDS

4 Result and Discussion

In this section results of various parameters like malicious node detection, average delay, routing overhead, packet delivery ratio and throughput for the leader based intrusion detection system and zone based leader election method is presented.

Figure 4 shows the performance of malicious node detection with existing IDS and proposed LBIDS. We have assumed that 20 attackers node in a network with 200 nodes. In the case of the propose LBIDS 18 attacker node has been detected, but in the existing can only 14 attackers node were only detected. An average of 90%, malicious node is detected by the proposed method. This is because of leaders are acting as a monitoring network.

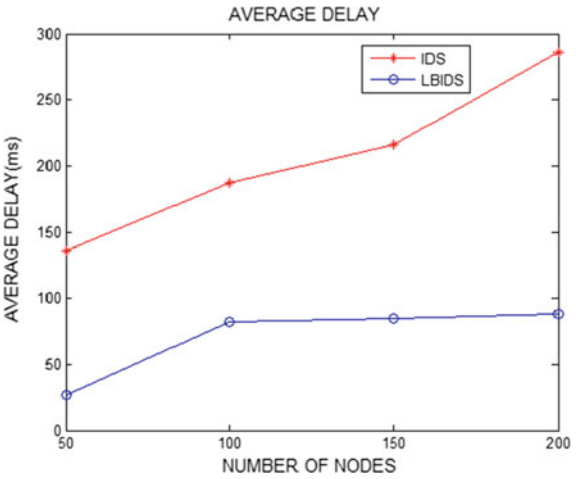

Fig. 5 Comparison of average delay with existing IDS and proposed LBIDS

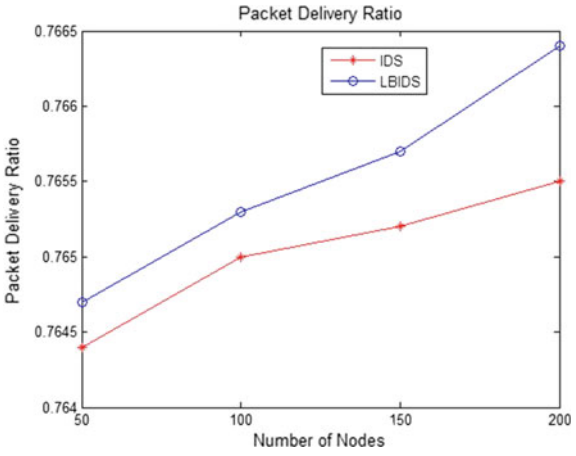

Fig. 6 Comparison of packet delivery ratio with existing IDS and proposed LBIDS

Figure 5 explain the evaluation of average delay for the existing IDS and proposed LBIDS. From the simulation results. It is shown that the average delay in the existing IDS is 135.67 ms and in proposed LBIDS is 27.06 ms for 50 nodes. Likewise, network of 200 nodes, the average delay for the existing IDS is 286.23 ms but in the proposed approach average delay is 88.27 ms.

Comparison of the packet delivery ratio for previous IDS and proposed LBIDS is depicted in Fig. 6. From the simulation results it is shown that the packet delivery ratio in the previous IDS is 0.7644 and in proposes LBIDS is 0.7647 for 50 nodes. For 150 nodes the packet delivery ratio in the existing IDS is 0.7652 and in proposed LBIDS is 0.7657.The increase in performance is due to the leader election process adopted in the proposed approach.

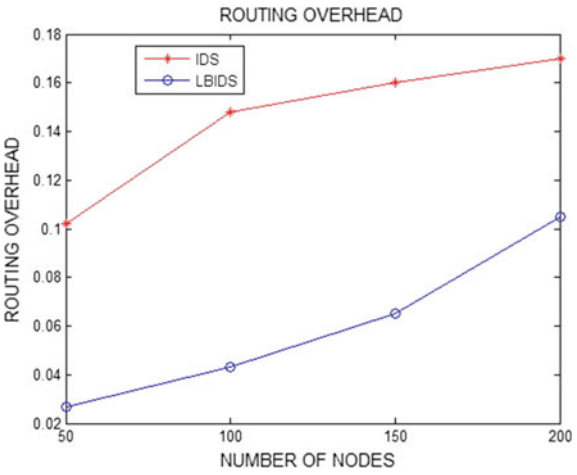

Fig. 7 Comparison of routing overhead with existing IDS and proposed LBIDS

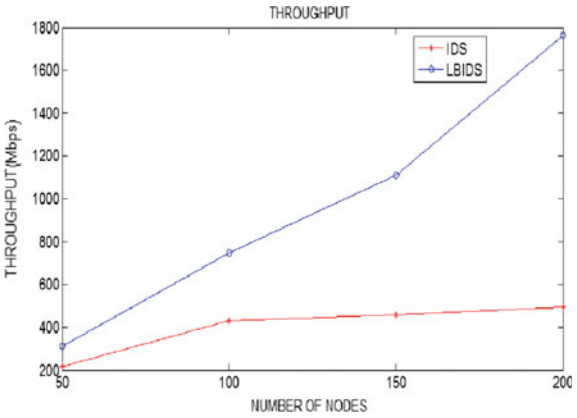

Fig. 8 Comparison of throughput with existing IDS and proposed LBIDS

Routing overhead with existing IDS and proposed LBIDS is presented Fig. 7. From the comparison results it is shown that the routing overhead in the existing IDS is 0.102 and in proposed LBIDS is 0.027 for a network of 50 nodes. Likewise, for 100 nodes the routing overhead in existing IDS is 0.148 and in proposed LBIDS is 0.043.

Figure 8 shows the comparison of throughput with existing IDS and proposed LBIDS. From the simulation results, it is shown that the throughput in the existing IDS is 218.12 and in proposed LBIDS is 218.12 for 50 nodes. Likewise, Edith Ngai et al. (2007) reported for 100 nodes the throughput for IDS was 430.29but the proposed LBIDS is 747.09.

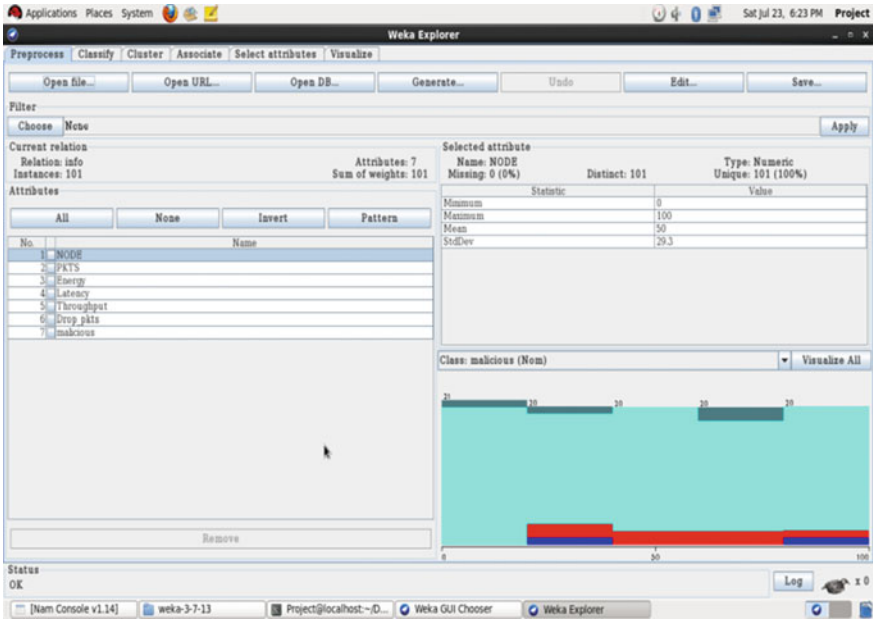

Fig. 9 Pre-processing technique to analyse the node

The result of the ZBLEM is performed using the weka tool. To analyse the behaviour of each node the machine learning technique is used. There is much unessential and excess data display for the period of training phaseit is more troublesome. In this manner, information can be pre-processing incorporates transforming, cleaning and feature extraction. The after effect of data pre-processing is the last training set which is for the most part of a considered and talked about underneath. Figure 9 shows the pre-processing method to analyse the node information. Here, the number of nodes is restricted to 100 as maximum and minimum as 0. All 101 nodes in the network are considered as an authenticated node by generic.

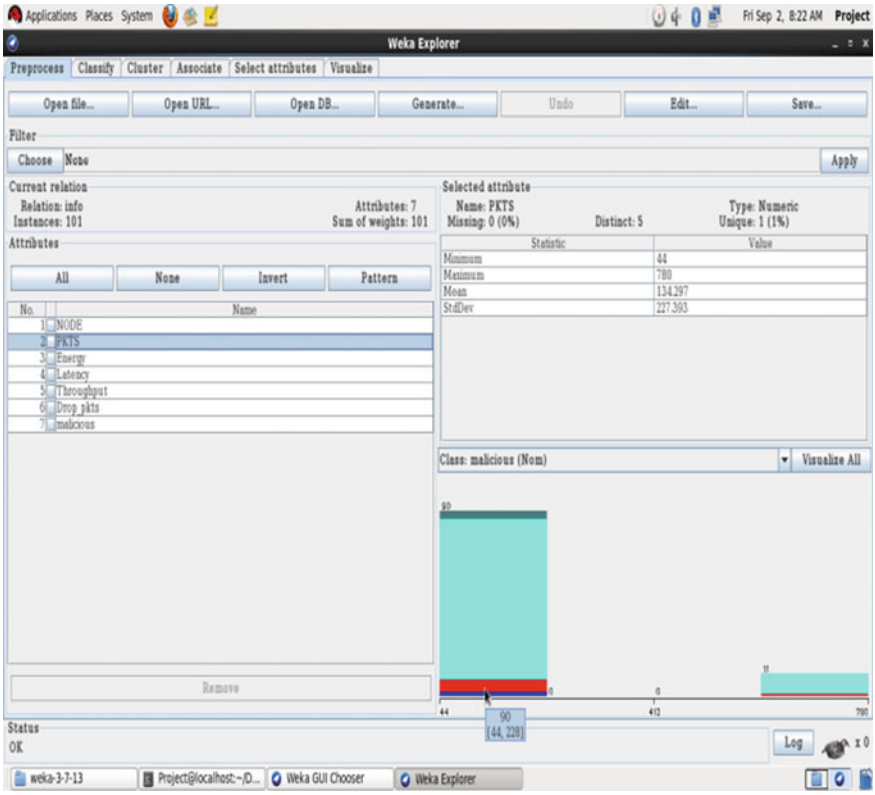

Fig. 10 Pre-processing technique to analyse packets

Ranges of transmitting data packets are analysed using pre-processing technique and are presented in Fig. 10. Here, 90 nodes are transmitting data packets from 44 packets to 228 packets and remaining 11 nodes transmitting data packets from 596 to 780 packets. From the figure it is seen that the minimum number of packets transmitted by the node is 44 and packets and the maximum number of packets transmitted by the node is 780.

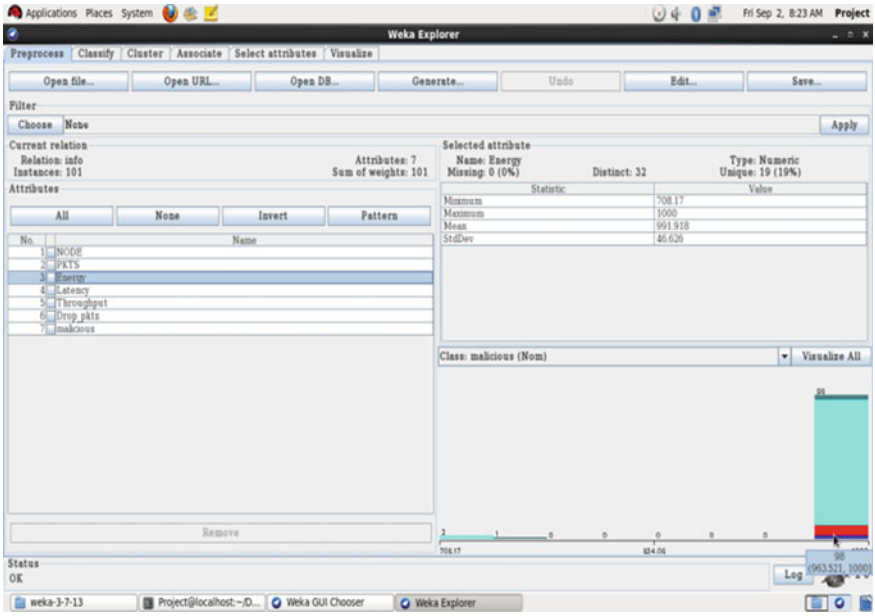

Fig. 11 Pre-processing technique to analyse energy

The energy level of the node in a network is depicted in Fig. 11. Here, only 2 nodes are having the energy level of 708.17 to 744.649 J, one node is having the energy in the range of 744.649 to 781.127 J. Remaining 98 nodes are having energy of 963.521 to 1000 J. From the pre-processing technique minimum of energy level of a node is 708.17 J and the maximum of energy level of a node is 1000 J.

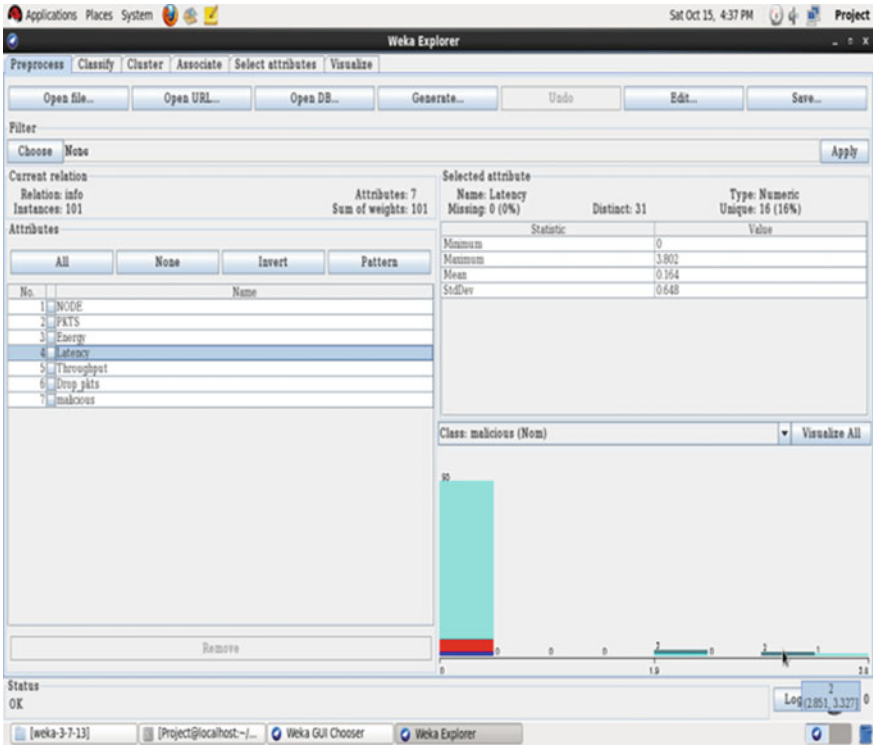

Fig. 12 Pre-processing technique to analyse latency

Latency of the node in a network is depicted in Fig. 12. Here, 95 nodes are having the latency in the range of 0 to 0.475, 3 nodes are having the latency in the range of 0.476 to 2.850, 2 nodes are having the latency in the range of 2.851 to 3.327 and one node is having the latency of 3.327 to 3. 802. From the pre-processing technique the minimum latency level of a node is 0 and the maximum of latency level of a node is 3.802.

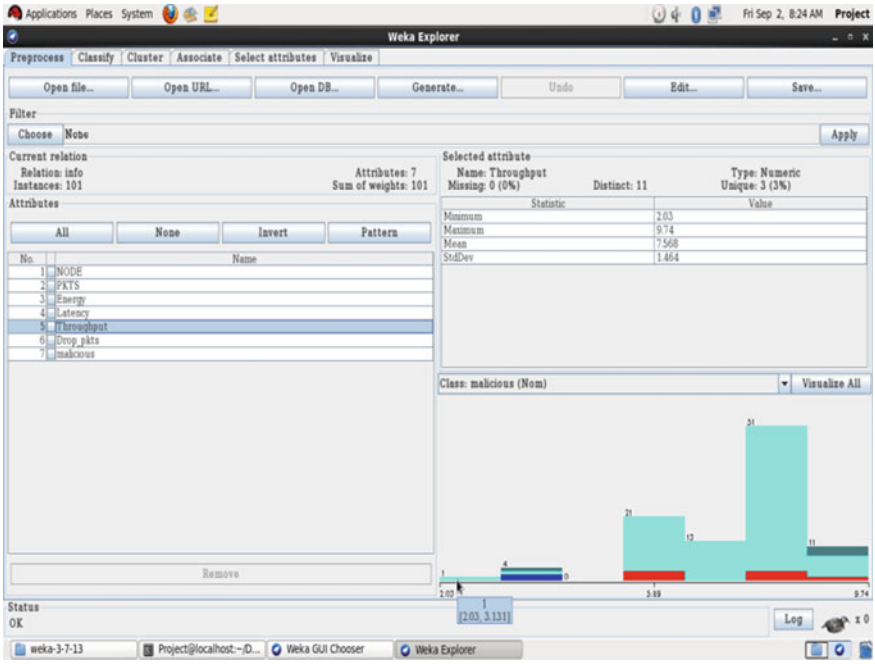

Fig. 13 Pre-processing technique to analyse throughput

Throughput of the node in a network is depicted in Fig. 13. Here, only one node is having throughput in the range of 2.03 to 3.131, 4 nodes are having the throughput in the range of 3.131 to 4.233, 21 nodes are having the throughput in the range of 5.334 to 6.436, 13 nodes are having the throughput in the range of 6.436 to 7.537, 51 nodes are having the throughput in the range of 7.537 to 8.639. 11 nodes are having the throughput in the range of 8.639 to 9.74. From the pre-processing technique minimum throughput level of a node is 2.03 and the maximum of throughput level of a node is 9.74.

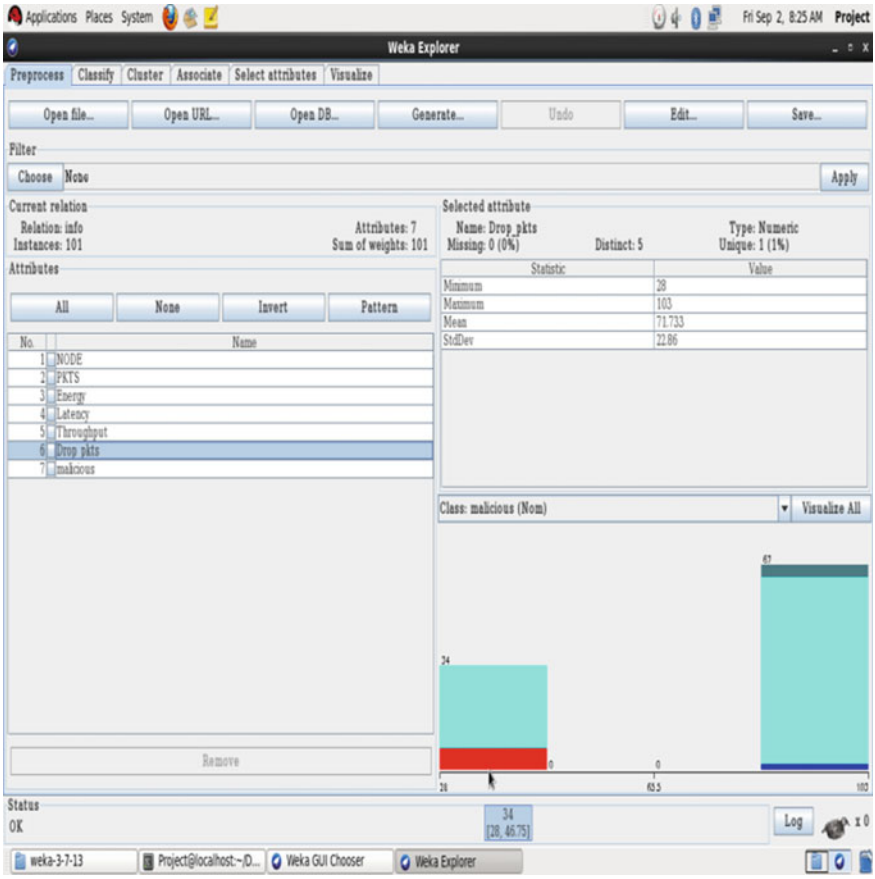

Fig. 14 Pre-processing technique to analyse drop packets

Packet drop of the node in a network is depicted in Fig. 14. Here, 34 nodes are dropping packets in the range of 28 to 46.75, 67 nodes are dropping packets in the range of 75 to 103. From the pre-processing technique the minimum amount of packet drop of a node is 28 and the maximum number of packet drop of a node is 103.

4.1 Classification Technique

After the pre-processing technique the nodes are classified using Zero R algorithms with confusion matrix. Here, nodes are grouped by using similar features which is considered as a classification label. Classifier model is a pruned decision tree in textual form that was formed with the full training data. Based on the classification

technique nodes are categorized. Among the 101 nodes only 2 node performances excellent and any one of the node can be considered as a base station. 7 node performances is good that node was treated as leader node or sub leader, 88 node performance was normal that node was treated as normal nodes in the network and remains 4 nodes performance was poor that node was treated as the compromised node and the classification technique.

5 Conclusion and Future Work

This chapter clearly explains about the sinkhole attack problem, and also a brief explanation about the proposed LBIDS. In this chapter, to offer a entire result to identify and avoid sinkhole attack through Leader Based Intrusion Detection System (LBIDS) and Zone Based Leader Election Algorithm (ZBLEM) is proposed which supports real time applications. The algorithm is used to find the attack efficiencies and also better the presentation of the network by way of malicious node detection rate.

References

1. Yu K, Gao M, Jiang H, Li G (2017) Multi-leader election in dynamic sensor networks. EURASIP J Wirel Commun Netw 10(1186):1–14
2. Li J, Cheng S, Li Y, Cai Z (2017) Approximate holistic aggregation in wireless sensor networks. ACM Trans Sensor Netw 13(2):1–24
3. He Z, Cai Z, Yu J, Wang X, Sun Y, Li Y (2017) Cost efficient strategies for restraining rumor spreading in mobile social networks. IEEE Trans Veh Technol 66(3):2789–2900
4. Cheng S, Cai Z, Li J, Gao H (2017) Extracting kernel dataset from big sensory data in wireless sensor networks. IEEE Trans Knowl Data Eng 29(4):813–827
5. Jigo Yu, Huang B, Cheng X, Atiquzzaman M (2017) Shortest link scheduling algorithms in wireless networks under the SINR model. IEEE Trans Veh Technol 66(3):2643–2657
6. Rajkumar US, Vayanaperumal R (2013) A leader based monitoring approach for sinkhole attacks in wireless sensor networks. J Comput Sci 9(9):1106–1116
7. Kumaramangalam MV, Adiyapatham K, Kandasamy CS (2014) Zone based routing protocols for wireless sensor networks. International Scholarly Research Notices, ID 798934, pp 1–9
8. Burgos U, Amozarrian U, Gomez Calzado C, Lafuente A (2017) Routing in mobile wireless sensor networks: a leader approach. Sensors 17(7):1–12
9. Rajkumar US, Vayanaperumal R (2015) A hybrid zone based leader for monitoring sinkhole attack in wirless sensor networks. Ind J Sci Technol 8(23):1–9
10. Lee S, Lee Y, Sg Y (2012) A specification based intrusion detection mechanism for the LEACH protocol". J Inf Technol 11(1):40–48
11. Ngai EHN, Liu J, Lyu MR (2007) An efficient intruder detection algorithm against sinkhole attacks in wireless sensor networks. Comput. Commun. 30(11):2353–2364

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Cascaded Adaptive Nonlinear Functional Link Networks for Modeling and Predicting Crude Oil Prices Time Series Data

Sarat Chandra Nayak, Santosh V. Kulukarni, and Karthik Jilla

Abstract Contrast to traditional neural networks functional link neural network (FLNN) is preferred for its single layer structural design, lower computational complexity and higher convergence rate. It achieves high dimensional representation space of input patterns through functional expansion of input signals. However, its nonlinear approximation capability is limited up to certain extent. Further improvement in performance may require enlargement in dimensionality of the input pattern, which increases the computational overhead significantly. Chebyshev FLNN (CFLNN) is a special case of FLNN and has universal approximation capacity along with faster convergence. Legendre neural network (LeNN) uses simple polynomial expansion functions and posses computational gain over FLNN. This paper develops two cascaded neural networks in order to improve the performance of FLNN. The first model combines the input expansion capacity of FLNN and better approximation of CFLNN to develop a model termed as CCFLNN. Similarly, the second model takes the advantages of FLNN and LeNN to develop another model termed as CLeFLNN. The weight and bias vectors are adjusted by gradient descent based back propagation learning method. The proposed models are evaluated on forecasting crude oil prices. Extensive simulation outcome and comparative performance investigation suggests suitability of the proposed model.

Keywords Crude oil price prediction · FLNN · Cascaded functional neural network · Chebyshev orthogonal polynomial · Legendre neural network

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_113

1 Introduction

Crude oil has imperative role in the economical development of a nation. It has been facing subjective changes in movement due to numerous socio-economical as well as political situations. The randomness associated with its price creates its forecast difficult. Even an insignificant change in its price can give a tremendous shock to the prices of petroleum products as well as worldwide economy. The instability in the crude oil price is mainly affected by factors like population, demand and deliver, political climate, international liaison [1]. Thus an accurate and efficient prediction tool is crucial for oil price forecasting. Recent improvements in computational intelligence methods such as artificial neural networks (ANNs) have been used as effective tools in this domain [2–6].

ANN mimics the human brain's way of thinking [7–9]. It also can emulate the decision making course of action of human brain to explain nonlinear problems. This makes it popular as a computational intelligent methodology for computing complicated systems. These are well recognized as effectual modeling procedures for input-output mapping in irregular datasets as the case of crude oil prices. These properties of ANN catch the attention of researchers to forecast oil price data with ANN. ANN deals with nonlinearity coupled with oil price by recognizing patterns in it and by means of such patterns to predict the future price.

Multilayer perceptron (MLP) with one hidden layer possess the capability of universal approximation. In MLP, the successive layers accomplish a series of mapping until a absolute representation is found where the desired separation is possible. Many real life applications required MLP with more than one hidden layer in order to achieve better generalization. MLP suffers from two well known lacunas such as high computational complexities and slow convergence. Also, in order to prevail over the problem of local minima, additional processing nodes required for the hidden layers. In this way, the increase in number of layers and number of neural nodes to the network increases the network complexities and hence increases the computational burden to the network. Numerous hidden layers with increased neuron size add more computational cost. No direct method available for ruling most favorable structure of MLP. The selection of best architecture suffers from elongated computational time due to iterative testing of a range of network parameters.

To reduce the complexities of MLP, FLNN was proposed as a single layer ANN. This single layer ANN has potential of development of complex decision margins [10]. Several basis functions have been used as functional expansion of input vectors for the network. These basis functions can be *sine* and *cosine* trigonometric functions, polynomials like Chebysheb, Lagurre, Legendre, and power functions. The single layer of FLNN provides a great drop in computational constraint and hence high convergence speed. The initial pattern representation is described in a multi dimensional space. The enhanced representation of original pattern is achieved by functionally expanding each component of input vector. The functions

used for expansion of input vector are subset of orthonormal basis functions across n-dimensional space. The functional link generates a set of functions which are linearly independent. The inputs after expansion by such functions cause an augment in dimensionality of input vector, thus generating non-linear boundaries [11, 12] which helps FLNN to handle complex problems. The FLNN models are applied for classification and forecasting financial time series and proved efficient [13–17].

Despite of characterizing with simpler architecture and better convergence speed, the nonlinear approximation power of FLNN based models may be limited to linear or mild nonlinear distortions. To improve the performance further, input space dimension may be enlarged, which will increase the number of nodes in the input layer. Hence increase in the complexity. There are few attempts in adopting cascaded FLNN models in the domain of nonlinear channel equalization. A cascade combination of FLNN and Legendre polynomial is proposed by George and Panda [18] for nonlinear active noise control and claimed improved noise mitigation capability compared to FLNN. Another cascading method using FLNN and Chebyshev polynomial is suggested for nonlinear inter symbol interference [19] which can approximate nonlinear judgment margins arbitrarily. The performance has been compared with simple FLNN, MLP, RBF and normalized least-mean-squared algorithms in terms of convergence rate, bit and steady condition error. The simulation outcome of the proposed equalizer established superior performance.

The above discussion can be summarized as follows.

- MLP model is a popular method for financial time series forecasting.
- Computational complexities and black-box nature of MLP paves path towards designing single layer, less computationally complex FLNN model.
- Cascaded based FLNN models are new applications to the domain of channel equalization problems.

However, with the aim of achieving better forecasting accuracy, the motivating factors are:

- Developing ANN-based forecast with less complex architecture and least computational load.
- Developing and analyzing cascaded functional link artificial neural based forecasting models for prediction of crude oil data series.

This article develops two cascaded FLNN based nonlinear adaptive neural forecasting models for prediction of crude oil data series. The former part of these models uses trigonometric functional expansion and the latter part expands the output of the former part by using Chebysheb polynomial, and Legendre polynomials functions to achieve further increase in dimensionality. The second stage of functional expansion has been adapted with the hope of better prediction performance of these models.

The article is organized in four major sections. Introduction and related researches is given by Sect. 1. Section 2 describes about the cascaded FLNN models. Experimental result and analysis is carried out in Sect. 3. Section 4 gives the concluding remarks.

2 Cascaded FLNN Models

This subsection describes the architecture for the cascaded models developed. As described above trigonometric expansion functions are used for input expansion. Taking the combination of two polynomials and using them alternatively at the first and second stage of expansion, two cascaded models are developed. Similar to the FLNN model, the bias and weight values of this cascaded model are optimized by gradient descent based back propagation learning method. The cascaded FLNN model architecture is depicted by Fig. 1.

As exposed in the Fig. 1, the model consists of two sections. The first section uses trigonometric nonlinear expansion functions and the latter part uses either Chebyshev polynomial or Legendre polynomial functions. The trigonometric, Chebyshev, and Legendre polynomial functions used in this article are shown by Eqs. 1–3.

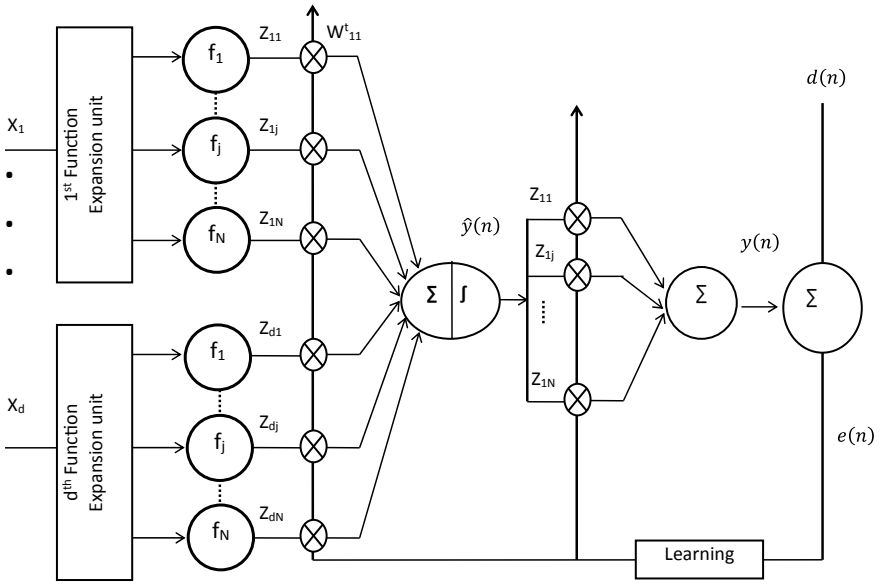

Fig. 1 Cascaded FLNN-based forecasting model

$$\left.\begin{array}{c} c_1(x_i) = (x_i), \\ c_2(x_i) = sin(x_i), \\ c_3(x_i) = cos(x_i), \\ c_4(x_i) = sin(\pi x_i), \\ c_5(x_i) = cos(\pi x_i), \\ c_6(x_i) = sin(2\pi x_i), \\ c_7(x_i) = cos(2\pi x_i) \end{array}\right\} \tag{1}$$

$$\left.\begin{array}{c} c_1(x_i) = (x_i), \\ c_2(x_i) = 2x_i^2 - 1, \\ c_3(x_i) = 4x_i^3 - 3x_i, \\ c_4(x_i) = 8x_i^4 - 8x_i^2 + 8x_i + 1 \end{array}\right\} \tag{2}$$

$$c_{n+1}(x_i) = \frac{1}{n+1} * ((2n+1) * x_i * c_n(x_i) - nc_{n-1}(x_i)) \Big\} \tag{3}$$

Let, X (n) = [x (n − l+1), …, x(n − 1), x(n)] is a series of crude oil prices used as input vector. The series undergoes nonlinear expansion by the first stage expansion function. Let it be represented as X' (n). Given X' (n) as an input, the model generates ŷ (n) as an output, which acts as an intermediate estimated value of the first section. The linear part estimation is calculated as in Eq. 4.

$$y'(n) = X'(n) * W(n) + b \tag{4}$$

where:
b = bias
$W(n)$ = weight for the n^{th} pattern.

The $y'(n)$ then applied with a nonlinear activation (sigmoid) to generate the estimation $\hat{y}(n)$.

$$\hat{y}(n) = \frac{1}{1 + e^{-\lambda y'(n)}} \tag{5}$$

As described above the second section uses another polynomial for expansion of the intermediate output of the adaptive model $\hat{y}(n)$. Let the expanded value is represented by $X''(n)$.

If $V(n) = [V_0(n), V_1(n), \ldots\ldots, V_{l-1}(n)]^T$ is adaptive weight of the second section, the overall cascaded FLNN output is computed as in Eq. 6.

$$y(n) = V^T(n) * X''(n) \tag{6}$$

The error $e(n)$, (difference of desired and estimated) is calculated as in Eq. 7.

$$error(n) = desired(n) - y(n) \tag{7}$$

The weight and biases are adjusted by gradient descent based back propagation method.

3 Experimental Results and Analysis

This part discusses about dataset and setup, model input and normalization of input, evaluation metrics, investigational results and comparative study.

3.1 Data

The crude oil prices (Dollars/Barrel) are retrieved from US Department of energy: Energy Information Administration web site: http://www.eia.doe.gov/ from April 1983 to July 2019. The price series are exposed by Figs. 2, 3, 4 and 5. The basic information and descriptive statistics are gathered in Tables 1 and 2 respectively. The simulation environment was MATLAB-2015 with Intel ® core-TM i3 CPU, 2. 27 GHz processing and 2.42 GB memory.

Table 1 The crude oil price dataset

S.No.	Dataset	Period	No. of data points
1	Daily cushing, OK crude oil dataset	April 04 1983–July 02 2019	9105
2	Weekly cushing, OK crude oil dataset	April 08 1983–June 28 2019	1891
3	Monthly cushing, OK crude oil dataset	April 1983–May 2019	434
4	Annual cushing, OK crude oil dataset	1983–2018	36

Table 2 Descriptive statistics

Crude oil price dataset (Dollars/ Barrel)	Statistics					
	Min.	Max.	Mean	Std dev.	Skewness	Kurtosis
Daily cushing, OK crude oil dataset	10.4200	145.2900	42.9828	28.5640	0.9953	2.8829
Weekly cushing, OK crude oil dataset	11.0900	142.4600	42.8949	28.5241	1.0011	2.8921
Monthly cushing, OK crude oil dataset	11.3100	134.0200	42.8508	28.5115	0.9969	2.8629
Annual cushing, OK crude oil dataset	14.4000	99.7500	42.6214	28.0382	0.8772	2.3527

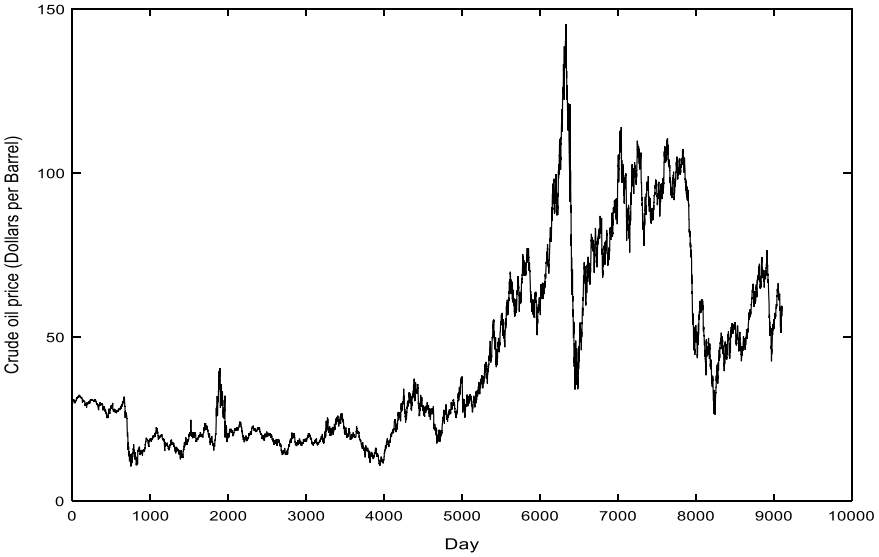

Fig. 2 Daily price series

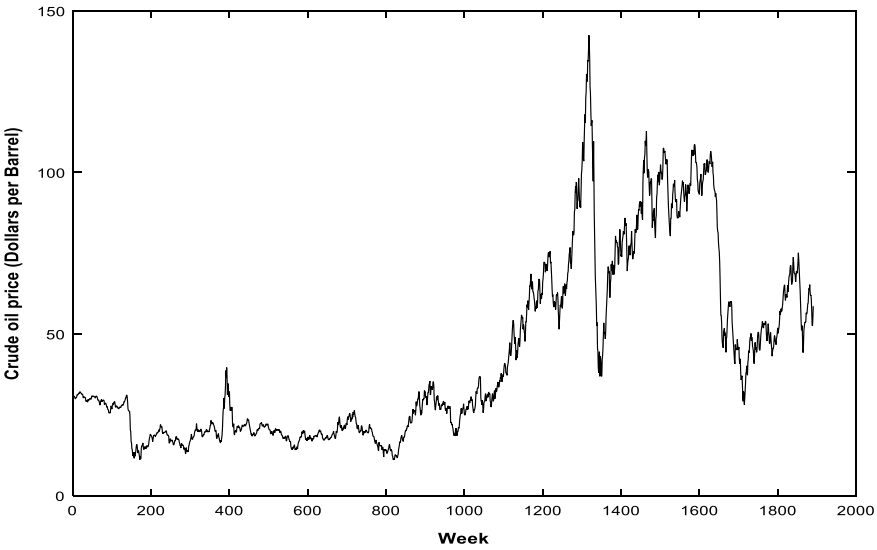

Fig. 3 Weekly price series

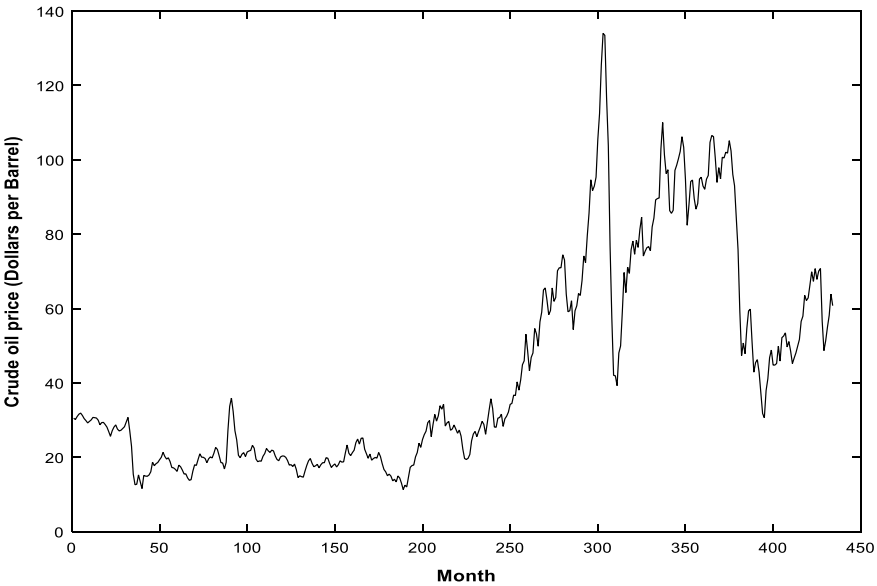

Fig. 4 Monthly price series

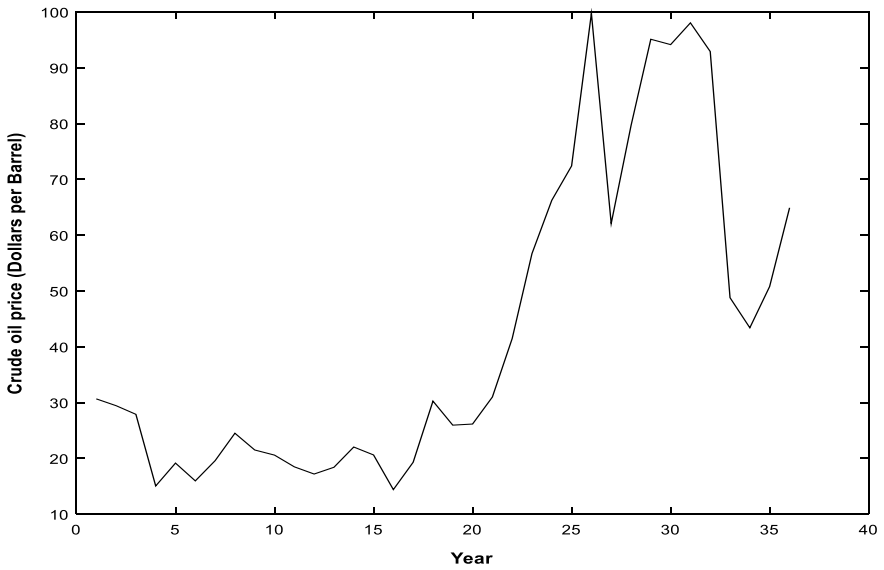

Fig. 5 Yearly price series

3.2 Input Selection and Normalization

The selection of model inputs was done by sliding window technique. On each sliding, a new data is added and the oldest one is removed. The window moves on the whole series to generate the inputs. We followed the procedure from article [14, 17, 20] for input selection and data normalization.

3.3 Results and Discussion

All the data series were passed through normalization process and then fed to the model [20]. The normalized data are then used as input to the cascaded networks for prediction of future data points in the time series. For each training set generated by the sliding window, the model was simulated twenty five times. The mean of these simulation errors is considered for comparison. The window adds only one new data in each step into the training dataset. Therefore, starting the search process with random weights afresh, we considered the pre optimized weights as the initial

Table 3 Forecasting errors

Crude oil price dataset	Error statistic	Forecasting models			
		MLP	FLNN	CCFLNN	CLeFLNN
Daily crude oil price dataset	Minimum	0.00008	0.00007	0.00007	0.00005
	Maximum	0.0488	0.0482	0.0391	**0.0376**
	Average	0.0098	0.0083	**0.0049**	0.0058
	Standard deviation	0.0081	0.0075	0.0033	**0.0019**
Weekly crude oil price dataset	Minimum	0.00005	0.00003	**0.00001**	**0.00001**
	Maximum	0.0468	0.0432	**0.0416**	0.0427
	Average	0.0125	0.0094	0.0088	**0.0067**
	Standard deviation	0.0155	0.0075	0.0077	**0.0039**
Monthly crude oil price dataset	Minimum	0.00006	0.00004	0.00004	**0.00001**
	Maximum	0.0542	0.0435	0.0403	**0.0385**
	Average	0.0157	0.0141	0.0091	**0.0087**
	Standard deviation	0.0117	0.0087	**0.0071**	0.0074
Annual crude oil price dataset	Minimum	0.00005	0.00005	**0.00004**	**0.00004**
	Maximum	0.0463	0.0381	0.0353	0.0193
	Average	0.0280	0.0173	0.0166	**0.0138**
	Standard deviation	0.0059	0.0063	**0.0038**	**0.0038**

weights for the current training set. Thus, the models are trained adaptively and the training time reduced significantly. For validation of the proposed models, two comparative models such as MLP and FLNN were developed. The input vector, weight and biases for all the four models were same. The models were trained in the same fashion. The output statistics from all datasets are listed in Table 3.

The optimal error statistic values are in bold face. From the experimental results, it is observed that the error values from the two cascaded networks are lesser than comparative models. For instance, the average error of CCFLNN model from four datasets are 0.0049, 0.0616, 0.0071, and 0.0038 respectively. These lower statistics justified the suitability of the proposed CCFLNN and CLeFLNN based forecasting. The forecast plots are depicted by the Figs. 6, 7, 8 and 9. For the sake of clarity we plotted the first hundred data points for daily, weekly, and monthly datasets.

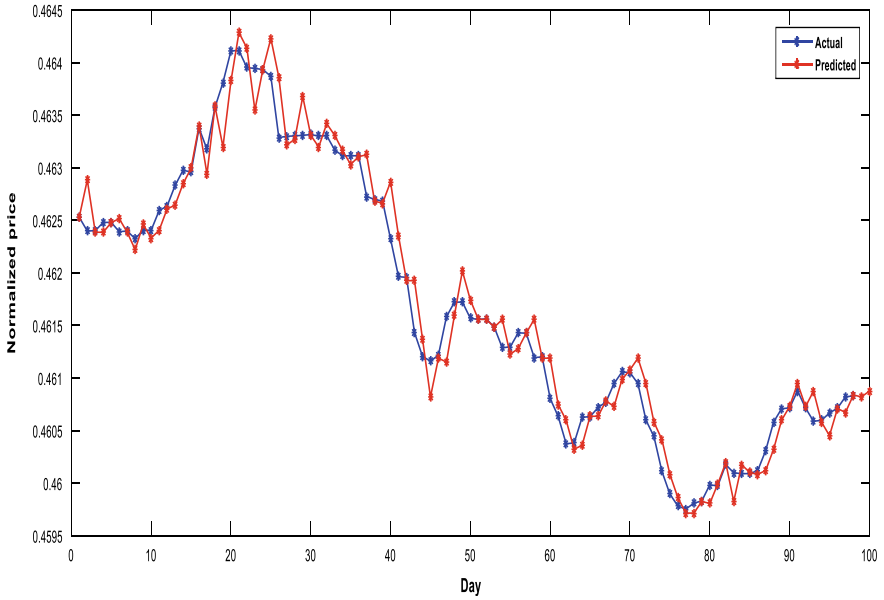

Fig. 6 Forecast plot from daily prices series

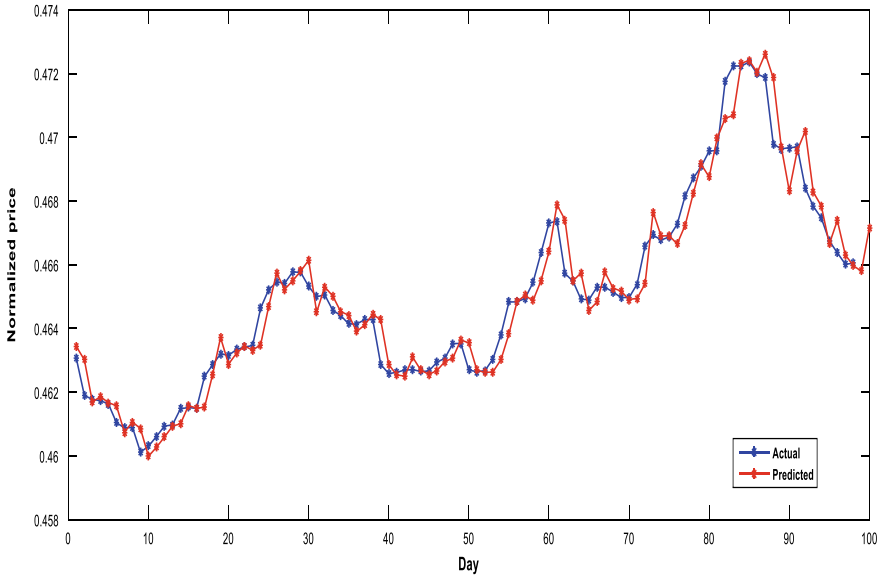

Fig. 7 Forecast plot from weekly prices series

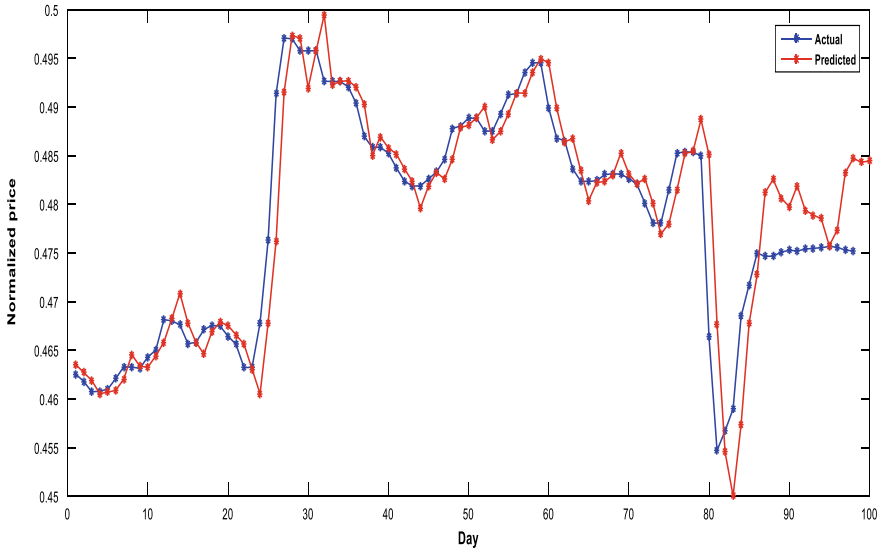

Fig. 8 Forecast plot from monthly prices series

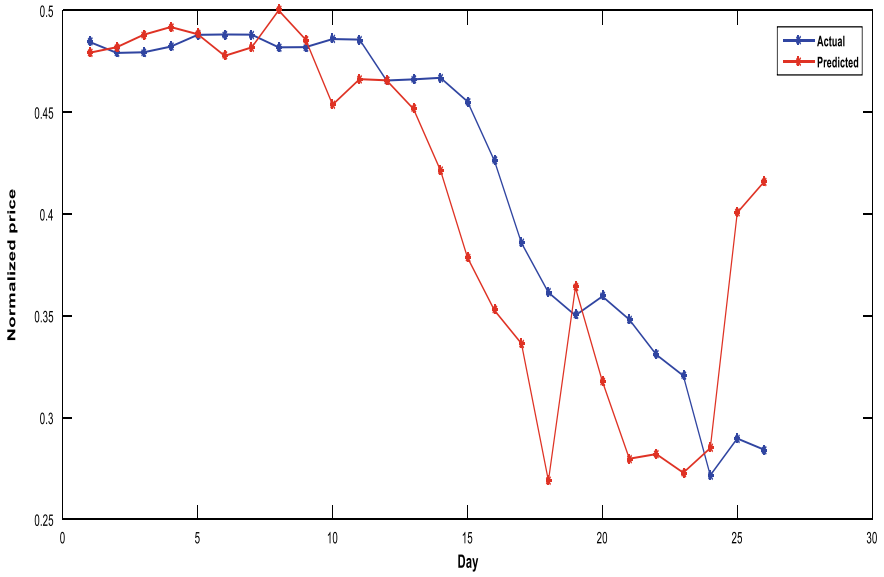

Fig. 9 Forecast plot from yearly prices series

4 Conclusions

This article constructed two cascaded functional link neural networks such as CCFLNN and CLeFLNN combining the input expansion capacity of traditional FLNN and better approximation of CFLNN and LeFLNN. The reason behind cascaded modeling was to achieve higher accuracy compared to simple FLNN. The weight and bias vectors are adjusted by gradient descent based back propagation learning method. The proposed models are evaluated on predicting crude oil price considering daily, weekly, monthly, and yearly datasets. The performances of cascaded models are compared with that of MLP and traditional FLNN based forecast. All the models are trained adaptively. Extensive simulation results and comparative performance analysis are in support of the proposed models. The current work may be extended with consideration of other basis functions and evolutionary optimization based training.

References

1. Nelson Y (1994) Results of Delphi VIII survey of oil price forecasts. Energy report, California Energy Commission (1994)
2. Mahdiani MR, Khamehchi E (2016) A modified neural network model for predicting the crude oil price. Intellectual Econ 10(2):71–77
3. Chiroma H et al (2016) A review on artificial intelligence methodologies for the forecasting of crude oil price. Intell Autom Soft Comput 22(3):449–462
4. Hamdi Manel, Aloui Chaker (2015) Forecasting crude oil price using artificial neural networks: a literature survey. Econ Bull 3(2):1339–1359
5. Wang Jie, Wang Jun (2016) Forecasting energy market indices with recurrent neural networks: case study of crude oil price fluctuations. Energy 102:365–374
6. Chiroma Haruna, Abdulkareem Sameem, Herawan Tutut (2015) Evolutionary neural network model for West Texas intermediate crude oil price prediction. Appl Energy 142:266–273
7. Simon H (2010) Neural networks and learning machines, 3/E. Pearson Education India
8. Vojislav K (2001) Learning and soft computing: support vector machines, neural networks, and fuzzy logic models. MIT press
9. Sanguthevar R, Vijayalakshmi Pai GA (2003) Neural networks, fuzzy logic and genetic algorithm: synthesis and applications (with cd). PHI Learning Pvt. Ltd
10. Pao Y-H, Takefuji Y (1992) Functional-link net computing: theory, system architecture, and functionalities. Computer 25(5):76–79
11. Misra BB, Dehuri S (2007) Functional link artificial neural network for classification task in data mining
12. BIHARI, MB, et al. (2008) Fuzzy swarm net (FSN) for classification in data mining: 1–8
13. Dash CSK et al (2019) An integrated CRO and FLANN based classifier for a non-imputed and inconsistent dataset. Int J Artif Intell Tools 28(03):1950013
14. Nayak SC, Misra BB, Behera HS (2019) ACFLN: artificial chemical functional link network for prediction of stock market index. Evol Syst 10(4):567–592
15. Kishore Kumar S et al (2016) Forecasting foreign exchange rates using CRO based different variants of FLANN and performance analysis. Int J Comput Syst Eng 2(4):190–208

16. Nayak SC, Misra BB, Behera HS (2016) An adaptive second order neural network with genetic-algorithm-based training (ASONN-GA) to forecast the closing prices of the stock market. Int J Appl Metaheuristic Comput (IJAMC) 7(2):39–57
17. Das S, Nayak SC, Nayak, SK, Sahoo B (2018) A GA-based polynomial FLANN with exploration and incorporation of virtual data points for financial time series forecasting. Int J Recent Technol Eng (2018)
18. George Nithin V, Panda Ganapati (2013) Active control of nonlinear noise processes using cascaded adaptive nonlinear filter. Appl Acoust 74(1):217–222
19. Zhao Haiquan, Zhang Jiashu (2008) Functional link neural network cascaded with Chebyshev orthogonal polynomial for nonlinear channel equalization. Signal Process 88(8):1946–1957
20. Nayak SC, Misra BB, Behera HS (2014) Impact of data normalization on stock index forecasting. Int J Comp Inf Syst Ind Manag Appl 6:357–369

Fruit Detection Using Recurrent Convolutional Neural Network (RCNN)

Kotagiri Ramadevi and A. Poongodai

Abstract An accurate image based fruit detection model is crucial for agriculture task, Robotic harvesting. The features such as color similarity, shape irregularity and back ground are complex. Hence the fruit detection turns to be a difficult task. Many machine learning techniques such as Support Vector Machine (SVM), K-Nearest Neighbors (KNN), Naïve bayes, have been used for the fruit recognition system which doesn't yield a good accuracy. This paper brings out the various techniques used in the fruit detection model and also how the deep learning techniques can be used for detecting the fruit by considering the various features of fruit.

Keywords Deep neural network · Agriculture robotics · RCNN · Fruit detection · Image processing · Harvesting robots · Visual fruit detection

1 Introduction

Process automation today plays an important role in manufacturing and agricultural fields and various applications in the area of automation have been found in digital image processing. Several image processing methods are used to evaluate agricultural images for tracking crop maturity, crop disease identification, and fruit and vegetable recognition [1]. Most real life applications can use fruit recognition and classification systems. An image classifier has been trained and tested to identify images of fruits and vegetables. Several machine learning techniques have been used to find the fruit for either gathering or counting purposes. Nevertheless, the problem of developing a fast and reliable fruit detection system persists. This is due to large variability in fruit appearance in the field, including properties of color,

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_114

form, size and texture. The purpose of this study was to improve the fruit detection system using deep learning techniques such as Convolutional neural network (CNN), Recurrent Neural Network (RNN), Recurrent Convolutional Neural Network (RCNN) by considering the above described properties.

2 Literature Study

In 2012 Sachimidhiber et al. [1] proposed image classification method in their paper, they used a method MCDNN for averaging the output of several Deep Neural Network (DNN) columns, won the German traffic sign recognition bench mark. Hossam M. Zawbaa et al. in 2014 used Support Vector Machine (SVM) and K-Nearest Neighbors (KNN) algorithms for classifying and identifying fruit types based on Shape and Color Features.

Liang et al. [2] proposed (RCNN) which is typically, feed-forward architecture for recognizing the object in 2015. They used following datasets in their paper: SVHN, MINIST, CIFAR-10 and CIFAR-100. In 2016, Inkyu Sa and their team [3] discuss early and late fusion methods in this paper to combine multi model Red-Green-Blue and Near–Infrared information, and use faster region based Convolutional Neural Network algorithms to detect objects.

Bargoti S and Underwood J [4] proposed image segmentation approach that includes two feature learning techniques (Multilayer Perception and Convolutional Neural Network) for the detection of fruit and yield estimation in image data of apple orchard. In this paper, an image processing framework is proposed for the detection and counting of fruit in the apple orchard. They also proposed another deep fruit detection algorithm that uses faster R-CNN for detecting the fruits in orchards in 2017. For expanding the dataset principle component analysis augmentation technique PCA were used. The data set contain 100–1000 fruits per image and using the proposed system, they were able to achieve performance of 0.9% in identifying the apple and mangoes.

In 2017, Li D Zhao and his team members [5] proposed a detection model for cucumber using its properties such as color and texture. This cucumber detection model used Maximally Stable Extremal Regions (MSER) and Histogram Oriented Gradients (HOG) for analysis of the texture in gray scale image, and then SVM classifier is used for identification task and the false positives is detected using scale-invariant feature transform. Horea muresan, Mihai Oltean proposed fruit recognition from images using deep learning in 2018. This paper presents Deep Neural Network (DNN) for the dataset Fruits-360 for identifying fruits from images. Tensor flow is used for developing the system.

In 2017, Blanke, Cheng H Damerow and their team members [6] studied the image analysis of apple fruit and tree canopy features and devised an early yield prediction model using neural network. The prediction model uses Artificial Neural Network (ANN) for image analysis and back propagation neural network model were designed for predicting the early and repining time after the drop of the fruit.

Guichao lin and this team members in 2019 [7] presents guava identification model using a low-cost red-green-blue-depth sensors.

The accuracy achieved by various image classification methods used by author in their publications is listed in the following Table 1.

Table 1 Comparative study of existing techniques

Sl. No	Paper title	Author name	Methods	Published year	Achieving accuracy
1	Multi-column deep neural networks for image classification	Ciresan D. C, Meier U	Multi column deep neural network (MCDNN), deep neural network (DNN)	2012	99.46%
2	Recurrent Convolutional neural network for object recognition	Liang M and Hu X	Recurrent convolutional neural network (RCNN)	2015	13:56%
3	Fruit detection and yield estimation in apple orchards	Bargoti S and Underwood J	Multilayer Perceptron (MLP), Convolutional neural network (CNN)	2016	0.858%
4	Fruit detection system using deep neural networks	Feras Dayoub and Zongyusn	Region based Convolutional neural network (R-CNN)	2016	0.807 to 0.808
5	Deep fruit detection in orchards [8]	Bargoti S and Underwood J	Principal Component Analysis (PCA)	2017	0.9%
6	Cucumber detection based on texture and color in greenhouse	Li D Zhao, H Zhao, X Gao Q	MSER, HOG, SVM, SIFT	2017	68%
7	Early yield prediction model using image analysis of apple fruit and tree canopy	Cheng H Damerow, L Sun Y	Artificial neural network (ANN), back propagation neural network (BPNN)	2017	0.70%, 0.83%
8	Fruit recognition from images using deep learning [9]	Mureşan H, Oltean M	CNN, RNN	2018	96.13%
9	Guava detection and pose estimation using low-cost RGB-D sensor	Lin G, Tang Y, Zou X, Xiong J, Li J	low-cost RGB-D sensor	2019	0.983 and 0.948

3 Methodology

3.1 Deep Learning

The most promising results were obtained in the area of image identification and recognition using artificial neural networks. Deep neural network is a artificial neural network with multiple hidden layers between input layer and output layer. Such networks serve as the basis for most models of deep learning. Deep learning is a specialized form of machine learning which is similar to human nervous system. Deep learning uses multiple hidden layers, mostly nonlinear. Deep neural networks have succeeded in beating other algorithms in machine learning. Deep learning is seen as an important step towards strong AI. The various neural networks are Convolutional Neural Network, Recurrent Neural Network and Recurrent Convolutional Neural Network.

3.1.1 Convolutional Neural Networks

Convolutional Neural Networks (CNN) is a specific type of neural data processing network with a defined grid-like topology. The term Convolutional neural network implies a mathematical procedure is performed by the network. The architecture of CNN is shown in Fig. 1 [10] Convolutional neural networks uses convolution in at least one of their layers in place of general matrix multiplication. CNN consist of four layers: a. Convolution layers b. Pooling layers c. Fully connected layers d. Loss layers (Fig. 1).

a. **Convolutional layers:**
Convolutional layer consists of set of learnable filters. The input image to the Convolutional layer is an array of pixel values ranging from 0 to 255. This pixel values describes the intensity of the image (strength and brightness). As an example, the original image is of size $32 \times 32 \times 3$ and the filter dimension is $5 \times 5 \times 3$. The number of locations that the filter of size $5 \times 5 \times 3$ fit into the

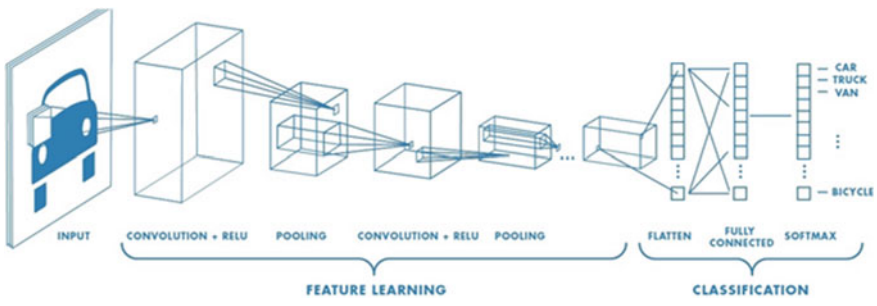

Fig. 1 Architecture of convolutional neural networks

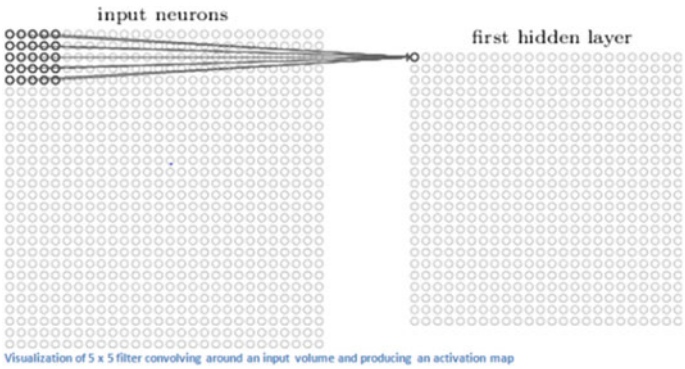

Fig. 2 Convolution of input image to activation map

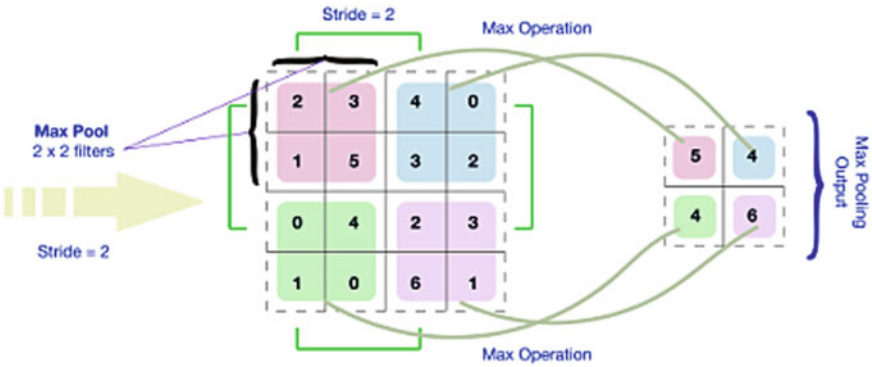

Fig. 3 Max pooling

image of 32 × 32 × 3 is 784 (28 × 28 × 1) which is shown in Fig. 2. Hence, as the filter is convolving over all the locations of the image from top left corner, an activation map is produced with size 28 × 28 × 1. When filter is at the first position, element wise multiplication is performed (leading to total of 75 multiplications).

If there are two filters of size 5 × 5 × 3 then the activation map also called as feature map of size 28 × 28 × 2 is produced.

b. **Pooling layers:**

Pooling layers are used to reduce the amount of computation performed with in the network and to diminish the spatial dimensions. The most widely used pooling layer has 2 × 2 scales and of two approaches: max pooling and average pooling. Max pooling is a sample-based discretization process, a down sampling strategy. It finds the maximum of every patch of the feature map and shown in Fig. 3. Average polling finds the average of every patch.

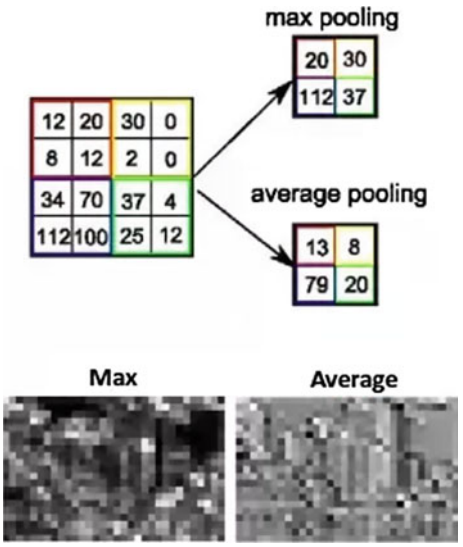

Fig. 4 Performance of max pooling and average polling

Max pooling extracts the most important features like edges and reject big chunk of data. On the other hand, average pooling extracts features so smoothly, do not reject all the data and retains more information. But the average polling does not extract good features and hence not used widely. The performance of max polling and average polling is shown in Fig. 4.

c. **Fully connected layers:**
Fully connected layer is used to learn the non linear combination of high level features in the image. In the fully connected layer, the output image of polling layer is flattened into a column vector and fed into feed forward neural network. In fully connected network with back propagation, back propagation is applied to every iteration. The various architectures of CNNs are LeNet, AlexNet, VGGNet, GoogLeNet, ResNet, ZFNet.

d. **Loss layers:**
Loss layer is the last layer and used to penalize any deviation from the expected output in the network. Loss function eases the training process of CNN based image detection. There are varieties of loss functions. Some of them include mean squared error, sigmoid cross entropy, and average binary cross entropy.

3.1.2 Recurrent Neural Network (RNN)

In traditional neural network all the input and output are independent of each other. In RNN the same task is repeated for every element of the sequence with the output

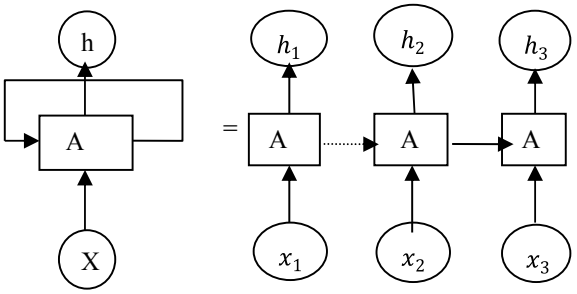

Fig. 5 Recurrent neural network model

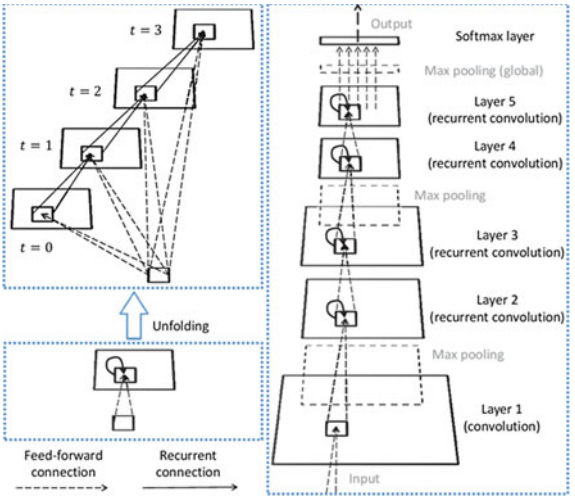

Fig. 6 Architecture of recurrent convolutional neural network (RCNN)

depending on the previous computation and shown in Fig. 5. RNN use the information in vary long sequence but look back only a few steps hence a long short term memory network is widely used. RNN are widely used for applications such as natural language processing and language modeling.

3.1.3 Recurrent Convolutional Neural Network (RCNN)

Convolutional neural network, a multilayer neural network reduces the number of parameters to be tuned it is widely used in computer vision application and automatic speech recognition. With great success achieved in CNN and RNN, these two models can be interleaved to recurrent CNN for object recognition. Together with CNN, RNN can also be used to describe the unlabeled the images RCNN is a Convolutional network with recurrent connections used in video processing since it is both spatially invariant and serial data (Fig. 6) [2].

4 Conclusion

In this paper, we have studied and presented different types of techniques under image processing which can be used for fruit detection. The deep learning techniques, which are Convolutional Neural Network, recurrent neural network, recurrent Convolutional neural network can be applied successfully in computer vision. Basically this paper gives literature review on the classifier using Artificial Neural Network.

References

1. Ciregan D, Meier U, Schmidhuber J (2012) Multi-column deep neural networks for image classification. In: Proceedings of the IEEE computer society conference on computer vision and pattern recognition
2. Liang M, Hu X (2015) Recurrent convolutional neural network for object recognition. In: Proceedings of the IEEE computer society conference on computer vision and pattern recognition
3. Sa I, Ge Z, Dayoub F, Upcroft B, Perez T, McCool C (2016) Deepfruits: A fruit detection system using deep neural networks. Sensors (Switzerland) 16(8)
4. Bargoti S, Underwood J (2017) Deep fruit detection in orchards. In: Proceedings - IEEE international conference on robotics and automation
5. Li D, Zhao H, Zhao X, Gao Q, Xu L (2017) Cucumber detection based on texture and color in greenhouse. Int J Pattern Recognit Artif Intell 31(08):1754016
6. Cheng H, Damerow L, Sun Y, Blanke M (2017) Early yield prediction using image analysis of apple fruit and tree canopy features with neural networks. J Imaging 3(1):6
7. Lin G, Tang Y, Zou X, Xiong J, Li J (2019) Guava detection and pose estimation using a low-cost RGB-D sensor in the field. Sensors (Switzerland) 19(2):428
8. Bargoti S, Underwood J (2017) Image segmentation for fruit detection and yield estimation in apple orchards. J F Robot 34(6):1039–1060
9. Mureşan H, Oltean M (2018) Fruit recognition from images using deep learning. Acta Univ Sapientiae Inform 10(1):26–42
10. https://towardsdatascience.com/a-comprehensive-guide-to-convolutional-neural-networks-the-eli5-way-3bd2b1164a53

Comparison of Diabetic Retinopathy Detection Methods

Heena and Vijaya Kumar Koppula

Abstract Diabetic Retinopathy (DR) is an eye disease associated with long-standing diabetes. Sugar levels in the blood cause Diabetic Retinopathy (DR) is an eye disease associated with long-standing diabetes. Sugar levels in the blood cause harm to veins in the retina. These veins can expand and break or they can close, preventing blood from going through. Some of the time strange fresh recruits vessels develop on the retina. These progressions can prompt loss of vision. As of now, identifying DR is a tedious and manual procedure that requires a prepared clinician to analyze and assess advanced shading Fundus photos of the retina. When human perusers present their surveys, regularly a day or two later, the deferred outcomes lead to lost development, miscommunication, and postponed treatment. In this paper, we compare the Diabetic Retinopathy Detection via Deep Convolution Networks for Discriminative Localization and Visual Explanation and Mechanized Detection of Diabetic Retinopathy utilizing Fluorescein Angiography Photographs.

Keywords Deep convolution network · Diabetic retinopathy

1 Introduction

Diabetes is a chronic disorder. When the pancreas does not produce an adequate amount of insulin or the human organic system cannot effectively use the insulin it produces. According to IDF (International Diabetes Federation) Diabetes Atlas, Ninth edition 2019 approximately 463 million grown-ups (20–79 years) were living with diabetes; by 2045 this will ascend to 700 million [1]. As diabetes advances, it

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_115

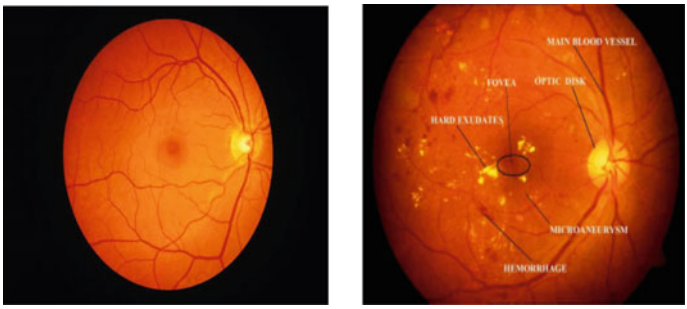

Fig. 1 **a** Healthy retina image. **b** DR effected image

will gradually influence the circulatory framework including the retina and happens because of long haul gathered harm to the veins, declining the vision of the patient prompting diabetic retinopathy. It is estimated that in 2002 Diabetic Retinopathy (DR) accounted for about 5% (5 million) of world blindness [2]. According to the Indian Journal of Ophthalmology 2018; India is considered the world's capital of diabetes. The diabetic masses right currently close to hitting the upsetting quality of 69.9 million by 2025 and 80 million by 2030 [3].

To detect DR ophthalmologists take color fundus images of the retina as shown in Fig. 1(a). To find the severity of disease there are medical conditions i.e. Micro aneurysms, Hemorrhages, and Exudates. Microaneurysms are in the condition where local distension of capillary walls is causing small saccular pouches. It looks like red dots. This also leads to big blood clots i.e. Hemorrhages. Hard exudates are formed because of the deposition of yellow lipid which appears as bright yellow lesions. The relation between optic-disk and fovea will also be used to determine the severity of DR. The DR affected eye is illustrated in Fig. 1(b).

2 Literature Survey

Recent Deep Learning approaches outperform rather than traditional approaches in the area of Computer Vision. The dataset for the DR is made available via the Diabetic Retinopathy Detection Competition in Kaggle by EyePACS. The dataset contains 35,126 high-resolution retina images that are taken under an assortment of imaging conditions. For every person, right and left eye images are provided. Class labels or severity levels of each image on the scale of 0 to 4 i.e. 0-No DR, 1-Mild, 2-Moderate, 3-Severe, 4-Proliferative DR.

According to Wilkinson et al. [4] in the first stage there is no effect cause to the retina. Few microaneurysms start to appear in the second stage called Mild DR. 'Moderate DR' is the third stage, which is identified by several microaneurysms,

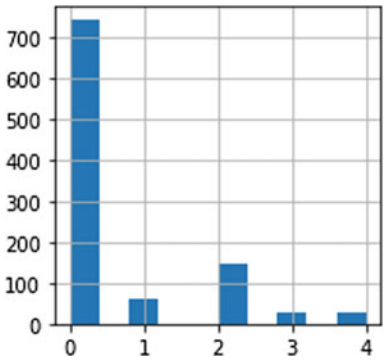

Fig. 2 Histogram of class levels of the dataset

dot, and hemorrhages which look like cotton wool spots. The fourth stage, called 'severe' DR is identified by intraretinal microvascular abnormalities. The Fifth stage, called 'Proliferative DR' is identified by neovascularization.

The Dataset is having the following issues to focus i.e. Resolution of images are vary from 2592 × 1944 to 4752 × 3128, Extra black space on either edge of eye and Aspect ratio of images are 3:2 or 4:3. The heterogeneity of images occurs because data were collected from different resources. Class label Imbalance is there in the dataset as shown in Fig. 2.

Alban et al. [5] is tried to give some solutions to the issues mentioned above. Fixed-size i.e. 256 by 256 is set to all images. To solve the extra black space problem they crop the images with a fixed number of pixels. But it leads to the loss of important features of the eye. Cropping and downsampling techniques are used to solve the aspect ratio issue. To handle the heterogeneity of data Non-Local Means Denoising (NLMD) [6] denoising scheme is used. Implementation of denoising scheme using NLMD of an images S = (s_1, s_2, s_3) on channel c at pixel p as

$$\hat{S}(p) = \frac{1}{C(p)} \sum_{i \in N(p,r)}^{K} S_i(p) w(p,i)$$

$$C(p) = \sum_{i \in N(p,r)} w(p,i)$$

N(p, r) is a neighborhood of pixel p with radius r, weight
w(p, i) is squared of the Frobenius norm distance between color patches centered at p and i.

To balance class labels two approaches are considered i.e. class balanced training sets and cost-sensitive learning. Former is achieved by augmentation of less

class label data and subsample of large class label data. Latter is achieved by selecting InfoGain loss layer which computed by as below

$$L = \frac{-1}{N} \sum_{M}^{N} H_{\ln} \log \hat{P}_M$$

Where H_{ln} is the *ln* row of the info-gain matrix (M) which is a diagonal matrix.

Convolutional Neural Network can give solutions to many problems with benchmark accuracy. Even though CNN giving excellent predictive solutions but it is hard for practitioners to intuitive or understands insights of it As the network goes deeper we will get units with discriminative features. AlexNet [7] and GoogLeNet [8] are used to build CNN models in [5]. Every CNN architecture we add a Fully connected layer after the last convolutional layer which is given to Activation function to get outputs. Because of the Fully connected layer, it is hard to recognize the significance of various units for distinguishing the output labels.

While this condition into consideration Wang et al. [9] Uses the GAP (Global Average Pooling) layer between the last convolutional layer and output layer rather than a fully connected layer. This method is mainly focused on Region of Interest after applying many convolutions to the input image. We get a spatial average of feature maps as the output of the GAP layer.

Suppose the final convolutional layer contains K feature maps $\{g_k(i, j) \mid \forall\ i, j\}$, where k = 1, 2 …., K, (i, j) is the spatial coordinate location in the feature map. In the GAP layer, each feature map $g_k(i, j)$ in the last convolutional layer is mapped into scalar t_k by the function $t_K = \sum_{ij} g_k(i,j)$.

The predicted label $\hat{y} = \sum_{K=1}^{K} t_K W_K$ where t_k is a scalar value from the GAP layer and w_k is the weight of a neuron k.

The Regression activation maps (RAM) is the weighted sum of the feature maps in the convolutional layer defined as $G(i,j) = \sum_{ij} g_k(i,j) W_k$. Therefore, the final prediction $\hat{\mathbf{y}}$ can also express as:

$$\hat{y} = \sum_{k=1}^{K} W_k \sum_{ij} g_k(i,j) = \sum_{ij} G(i,j)$$

The activation function in Alban et al. is softmax because of adding the InfoGain loss layer to balance classes. The loss function is used in this paper is

$$L_i = -\log\left(\frac{e^{W_{yi}}}{\sum_j e^{sj}}\right)$$

Where s_{yi} is the score for i's label and s_j is the score for a particular label j.

LeakyReLU Activation function is selected in Zhiguang et al. ReLU (Rectified Linear Unit) is a non-linear activation function use to get the output of the node. If f (z) is a ReLU activation function, is give z when z is above or equal to zero; give

Table 1 Comparison of parameters of models

Parameters	Alban et al.	Zhiguang et al.
Dataset	EyePACS	EyePACS
Fully connected layer	Yes	No
RAM	No	Yes
Activation function	Softmax	LeakyReLU
Loss function	Log loss	MSE
Batch size	25	32
Accuracy	AlexNet- 0.4073 GoogLeNet- 0.4168	0.8448

zero when z is less than zero. The issue in ReLU is that all the negative values become zero immediately which decreases the ability of the model to fit or train from the data properly. LeakyReLU gives a solution to this problem. In LeakyReLU when z value is less than zero, it will multiply by smaller value like 0.01. In the Baseline paper, LeakyReLU is considered rather than the ReLU activation function.

The problem considers as regression in Zhiguang et al. So selected loss function is mean squared error (MSE) or Mean squared deviation (MSD). It is calculated by averaging the squared difference between the estimated value ŷi and the actual value yi over n number of data points.

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(y_i - \hat{y}_i)^2$$

The Dataset used in papers is provided by the EyePACS platform. AlexNet and GoogLeNet are used to build CNN give different accuracy for the system. An activation function is one of the important hyperparameters of the model. Batch size refers to the number of training examples select for one iteration. All these parameters are briefly explained in Table 1.

3 Conclusion

Zhiguang et al. model is biased to the '0' class because of the existence of a high percentage of '0' over other classes. It did not consider ambiguous images over the entire dataset. The quality of the images is also not considered. These conditions affect the accuracy of the system. In Alban et al. was used GoogLeNet and AlexNet which have deep network architecture. Most of the important features are a loss because of deep architecture. Even though these networks mark the accuracy in ILSVRC [10] but not give predicted accurate values in this problem.

References

1. IDF Diabetes Atlas Ninth Edition 2019. https://www.idf.org/aboutdiabetes/what-is-diabetes/facts-figures.html
2. World Health Organization (2002) https://www.who.int/blindness/causes/priority/en/index5.html
3. Indian Journal of Ophthalmology (2018). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6213704/
4. Wilkinson CP et al (2003) Proposed international clinical diabetic retinopathy and diabetic macular edema disease severity scales. Ophthalmology 110(9):1677–1682
5. Alban M, Gilligan T (2016) Automated detection of diabetic retinopathy using fluorescein angiography photographs. cs231n, project
6. Buades A, Coll B, Morel JM (2005) A review of image denoising algorithms, with a new one. Multiscale Model Sim 4(2):490–530
7. Krizhevsky A, Sutskever I, Hinton GE (2012) 2012 AlexNet. Adv Neural Inf Process Syst
8. Szegedy C et al (2015) Going deeper with convolutions. In: Proceedings of the IEEE computer society conference on computer vision and pattern recognition
9. Wang Z, Yang J (2017) Diabetic retinopathy detection via deep convolutional networks for discriminative localization and visual explanation. CoRR, vol. abs/1703.1
10. Russakovsky O et al (2015) ImageNet large scale visual recognition challenge. Int J Comput Vis 15(3):211–252

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IoT Based Automatic Irrigation System Using Wireless Sensor Networks

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Abstract In ancient times, farmers estimated the maturity of the soil and the reserves to generate revenue. A lower concentration of humidity, water level and certain climatic conditions is becoming increasingly difficult for a farmer. Wireless Sensor Network (WSN) contains different sensor nodes with the option of detection, computer and wireless communication. WSN technology is used to control and monitoring of the environment and soil parameter in the field. WSN used as part of farming for a few reasons, such as indicates high Interpretation, increase the production of harvest, low energy consumption and collection distributed data. Effective management of water plays an important role Agriculture. Shortage of water resources and high pumping costs make good water more critical management. Today is one automatic irrigation system (AIS) used to improving the use of water resources into increase production. This one part of the irrigation system allows development in different places with water deficit. In this way a productive planning of watering system gives the highest efficiency low amount of water.

Keywords Internet of Things (IoT) · Wireless Sensor Networks (WSN) · Automatic Irrigation System (AIS)

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_116

1 Introduction

Agriculture is a fundamental necessity for human survival because it is the main source of food grains and other raw materials. It plays a crucial role in the economic development of our country. Current farming methods result in low yields due to certain environmental conditions such as temperature, humidity and soil moisture. It is therefore important to modernize agriculture by implementing the Wireless Sensor Networks (WSN), which increases productivity.

WSN consists of different independent devices like sensor node, communication device, power supply and processors. Sensor nodes deploy in the interested area and sense data. The sensor nodes send data to base station by different communication ways as direct or clustering. Wireless Sensor network provide characteristics like fault tolerance, low cost, high sensing capability. Sensor network provide an improvement over traditional sensors like random deployment of nodes in the field. Wireless sensor network faced a few challenges like energy limitations, scalability, security and reliability.

Agriculture is one of the most important areas of development of the Wireless Sensor Networks in India. Agriculture, the beginning of human civilization, has been an essential part of human society as a whole, because it depends directly on agriculture to support every civilization. India in particular is a strong economy in agriculture. Surprisingly, agriculture, unlike other areas such as communication, transport, education, finance, etc., has not had the opportunity to take advantage of recent developments in advanced technologies. Progress in agriculture is needed to balance supply and demand as the population grows every day.

Intelligent agriculture therefore combines crop information (crop performance, environmental, soil, irrigation and fertilization information) and information analysis results that are related to certain crop varieties (genes and phenotypes of plants). The organization of information will revolutionize food production around the world. Typical crop studies require phenotyping to understand important variables (e.g., PH concentrations in the soil, nitrogen depletion rates) that influence the development to follow the development of plants under changing real-world conditions (quality), soil, environmental conditions, etc.

Efficient water management plays an important role in agriculture [1, 2]. Wireless sensor-based irrigation control system provides a best solution to optimize use of water [3]. Using WSN, automated irrigation helps the farmer in a best way by avoiding money loss usually spend on labor to do the watering [4] and avoid the wastage of water [5]. Automated irrigation proceeds with the help of solenoid valve [6] and pumps [4]. By Using information, the AIS proceed their task to automatically open or closed [7] the motor [8, 9] to irrigate the field when there is a need occur for the water in the field or not. AIS are able to control the water during unconditional season like rainfall [10, 11] by equally distribute water in the whole farm.

In this paper, we represent a literature review on AIS in agriculture by using WSN. Our aim is to provide a better understanding of the current research issues in this field. The remainder part of the paper has organized as follows: We discuss different protocol and software in literature review that developed to increase the productivity of the field and next comparison by considering different parameters. We then conclude our paper.

2 Challenges in the Agricultural System

- Deficient data about manufacturing.
- Less weather forecast knowledge.
- Not enough data about the allocation of revenues.
- Poor infrastructure for ICT (Information and Communication Technology) and ICT analphabetism.
- Farmers lack of knowledge of the advantages of ICT in agriculture.
- Competencies in marketing research and research center.
- Drastic climate changes
- Lack of interest among young and trained practitioners in the agricultural industry.
- High labor price machinery.
- More handicrafts.
- Keep a record track manually.

3 Literature Overview

Smart farming can be implemented using various techniques. Various methods are discussed in this section. Each method uses different processors, platforms, architectures and communication modules with their own benefits and applications. One method can be used to promote farmers based on necessity. Field sensors retrieve information in real time and send it to the server. The information is processed and the suggestions are sent to the farmer as a message.

Irrigation is of the utmost importance for the high yield of the farm. Nowadays, WSN technology makes it possible to monitor and control environmental conditions such as soil moisture, temperature, wind speed, wind pressure, salinity, turbidity, humidity, etc. for irrigation. Automated irrigation carried out using a solenoid valve and a pump. The solenoid valve is an electromechanical valve that is used with a fluid controller to control an electronic flow through a solenoid that is a wire coil that can control the condition of the valve in accordance with irrigation needs.

4 Literature Survey

Kim et al. [12] represent real-time monitoring and control of the variable current irrigation controller. Sensor nodes measure the environmental parameters and data to the base station where it processes the data through a program of friendly decision making and all data commands are sent to the irrigation control station. The irrigation control station sends the location of the machine via GPS to the base station, sends the control signal back to the irrigation control station according to the location of the GPS head for real-time monitoring and remote control of the water.

Anurag [13] designed a network storage network to remotely monitor agricultural parameters and automate irrigation and fertigation control for precision farming. The static routing algorithm is growing to prevent wastage of address space and the use of a tree structure helps to maintain efficient routing. As the rising threshold, the system is an automated warning message on the console generation to on to indicate what action to take. The valves open automatically, depending on the value to start irrigation and fertilization if necessary.

Martinelli et al. [14] represent the use of WSN that provides real-time data collected by a sensor node. Each node collects data regarding the battery voltage, internal voltage and current supplied by the solar panel and the temperature of the microcontroller to perform real-time monitoring of the indicated network. After the measured data has been measured, the sensor card is turned off and RF transmits the data collected by the radio channel to the receiving node. After the data is collected, the receiving node sends the collected data package to a gateway by measuring the RSS value (received signal strength) of each package and the gateway sends the data to a data management database on a public website. The network is organized in star topology to improve the reliability of the measurement system and to reduce power consumption compared to the multi-hop network topology.

Fazackerley et al. [15] represents the design of an adaptive irrigation controller that uses WSN to monitor soil moisture status and control the irrigation program. Irrigation is based on data from wireless nodes for soil moisture sensor. The controller analyzes the data to determine when and how much water is needed for each part of the field. The water can be controlled by the controller via a flow meter and uses the clock to control the start and end times of watering, and when the program event is triggered, it is added to a queue. Water and at a given moment only a part of the water supplied is supplied. Experimental results show that irrigation water consumption is reduced through the use of a water adjustment program in turf.

Regan et al. [16] have developed a real-time heterogeneous water monitoring network system for monitoring water quality parameters such as pH, temperature, turbidity and conductivity. The implementation of intelligent sensors integrates TEDS (Transducer Electronic Data Sheet) a specification readable machine features the sensor allows the sensor to handle the way plug-and-play system. PSOC system used to create a generic sensor interface. The plug and play functions of the developed WSN platform enable the integration of all commercially available water

quality sensors. PSOC plug-and-play system that can send data to the sensor that has processed the data for sending to the web.

Aqeel-ur-Rehman et al. [17] the indigenous design and development WSAN. To better control the irrigation process in third world countries such as Pakistan, it is necessary to develop a cost-effective material system. They design a three-component system as a sensor node to detect data, an actor node to enable or disable connected actuator devices, and a receiving node to collect data for decision making.

Singh et al. [18] represents the design of a system that takes soil samples when an event is caused by an external event such as a rain event. The system has variable sampling rates with an interface with the soil sensors and the rain meter. The wireless floor sensor network monitors a rain event and soil moisture content. This system includes a rain detection module and a sensory module. The rain detection module detects a rain event and the sensor module measures the soil moisture level. Both modules measure the data based on the sampling rate set by the gateway. Hybrid star mesh topology used to organize sensor nodes in star topology around routers that offer fault tolerance.

Li and Shan-shan et al. [19] proposed Support Vector Machine predict water consumption and genetic algorithm is used to select parameter from SVM. GA-SVM is more robust and accurate due to its strong general search capabilities. Experimental results show that GA-SVM can achieve higher predictive accuracy than ANN (artificial neural network) when predicting water use in agriculture.

Yao et al. [20] proposed the design of a water-based irrigation system based on WSN that combines fuzzy logic and the neural network. Fuzzy logic is a mathematical model and a neural network with a self-learning ability to adapt to a changing environment. The fuzzy neural network is an integrated set of fuzzy logic reasoning and powerful self-learning capabilities of the neural network. Sensor nodes measure soil moisture, temperature, humidity, light intensity and LAN or WAN data are sent to the machine's top gateway and irrigation system irrigation based on feedback information collected in real time.

Dursun et al. [1] are developing the prototype of a remotely controlled irrigation system for real-time soil content monitoring, powered by a solar panel to control drip irrigation. The irrigation site-specific distance-controlled and based sensors prevent water stress from trees and salt formation. PC unit used to collect data and control values. The system ensures efficient management and use of water resources.

Ahmed et al. [21] describe the design of a cheap remote irrigation system in which information is exchanged as a message and gaps between the system and the user's mobile phone when normal conditions are met. The system offers automatic control based on the parameter specified by SMS/miscalls or a keyboard and offers overcurrent and overvoltage protection. When normal circumstances occur, such as a power failure, drying and rain, the system warns the manufacturer by text message or other calls. Using a microcontroller relay, the system transmits a signal based on received commands and current sensor conditions to turn the motor on/off. The

developed system ensures optimum water distribution in the fields via an SMS-based water pump or incorrect mobile phone calls and protects the motor against overcharging and overheating.

Sudha et al. [4] proposed a TDMA-based MAC protocol that is used to collect data such as moisture and soil temperature for optimum energy-saving irrigation. The MAC protocol plays an important role in reducing energy consumption. Two methods used for energy efficiency as a method for direct communication and aggregation method. The direct communication method allows collision less data transmission because all sensor nodes send data directly to the base station without requiring a header node. This method is preferred when the base station is close, but not optimal when the base station is remote, because the sensor nodes use more power when sending data and, if there is a lot of data at the destination of the sensor node, they get damaged quickly. The data aggregation method is better to use than the direct communication method. The sensor node detects the data and sends it to the main node. The master node collects data from the entire sensor node, performs aggregation using different aggregation techniques, and sends the data to the base station. The total power consumption of the network is thus reduced with the aid of the aggregation method. The results of the simulation show that the method of aggregation better performance provides the direct communication method. It provides a 10% increase in residual energy and a 13% increase in transit. Sensor buttons use more energy when sending data.

Feng [7] focused on analyzing the routing protocols of sensor network nodes to realize hardware and software design. The use of mobile phones and wireless PDAs makes it easy to check the moisture content of the soil and the control of an irrigation system. The results show that water is used effectively with the help of an integrated control technology system.

Zhang et al. [22] represent the design of the distributed wireless indoor temperature and humidity control system to improve overall system performance by detecting changes in temperature and humidity. The fuzzy control algorithm used to control the system environment factor and the software tools used for the supported design of a fuzzy operating system. Real-time data collected by the monitoring software and reports made for decision making.

Chaudhary et al. [23] have proposed and analyzed the use of PSoC technology in WSN to monitor and control various greenhouse parameters. In order to solve the problem of the management server, in particular concerning the data, congestion and intercommunication between nodes, WSN applications are used with a specific protocol and hardware based on system on chip with radio programmable, who would like to designate the design of the greenhouse control. The greenhouse is an emerging agricultural technology that helps the farmer to get a better return from a crop. The fertilizers and water required for the plant are based on weather conditions. The sensor thus detects the indoor and outdoor climate of the greenhouse. This requires control of the air temperature, humidity control and soil conditions for a better crop yield. Climate control in a greenhouse is a control system for events on the basis of the intersection sampling. This method is also called adaptive sampling method.

Jagyasi et al. [24] have an agro collateral proposed system in that on the event-based query modeling offers with which the history of events and their links in the spatial-temporal can be dimensions requested. The mKRISHI mobile phone app can be used by farmers to request text, voice, photo and video. All information stored as events in EventBase. In mKRISHI the architecture of different events as defined in the function of the event sensor, an event occurs when a parameter perceived by a sensor is abnormally high or low, each farmer's request is an event and expert responses o the query other event. Many actions, such as irrigation by the farmer, are also an event and many other events take place. The event-based approach offers past experiences to improve decision-making. This approach offers agricultural experts a history of agricultural experience to improve the answers to questions from farmers. For the system of the agro board mKRISHI, the model offers a platform for sharing experiences between different experts.

Zhang et al. [25] analyze the temporal and spatial variability of soil moisture for variable irrigation and improved agricultural yield. The temporary variability takes over changes in soil moisture at the location where the sensor nodes are installed and analyzes changes in soil moisture at different times, depending on the season. Spatial variability analyzes calculate all soil moisture parameters on average, maximum and minimum over the entire surface. The temporal variability curve was determined according to the measurement data. She showed that the corn was in a state of severe water stress during the full monitoring period.

Peng et al. [26] are developing a water-saving, intelligent irrigation system based on fuzzy control and WSN processing. The sensor node collects data such as soil moisture and air temperature and sends it to the coordination node and the fuzzy controller in the coordination node. It takes input information, the amount of water used for crops and sends it to the irrigation control node. The irrigation control node receives information and sends an irrigation command through the input/output port to control the action of the electrical control valve to complete the irrigation. The results show that the system uses less energy and accurately calculates the amount of water demand from crops to save irrigation water.

Wan [27] have proposed tree and cluster topology based multihop algorithm routing to reduce energy consumption, while transferring nodes of data using WSN to monitor water monitoring and gathering needs for crops such as temperature, humidity, soil moisture and the volume of irrigation built the machine learning model and data aggregation for signal processing together. The data of the processed crop water requirement converted into a machine learning model is used to accurately determine crop water requirements, improve crop productivity and implement accurate irrigation remotely.

Mafuta et al. [28] describe the implementation of a WSN-based irrigation management system. This document also describes the design and implementation of a cheap, robust and efficient information management system. It combines sensors and actuators in a WSN for the successful deployment of WSN for PA. He used photovoltaic and rechargeable solar cells to charge electrical devices. The soil moisture sensors take soil moisture and temperature samples and also send data to the storage and data coordinator node to the external server via the gateway

and open or close the gate valves. irrigation via a mobile network. They also show the correlation between RSSI (received signal strength indicator) of each packet and the battery level.

The wireless mesh network is used for communication. Actuators that are operated on the controller side use electrical switches. The algorithm has been tested on a CC2420 board based on Texas Instrument.

Casadesús et al. [29] proposed an algorithm using a feedback mechanism that provides an answer to the effect of applying the scheme that it generates for crop water needs. The purpose of this algorithm is to plan irrigation based on the needs of each plant and the variability during the season caused by weather and other factors. The algorithm performs seven different tasks. It first measures how much water is delivered to the farm every day based on weather conditions and crop growth. It implements the installation of the water management system to manage the amount of water supplied to the crops of the farm, to carry out the irrigation program and to measure the effects of the program on the crop and the data collected by the treated sensors. To extract meaningful information. for decision making. The algorithm for an event to be detected, will activate the implementation of specific procedures for this type of event, and will ultimately implement the return mechanism in order to close the loop of the algorithm. The result shows that a simple water balance offers a quicker response than a feedback mechanism for weather conditions.

Keshtgary et al. [30] represent two topologies for PA:- in the first topology, each sensor is placed on the corner of each screen and in the second technology; the nodes are placed in a random position. In the grid topology, the access points in the middle of the battery are randomly distributed in the topology, distributed in an unexpected situation. Each access point connects to the server via one cable and two routers. Both topologies were evaluated using OPNET Modeler. The sensor button collects data such as water level, precipitation and soil moisture. The collected data is sent via Wi-Fi to the receiving node, the data is stored and processed by the information center and a set of performance metrics used to compare topologies, including delay, load and throughput.

Gutiérrez et al. [6] proposed an irrigation system with a photovoltaic solar panel to power the system, because the power supply would be expensive. For water-saving purposes, an algorithm has been developed with a temperature and soil moisture threshold programmed in a microcontroller gateway. The system has full-duplex communication connections based on a mobile internet interface with GPRS of mobile data for graphic display and stored in a database server. The automated irrigation system consists of two components: WSU and WIU. Components of the wireless sensor unit (WSU) have been used to minimize power consumption because the microcontroller is well suited for its lower standby power. The Wireless Information Unit (WIU) sends soil moisture and temperature data to a web server using the GPRS module. The WIU identifies registered and analyzed data on soil temperature and soil moisture collected by WSU. The WIU function is based on a microcontroller programmed to perform various tasks such as downloading date and time information from the web server and comparing the

temperature and humidity value of the soil with the maximum soil humidity and temperature. Minimum temperature value so that irrigated pumps are activated.

Abd El-kader et al. [31] proposed APTEEN (periodic threshold old sensitive sensor effective energy network) protocol. APTEEN is a hierarchy-based routing protocol in which nodes are clustered in clusters. Each cluster has a primary node and the primary node is responsible for sending the data to the base station. APTEEN transmits parameters, that is a set of physical parameters in which the user wants to obtain information, the thresholds as a strict threshold and a soft threshold, the program as a TDMA program uses the allocation of slots to save energy, resulting in collision-free transmission. It controls energy consumption by changing the threshold values and the counting time. The performance of the proposed protocol is better than LEACH on average 79% and LEACH-C on average 112%.

Satish Kannan et al. [32] proposed a WSN-based system that provides an online system for remote control and maintenance of the farm by connecting to an agricultural website. The cameras were used to make live videos of the farm. By using these videos, the user can see the current status of the battery and control it remotely from any part of the world. The proposed system is divided into three modules: initial measurement of different parameters and recording of live video from the farm, management module that controls the irrigation station by collecting real-time data and monitoring and control module that describes the software part to which the website of the farm is accessible.

Illes et al. [33] describe the design and implementation of a low-cost water level control system using the logical programming controller and the WSN that represents the maximum water level, the minimum water level in the tank. The motor error and the correct operation of the motor are visually indicated by an LED connected to the controller of the programming logic. The sensor sends an information signal to the pump so that it switches on the motor when the water level is below the minimum level and when the speed of the pump motor is not too high, the motor is switched off.

Nayak et al. [34] describe that the battery of sensor nodes is charged by exploiting wind energy. A routing algorithm called DEHAR is proposed to increase the overall charge of the batteries. The proposed method is effective when the number of sensor nodes is very low due to latency due to synchronous sleep planning. A small band of tape used to utilize wind energy on sensor nodes. The wind tire is an aerodynamic floating, capable of utilizing the wind force. Exploiting wind energy is a renewable energy source. However, the biggest problem with controlling wind energy is unreliability because the wind energy is not permanent.

Balaji Bhan et al. [35] proposed a system for the development of WSN-based soil moisture controllers that determine the water requirement by comparing soil moisture with a predefined threshold value. An intelligent remote system includes wireless sensor nodes and a computer system in which data is sent to a server system from which data has access to decision-making data for automated irrigation control for yield productivity. Field validation tests are regularly performed on different soils to measure soil moisture and the amount of water in the soil for an

effective irrigation system. If the stored data does not match the measured soil data, a fall to the pressure unit and automatic irrigation stop.

Khriji et al. [36] describe different types of sensor nodes for effective monitoring and control of the irrigation system. Each node consists of a motor and a TelosB actuator. TelosB mote is a wireless module with very low power for application monitoring. Soil knots used to measure soil moisture. Meteorological nodes used to measure environmental parameters and actuator used to control the opening of valves for irrigation. The system is cost effective and reduces the energieverbruik. Het experimental result shows that the plants are well irrigated and that if the threshold is changed, the system warns the problem producer and asks him to make the right decision.

Usha Rani et al. [37] proposed a moisture-based AIS system using a Grove moisture sensor to control the water level on the pipe. Depending on the soil moisture level, the water flow sensor detects the flow range and the operating pressure. Controlled data that has been updated over time in a database and displayed on the web portal through web service technology, updated information through web technology and updated information are available on the web page from where the farmer checks the humidity level and condition of the engine. By using the functions of the GSM engine, the status is also sent to the farmer.

Mat et al. [38] describe the WSN technology that has enabled automated irrigation for precision farming in a greenhouse. In this article greenhouse monitoring is used to check the parameters for temperature, humidity and soil moisture. The data collected by the sensors is sent to the external server for analysis. Depending on the threshold value of the humidity data, an automated check of the irrigation value is carried out. Use of integrated automated sensor information technology and management; PA was used to improve the quality of the product and the efficiency of the use of agricultural chemicals. The results show that automatic irrigation is better than programmed irrigation because it optimizes the use of water and fertilizer and maintains soil moisture.

Kaewmard et al. [39] describe the design of an automated irrigation system using WSN, including a soil moisture sensor, an air temperature sensor and an air humidity sensor. Air to collect environmental data and regulate the irrigation system. Using a smartphone, the irrigation system uses values to switch the solenoid valve on or off. The irrigation system regulates water by sending and receiving orders from a smartphone application via the internet. The results show that the proposed AIS systems are useful, cost effective and offer better performance than conventional systems.

Sales et al. [40] present the implementation of GPRS communication as a gateway between WSN and the internet. AIS connected to the internet via GPRS. Different approaches to data transmission that are used to implement a closed loop irrigation system in the PA. The closed loop irrigation system is used to put the right amount of water in the right place at the right time and to conserve natural resources. For reliable data, UPR (User Datagram Protocol)-based GPRS transfers were implemented, such as byte stream and independent frame. It is important to maintain the order of packages during shipment. With the Go backend architecture,

you can receive packages in the correct order. The transfer of packages with independent confirmation gives the best result that the arrival of information through retransmission guarantees packages unconfirmed and thus makes a reliable transfer of information.

Alagupandi et al. [41] proposed a simple and cost-effective smart irrigation system. The system is modeled in an outdoor environment using Tiny OS-based IRIS patterns to measure the moisture level of the rice field. Humidity sensors measure the level of soil moisture. The system has set a threshold value and if the voltage exceeds this threshold, it represents the driest soil. The proposed system has an improved graphic visualization and monitoring interface. The motor is automatically switched on by pressing the main task on the display. AIS is performed using the MOTEWORKS visualization tool. The visualization tool of the MOTEVIEW software performs the automatic motor check to enable or disable the server-side motor.

Hema et al. [42] propose a technique to predict the local weather interpolation parameter in real time using the automated weather station. By using economical WSN with a soil moisture sensor, this document provides error correction and accuracy of around 99.59% for real-time interpolated data. This system provides previous, current and future predictions using nearby ASW data and controls irrigation in conditions such as precipitation. For irrigation control, used soil moisture and AWS data and for error correction, interpolated data is compared with soil moisture data.

Meyer et al. [43] represent the design of an intelligent sprinkler system that uses a mesh-based WSN for monitoring and controlling irrigation systems in the field. This system provides accuracy by controlling the soil moisture level between the thresholds. The sensor buttons send data to the base station when the timing variable overflows. The base station has an actuator interface for controlling the solenoid valve using the graphic interface. The graphical interface provides system information to the user and allows you to change the setting and initially configure the system. Air temperature, soil temperature and humidity have a major influence on the tomato harvest. Some diseases occur in tomato growing due to high humidity and high temperatures, such as gray fungus and moldy leaves.

Sales et al. [44] proposed a cloud-based WSAN communication system, monitoring and control of a set of sensors and actuators to measure water needs. Cloud computing offers a large storage and processing capacity. The proposed architecture is divided into three components, namely a WSAN component, a cloud platform component and a user application component. The WSAN network contains three types of nodes: a receiving node, a sensor node and an actor node. Cloud computing offers an attractive solution for a large amount of data. In addition, the web application provides user interfaces that allow the user to view the location of network nodes to access historical data.

Kodali et al. [45] represent the general history of spices such as black pepper, cardamom and cloves in different states where these spices are grown and exported, as well as the problem that arises from the agricultural community related to pests and irrigation. That is why WSN used different soil and environmental parameters

and the presence of pests among crops and offered useful measures for the user to make the right decision to improve harvest yield. The MEMSIC EKO nodes are used for real-time monitoring of parameters and control of the irrigation system.

Ameer et al. [46] describe the use of solar energy for an automatic irrigation system to supply water for the pump set. Solar module used to convert sunlight into electricity. Electricity produced by sunlight can be stored in batteries. Humidity sensors detect wet and dry soil conditions. Once the data is detected, the sensor node sends a signal to the microcontroller and the microcontroller sends a signal to the relay, which is an electrically operated switch to turn the motor on and off when the soil is dry and to turn the motor off in wet conditions. The system works automatically without human interruption, so there is no need for manual operations for the farmer.

Gutiérrez Jagüey et al. [47] report that sensors use a smartphone to capture and process soil images. Images can be made to estimate the soil moisture content. The router node is used to send the collected values to the gateway that automatically pumps water to the crop in a field. An Android application that is used for connectivity such as Wi-Fi. The Android application activates the smartphone using certain parameters. The integrated camera creates an RGB image of the ground through an anti-reflective window to estimate dry and wet areas. With the mobile application, the smartphone's Wi-Fi connection can send the estimated value via a router node to the gateway to operate an irrigation water pump.

Patil et al. [48], proposes a wise agricultural model in integration with ICT. ICT have always mattered in Agriculture domain. Over period, weather patterns and soil conditions and epidemics of pests and diseases changed, received updated information allows the farmers to cope with and even benefit from these changes. It is really challenging task that needs to provide such knowledge because of highly localized nature of agriculture information specifically distinct conditions. The complete real-time and historical environment information helps to achieve efficient management and utilization of resources. The issue is that the technique can achieve convenient wireless connection within a short-distance.

Mancuso et al. [49] The Rinnovando Group (Rgroup) cooperates with agricultural experts who focus on microclimate monitoring in tomato greenhouses. The main purpose of monitoring is to determine when the crop is likely to grow and the farmer only treats the field with fertilizer.

Suma et al. (2017) A document in which wireless sensor networks are used to constantly note the soil characteristics and environmental conditions. At different sites on the land, different sensor nodes were deployed. These parameters were controlled via any wireless device or internet services and interfacing sensors, Wi-Fi and raspberry pi camera are operational. This idea has been established as a commodity and has been given to the welfare of farmers [50].

Kumar et al. [51] suggested that the Microcontroller transmit the data over the internet via an IoT network in the type of a wireless ESP8266 device. This enhances automatic irrigation as when the water pump is turned on or off using controller data, using LDR and Laser [52] to obtain the chlorophyll content as well as the nutrient value of the plant.

5 Comparison

	Sensor	Soil moisture	Temperature	Humidity	Air temp	pH	Light intensity	Weed detection	Solar radiation	Rain fall	Wind speed	Wind direction
[4]	LM35	Yes	Yes	No	No	No	No	No	No	No	No	No
[34]	Moisture	Yes	Yes	Yes	No	No	No	Yes	No	No	No	No
[25]	Moisture	Yes	No	No	No	No	No	No	No	No	No	No
[6]	HH400/DS1822	Yes	Yes	No	No	No	No	No	No	No	No	No
[31]	MTS400/ MIDA300	Yes	Yes	Yes	No	Yes	Yes	No	No	No	No	No
[35]	Soil moisture	Yes	No	Yes	No	Yes	No	No	No	No	No	No
[43]	Watermark soil moisture	Yes	Yes	Yes	No	No	No	No	No	No	No	No
[44]	Soil moisture	Yes	Yes	Yes	No	No	No	No	No	No	No	No
[18]	Moisture	Yes	Yes	Yes	No	No	No	Yes	No	No	No	No
[45]	Temperature/ humidity EC/ pH	Yes	Yes	Yes	No		No	No	No	No	No	No
[17]	LM35/SHT71	Yes	Yes	Yes	No	No	No	No	No	No	No	No
[18]	EC-5	Yes	No	No	No	No	No	No	No	No	No	No
[37]	Moisture/water flow	Yes	Yes	Yes	No	No	No	No	No	No	No	No
[22]	Temperature/ humidity	No	Yes	Yes	No	No	No	No	No	No	No	No
[15]	Soil moisture	Yes	No	No	No	No	No	No	No	No	No	No
[1]	Soil moisture	Yes	No	No	No	No	No	No	No	No	No	No
[39]	DHT22	Yes	No	No	Yes		No	No	No	No	No	No
[23]	Temp, humidity, Co_2, soil	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
[40]	Soil moisture/ Soil temp.	No	No	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes
[41]	Soil moisture	Yes	No	No	No	No	No	No	No	No	No	No
[24]	Soil moisture	Yes	No	No	No	No	No	No	No	No	No	No

6 Conclusion

Agriculture can minimize losses if it is implemented with the Internet of Things. WSN is used for video surveillance of information and offers higher bandwidth, but WSN is less secure. The collection of sensor information and the processing of the MCU are relatively slow. In this article we investigate various emerging techniques related to WSN and irrigation in agriculture. Because the low power of the batteries is a big problem with WSN. Various technologies are used to charge sensor batteries, such as the exploitation of wind energy or photovoltaic panels. Energy efficient routing protocols used to manage energy as APTANS. AIS makes efficient use of water resources possible. The system offers real-time monitoring and control of environmental and soil parameters, collects data and delivers results to the farmer via internet or on his mobile phone via SMS. The farmer therefore knows exactly whether a field needs water or not. For example, a farmer saves time, money and water by using AIS.

References

1. Dursun M, Ozden S (2010) A prototype of PC based remote control of irrigation. In: 2010 international conference on environmental engineering and applications, Singapore, pp 255–258
2. Lenka SK, Mohapatra AG (2015) Gradient descent with momentum based neural network pattern classification for the prediction of soil moisture content in precision agriculture. In: 2015 IEEE international symposium on nanoelectronic and information systems, Indore, pp 63–66. https://doi.org/10.1109/iNIS.2015.56
3. Haule J, Michael K (2014) Deployment of wireless sensor networks (WSN) in automated irrigation management and scheduling systems: a review. In: 2014 Pan African conference on science, computing and telecommunications (PACT), Arusha, pp 86–91. https://doi.org/10.1109/scat.2014.7055144
4. Nesa Sudha M, Valarmathi ML, Babu AS (2011) Energy efficient data transmission in automatic irrigation system using wireless sensor networks. Comput Electron Agric 78 (2):215–221. https://doi.org/10.1016/j.compag.2011.07.009 ISSN 0168-1699
5. Pham MH, Saleem SK, Okello N (2013) Real-time optimization of irrigation scheduling in agriculture. In: 2013 25th Chinese control and decision conference (CCDC), Guiyang, pp 4435–4439. https://doi.org/10.1109/ccdc.2013.6561733
6. Gutiérrez J, Villa-Medina JF, NietoGaribay A, Porta-Gándara MÁ (2014) Automated irrigation system using a wireless sensor network and GPRS module. IEEE Trans Instrum Meas 63(1):166–176
7. Feng Z (2011) Research on water-saving irrigation automatic control system based on Internet of Things. In: 2011 international conference on electric information and control engineering (ICEICE), Wuhan, pp 2541–2544
8. Vishwakarma RG, Choudhary V (2011) Wireless solution for irrigation in agriculture. In: 2011 international conference on signal processing, communication, computing and networking technologies (ICSCCN), Thuckafay, pp 61–63
9. Patil P, Narkhede A, Chalke A, Kalaskar H, Rajput M (2014) Real time automation of agricultural environment. In: 2014 international conference for convergence of technology (I2CT), Pune, pp 1–4. https://doi.org/10.1109/i2ct.2014.7092040
10. Codreanu N, Varzaru G, Ionescu C (2014) Solar powered wireless multi-sensor device for an irrigation system. In: Proceedings of the 2014 37th international spring seminar on electronics technology, Dresden, pp 442–447. https://doi.org/10.1109/isse.2014.6887641
11. Saelao J, Patcharaprakiti N (2015) A rainfall trend analysis for agriculture irrigation system management case study: Sansai district - Chiangmai province. In: 2015 international conference on science and technology (TICST), Pathum Thani, pp 519–522. https://doi.org/10.1109/ticst.2015.7369409
12. Kim Y, Evans RG, Iversen WM (2008) Remote sensing and control of an irrigation system using a distributed wireless sensor network. IEEE Trans Instrum Meas 57(7):1379–1387
13. Anurag D, Roy S, Bandyopadhyay S (2008) Agro-sense: precision agriculture using sensor based wireless mesh networks. In: First ITU-T kaleidoscope academic conference on innovations in NGN: future network and services, KINGN 2008, Geneva, pp 383–388. https://doi.org/10.1109/KINGN.2008.4542291
14. Martinelli M, Ioriatti L, Viani F, Benedetti M, Massa A (2009) A WSN-based solution for precision farm purposes. In: 2009 IEEE international geoscience and remote sensing symposium, Cape Town, pp V-469–V-472
15. Fazackerley S, Lawrence R (2010) Reducing turfgrass water consumption using sensor nodes and an adaptive irrigation controller. In: 2010 IEEE sensors applications symposium (SAS), Limerick, pp 90–94
16. Regan F et al (2009) A demonstration of wireless sensing for long term monitoring of water quality. In: 2009 IEEE 34th conference on local computer networks, Zurich, pp 819–825

17. Aqeel-ur-Rehman, Shaikh ZA, Yousuf H, Nawaz F, Kirmani M, Kiran S (2010) Crop irrigation control using wireless sensor and actuator network (WSAN). In: 2010 international conference on information and emerging technologies (ICIET), Karachi, pp 1–5
18. Singh A, Chyan LS, Sebastian P (2010) Sensor integration in a wireless sensor network system for environmental monitoring system. In: 2010 international conference on intelligent and advanced systems (ICIAS), Kuala Lumpur, Malaysia, pp 1–5
19. Li YZ, Shan-shan Y (2010) Application of SVM optimized by genetic algorithm in forecasting and management of water consumption used in agriculture. In: 2010 the 2nd international conference on computer and automation engineering (ICCAE), Singapore, pp 625–628. https://doi.org/10.1109/iccae.2010.5451325
20. Yao Z, Lou G, Zeng X, Zhao Q (2010) Research and development precision irrigation control system in agricultural. In: 2010 international conference on computer and communication technologies in agriculture engineering, Chengdu, pp 117–120
21. Ahmed V, Ladhake SA (2010) Design of ultra low cost cell phone based embedded system for irrigation. In: 2010 international conference on machine vision and human-machine interface (MVHI), Kaifeng, China, pp 718–721
22. Zhang X, Chang B (2011) Research of temperature and humidity monitoring system based on WSN and fuzzy control. In: 2011 international conference on electronics and optoelectronics (ICEOE), Dalian, pp V4-300–V4-303
23. Chaudhary DD, Nayse SP, Waghmare LM (2011) Application of wireless sensor networks for greenhouse parameter control in precision agriculture. Int J Wirel Mob Netw (IJWMN) 3 (1):140–149
24. Jagyasi BG, Pande AK, Jain R (2011) Event based experiential computing in agroadvisory system for rural farmers. In: 2011 IEEE 7th international conference on wireless and mobile computing, networking and communications (WiMob), Wuhan, pp 439–444
25. Zhang M, Li M, Wang W, Liu C, Gao H (2013) Temporal and spatial variability of soil moisture based on WSN. Math Comput Model 58(3–4):826–833 ISSN 0895-7177
26. Peng X, Liu G (2012) Intelligent water-saving irrigation system based on fuzzy control and wireless sensor network. In: 2012 fourth international conference on digital home (ICDH), Guangzhou, pp 252–256
27. Wan S (2012) Research on the model for crop water requirements in wireless sensor networks. In: 2012 international conference on management of e-Commerce and eGovernment (ICMeCG), Beijing, pp 234–237
28. Mafuta M, Zennaro M, Bagula A, Ault G, Gombachika H, Chadza T (2012) Successful deployment of a wireless sensor network for precision agriculture in Malawi. In: 2012 IEEE 3rd international conference on networked embedded systems for every application (NESEA), Liverpool, pp 1–7
29. Casadesús J, Mata M, Marsal J, Girona J (2012) A general algorithm for automated scheduling of drip irrigation in tree crops. Comput Electron Agric 83:11–20 ISSN 0168-1699
30. Keshtgary M, Deljoo A (2012) An efficient wireless sensor network for precision agriculture. Can J Multimed Wirel Netw 3(1):1–5
31. Abd El-kader SM, Mohammad El-Basioni BM (2013) Precision farming solution in Egypt using the wireless sensor network technology. Egypt Inform J 14(3):221–233 ISSN 1110-8665
32. Sathish Kannan K, Thilagavathi G (2013) Online farming based on embedded systems and wireless sensor networks. In: 2013 international conference on computation of power, energy, information and communication (ICCPEIC), Chennai, pp 71–74
33. Illes C, Popa GN, Filip I (2013) Water level control system using PLC and wireless sensors. In: 2013 IEEE 9th international conference on computational cybernetics (ICCC), Tihany, pp 195–199
34. Nayak A, Prakash G, Rao A (2014) Harnessing wind energy to power sensor networks for agriculture. In: 2014 international conference on advances in energy conversion technologies (ICAECT), Manipal, pp 221–226

35. Balaji Bhanu B, Hussain MA, Ande P (2014) Monitoring of soil parameters for effective irrigation using wireless sensor networks. In: 2014 sixth international conference on advanced computing (ICoAC), Chennai, pp 211–215
36. Khriji S, Houssaini DE, Jmal MW, Viehweger C, Abid M, Kanoun O (2014) Precision irrigation based on wireless sensor network. IET Sci Meas Technol 8(3):98–106
37. Usha Rani M, Kamalesh S (2014) Web based service to monitor automatic irrigation system for the agriculture field using sensors. In: 2014 international conference on advances in electrical engineering (ICAEE), Vellore, pp 1–5
38. Mat I, Kassim MRM, Harun AN (2014) Precision irrigation performance measurement using wireless sensor network. In: 2014 sixth international conference on ubiquitous and future networks (ICUFN), Shanghai, pp 154–157
39. Kaewmard N, Saiyod S (2014) Sensor data collection and irrigation control on vegetable crop using smart phone and wireless sensor networks for smart farm. In: 2014 IEEE conference on wireless sensors (ICWiSE), Subang, pp 106–112
40. Salas J, Vega H, Ortiz J, Bustos R, Lozoya C (2014) Implementation analysis of GPRS communication for precision agriculture. In: IECON 2014 – 40th annual conference of the IEEE industrial electronics society, Dallas, TX, pp 3903–3908. https://doi.org/10.1109/iecon.2014.7049083
41. Alagupandi P, Ramesh R, Gayathri S (2014) Smart irrigation system for outdoor environment using Tiny OS. In: 2014 international conference on computation of power, energy, information and communication (ICCPEIC), Chennai, pp 104–108
42. Hema N, Kant K (2014) Local weather interpolation using remote AWS data with error corrections using sparse WSN for automated irrigation for Indian farming. In: 2014 seventh international conference on contemporary computing (IC3), Noida, pp 478–483. https://doi.org/10.1109/ic3.2014.6897220
43. Meyer TC, Hancke GP (2015) Design of a smart sprinkler system. In: TENCON 2015 – 2015 IEEE region 10 conference, Macao, pp 1–6
44. Sales N, Remédios O, Arsenio A (2015) Wireless sensor and actuator system for smart irrigation on the cloud. In: 2015 IEEE 2nd world forum on Internet of Things (WFIoT), Milan, pp 693–698
45. Kodali RK, Muraleedhar A (2015) WSN in spice cultivation. In: 2015 international conference on green computing and Internet of Things (ICGCIoT), Noida, pp 1173–1177
46. Ameer S, Chaubey SS, Joseph M, Rajasekhar P, Abhinav S, Ravikiran R (2015) Automatic irrigation system through a solar power. In: 2015 international conference on electrical, electronics, signals, communication and optimization (EESCO), Visakhapatnam, pp 1–5. https://doi.org/10.1109/eesco.2015.7254015
47. Gutiérrez Jagüey J, Villa-Medina JF, López-Guzmán A, Porta-Gándara MÁ (2015) Smartphone irrigation sensor. IEEE Sens J 15(9):5122–5127
48. Patil KA, Kale NR (2016) A model for smart agriculture using IoT. In: International conference on global trends in signal processing, information computing and communication. IEEE
49. Mancuso M, Bustaffa F (2006) A wireless sensors network for monitoring environmental variables in a tomato greenhouse. In: 2006 IEEE international
50. Suma N, Samson SR, Saranya S, Shanmugapriya G, Subhashri R (2017) IOT based smart agriculture monitoring system. Int J Recent Innov Trends Comput Commun 5(2):177–181
51. Kumar VV, Ramasamy R, Janarthanan S, Babu MV (2017) Implementation of IOT in smart irrigation system using arduino processor. Int J Civ Eng Technol 8(10):1304–1314
52. Muthukumaran N, Ravi R (2016) Hardware implementation of architecture techniques for fast efficient loss less image compression system. Wireless Pers Commun 90(3):1291–1315

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IoT Based Smart Farming Using Thingspeak and MATLAB

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Abstract Climate changes have contributed to the growing importance of monitoring of the climate. A continuous monitoring of the environmental parameter is important to assess the value of the atmosphere. The IoT technology had taken revolution to any area of human life, making it digital and insightful. IoT is a collection of things that make up a network for self-configuration. Since the IoT is the most advanced technology, the collection of data from the sensor system plays a key role. This paper presents a Arduino UNO Wi-Fi module (ESP8266) which helps processing and transfers sensed information to the thing speak cloud, usually comprised of various sensors such as temperature, humidity and moisture, etc. Then, the obtained parameters are stored on the cloud server. A cloud computing system tracks environmental changes as a repository. Things talk will provide a function for a public channel, which is measured and calculated by the general public. A free access to measurement parameters is provided with an Android framework. This paper is aimed at proposing a new smart IoT based farming that supports farmers in obtaining live data (temperature, soil humidity) for successful environmental monitoring so that they can make smart farming and increase overall production and value of their products. The Novel Intelligent IoT Farming is embedded with Arduino Technology and the breadboard can be obtained from Thingsspeak.com with different sensor modules and live data feeds. A supporting, open API platform for IoT's Thingspeak's internet services is a host for a range of

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_117

sensor systems that manage sensitive information at cloud level and incorporated a special feature of transferring sensed data to MATLAB R2019a. A Channel ID and API key assigned through the services can be used to monitor data quality at specific intervals.

Keywords Arduino UNO · Thingspeak · Internet of Things (IoT) · Wi-Fi module

1 Introduction

The Internet of Things (IoT) plays a critical role in transforming "ordinary engineering" from home to workplace into "new generation computing everywhere." In research throughout the corner of the world, in traditional wireless technology, Internet of Things [1] is becoming a major factor. The term "IoT" refers to a system that was implemented in 1998 for individual objects, items and their virtual representations on the internet. The Internet of Things [2] has been discovered by "Kevin Ashton," with regard to supply chains management in 1999. The power and flexibility of IoT has improved these days and is now used even by normal users. IoT [3] has laid the foundation for the development of several devices from the standard consumer perspective, such as smart building, e-health, robotics and even intelligent education. Nevertheless, IoT is now being used from a strategic angle in business administration, construction, intelligent transport and even farming. "Farming" is one of the key areas where IoT technology and new daily products are being launched, allowing businesses to expand production better and more efficient. The field of farming is seen as the most important area for food safety at a global level. Speaking to farmers in India who are in great trouble right now, and who find themselves at a disadvantage in terms of farm size, technology, trade, politics, and environment and so on. ICT technology had definitely solved problems, but it's not sufficiently good to make development safe and effective. ICT has progressed to IOT, also known as Ubiquitous Computing [4]. Agricultural production involves many activities, including monitoring of soil and crop, monitoring of environment like moisture and temperature, transport, control of supply chain, system (Fig. 1).

In view of the current agriculture scenario which is subject to loads of problems, IoT based intelligent agriculture is absolutely necessary. Internet of goods on the basis of things only has to be planned and implemented at regular and also very fast intervals so that smart agriculture can be accomplished in the modern world. The objective of this research is to introduce IoT-based intelligent farming which enables farmers to attain live soil moisture data at a very cheap room temperatures, making living monitoring easy.

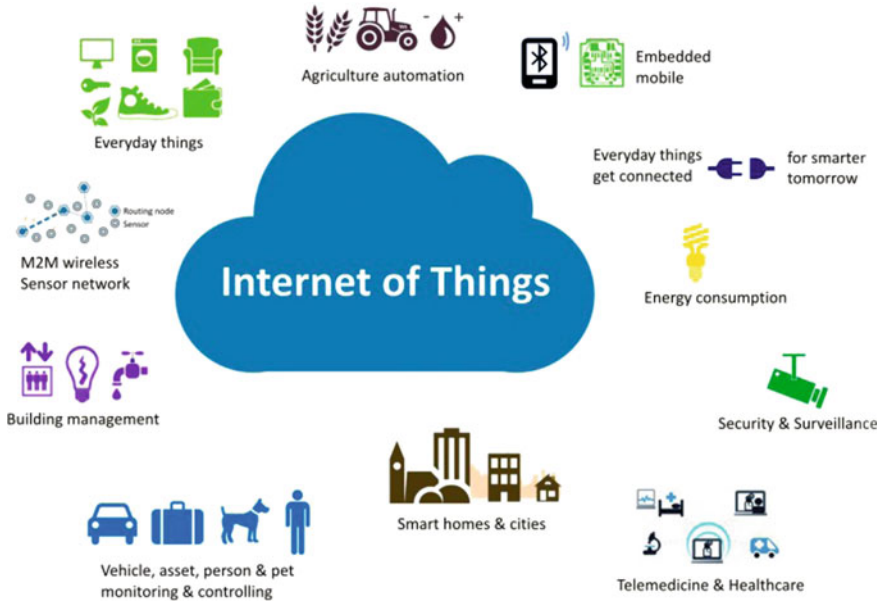


Fig. 1 The current IoT situation

2 Agricultural IOT Technologies

2.1 Internet of Things

Two ideas are present in the Internet of Things [5, 6]-the internet as well as the things. The word objects in IoT refers to many IoT devices of unique identity, capable of remotely monitoring and controlling all kinds of data. IoT devices may also direct and indirect sharing of data or collection of data from many other devices, process the data, and send data live from many other smart devices to different servers. The other word "Internet" refers to the worldwide communication network that connects trillions of computers across the globe and makes information sharing possible. As various analysts estimate, 50 trillion IoT-based devices will be connected all over the world by 2020. The Iot (IoT) has also been characterized as [7], a global design for dynamics networks which has automation-based interfaces that have equivalent physical or virtual 'thing' and physical properties and virtual identifications. There are several interfaces for establishing wired or wireless communication in an optimized IoT network. The following components comprises an IoT-based device:

- Sensor I/O interface.
- Internet connectivity GUI.
- Memory and Space Interface.
- Audio/Video GUI.

2.2 Enabling Technologies in IoT

Numerous technological enablers will benefit from a strong infrastructure: networks for wireless sensors, cloud computer systems, large data systems, integrated systems, software and security protocol, dynamic routing, online services, internet and web engines.

1. **Wireless sensor networks (WSN):** The network consist of various sensor/nodes, connected for the detection and monitoring of different data types.
2. **Cloud computing:** most on-demand technology is an Internet based type, providing a shared processing resource and data for computers and other on-demand devices. They could, in many ways, be PaaS, DaaS, SaAS, IaaS etc.
3. **Big Data Analytics:** The large set of data technique containing various data types, namely the assessment of large amounts of data. Big data–to find hidden models, unspecified relationships, trends in markets, consumer preferences, etc.
4. **Embedded Devices:** This is a sort of computer system that is equipped for specific tasks with software and hardware. The microprocessors, RAM/ROMs, network modules, I/O devices and storage systems are included in it.
5. **Communication protocols**: they form the core of IoT systems, allowing communication including connecting to applications and facilitating data exchange over the network, data transfer, data encoding and format addressing (Fig. 2).

2.3 Agriculture IoT Applications

By adopting IoT, we can see huge potential for making everything smart and intelligent, in different areas like industrial, domestic and cities. Even in the farming

Fig. 2 Enabling technologies of IoT

sector IoT technique is currently being introduced, leading to the growth of the 'Farming Internet of Things'.

In farming, different projects as well as applications result to effective management and control of the different activities shows below (Tables 1 and 2).

Table 1 Current scenarios and future forecasts for IoT and agriculture

Name of the application	Summary
Crop water management	Adequate water is needed to perform farming tasks efficiently. To ensure that water is properly managed for irrigation, agriculture IoT is included in the Cloud Map Services (CMS) and the Sensor Observation Services (SOS) for the minimization of waste
Precision agriculture	High weather precise is necessary, reducing the likelihood of plant damage. Agriculture IoT ensures that farmers are provided promptly with real time weather forecasting, soil quality, labor costs and much more data
Integrated Pest Management or Control (IPM/C)	IoT systems guarantee farmers accurate environment data, so that adequate caring can be carried during manufacturing, with a standard living temperature and moisture, plant growth as well as the monitoring of pest rates
Food production & safety agriculture	In addition, IoT monitors many variables, including warehouse temperatures and inventory management, in a reliable manner, and incorporates cloud-based monitoring systems

Table 2 Showing growth from 2015–2019 and forecasts for the year 2022–2050, IoT oriented adoption in the field of agriculture

Year	Analysis of data
2015	15.41 Million farms connected to IoT
2016	540 Million farms connected to IoT
2017	20.35 Billion farms connected to IoT
2018	23.14 Billion farms connected to IoT
2019	26.66 Billion crops to Iot
2022	29 Billion crops will link with Iot
2035	78 Billion crops to IoT 2 Billion crops possibly connect with IoT
2050	2 trillion farms will probably be associated with IoT

3 Thingspeak

The Talk is a IoT platform that allows you to collect and store sensor data in the cloud and to create IoT apps. Thing Speak IoT provides applications for analyzing the data in MATLAB R2019A and for visualizing the information and acting on the

data. Arduino, Raspberry Pi, Bone Black and other hardware will send sensor data to Thing Talk. Thing Speak has incorporated the MATLAB R2019A mathematical computer software for Thing Speak users to analyze and display Matlab-based data without the purchase of a MathWorks Matlab R2019a license.

A web-based IoT Server Thingspeak is an open web-based IoT source information service [8–10] which incorporates sensor data processing in different 'IoT applications' in graphic format on the Web. Thingspeak interacts with the assistance of the Connection to the internet that serves as a 'machine' packet for the cloud's download, get/talk, evaluate and monitor sensed information such as Arduino, Raspberry-pi, and so on from the connecting microcontroller to the database. Thingspeak interacts regularly.

Thingspeak promotes the development of a fascinating sensor-based monitoring system, location/positioning tracking software, and the 'social media site' of up-to-date items/objects and the monitoring of "home automation" items, which are connected from a location-of-existence through public-domain (internet) system.

Thingspeak also provides a feature to create a public forum for community criticism and evaluation. To engage 'things/objects' in the sensing and transmitting of data on the Internet and to connect data from a PC further, the collect (sensor) objects need the data to be uploaded to the network in the form of server (running apps) and such types can be considered cloud. The "internet" uses interactive simulation operating systems and is accessible as a Virtual database for users and objects are connected with the cloud by the possibility of 'WLAN' for users and the majority of the objects are told about our environmental analog information by the sensors/actuators. The IoT brings it all together and enables us to communicate to our objects and allows objects/things to interact with the other "substances" (Fig. 3).

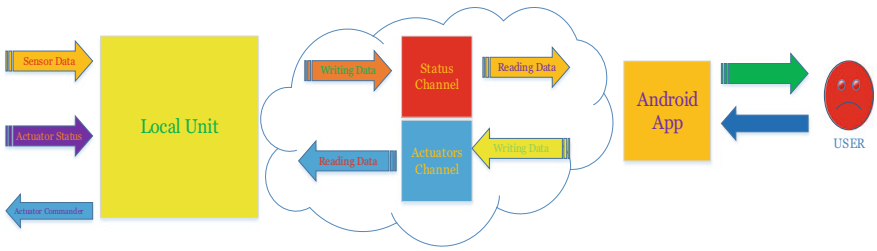


Fig. 3 Thingspeak working principle

4 Microcontrollers and Sensors IOT Dependent Arduino

We used the MQ Sensor protocols in this paper to link the device to IOT cloud. And we also use the Sensor Protocol to transfer data via Post methods between circuit and cloud applications. There are several IoT data contact and information management protocols. They are:

1. Meter for temperature and moisture
2. Sensor MQ135
3. Sensor BMP 280
4. Sensor MQ6
5. WLAN Modem ESP8266
6. Recording and predicting Cloud Server
7. And web apps

4.1 IoT Hardware

In order to create an IoT structure, a hardware combination is required. Ethernet protection, detectors are one of these for this microcontroller. The short hardware summary is given below: we used Arduino UNO, the most common microcontroller. A certain I/O pin is given by Arduino Uno. The system consists of Power, GND, Serial Pin, Analog Pin, INT, Physical Pin, Port Pin, Internet Pin, PWM Pin, Port Power. Power is included. The full pin diagram is shown in Fig. 4. The diagram below is shown here.

4.1.1 Arduino Technology Basic Functions

- Digital reading pin reads the digital value of the given pin.
- For the digital value of a given pin a digital write pin is used.
- To set the pin to I/O mode, the pin mode pin is applied.
- Read and return value of the analog read pin.
- The pin written in an analog pin is the pin value.
- The pin begins by setting the bit rate to begin serial communication.

4.1.2 Advantages

- The software is good for all sorts in operating systems such as Linux, Windows and Macintosh

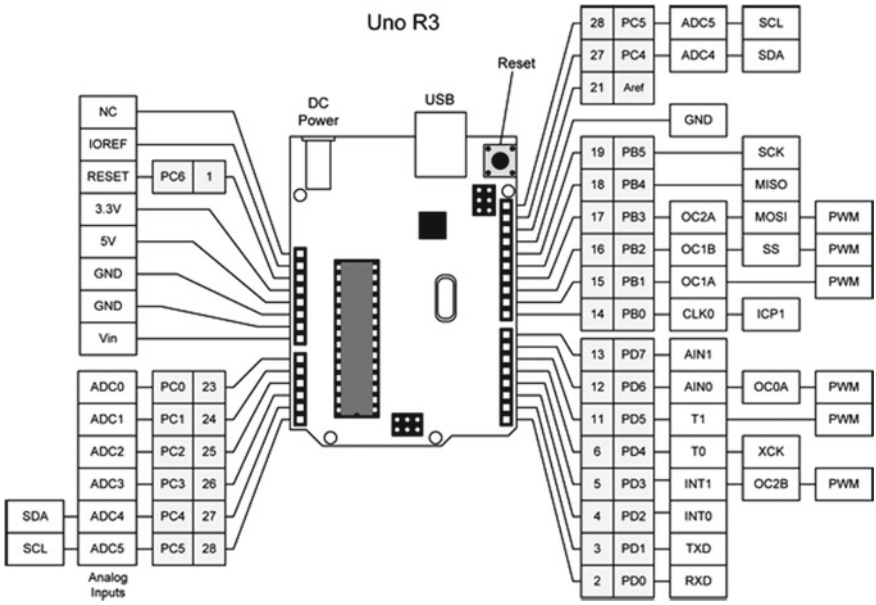


Fig. 4 Pin out diagram for Arduino microcontroller

- It has also an open source software that allows robust developers to use Arduino code to merge with the prevailing software
- It is inexpensive
- It comes with open source hardware, enabling users to develop their own kit.

5 Components

Different components in this section i.e. agricultural development Arduino UNO Wi-Fi Module & Sensors for Smart IoT are discussed:

5.1 Modules

5.1.1 Board of Arduino UNO: Data Processing

The expansion of Arduino came into being in 'Italy' to produce low-cost communication hardware [11]. For all IoT prototyping the Arduino Uno was an ideal choice, and can exclude and carve software based on interfacing circuits needed to understand switching and adding capabilities. Microcontrollers based in Arduino

have flexibility and supply one-board computers. There's a boot loader for Arduino UNO internally.

It helps you to upload the new code without any external hardware developer. Coding is performed using the language Arduino (APL) which tends to 'wire' and the environment for Arduino creation (ADE), which provides 'engineering.' Users are given the option of connecting microcontroller [12] to a 'computer' using a cable or even a portable AC 'to DC' charger or 'battery capacity,' which allows them to initiate a uno function (Fig. 5).

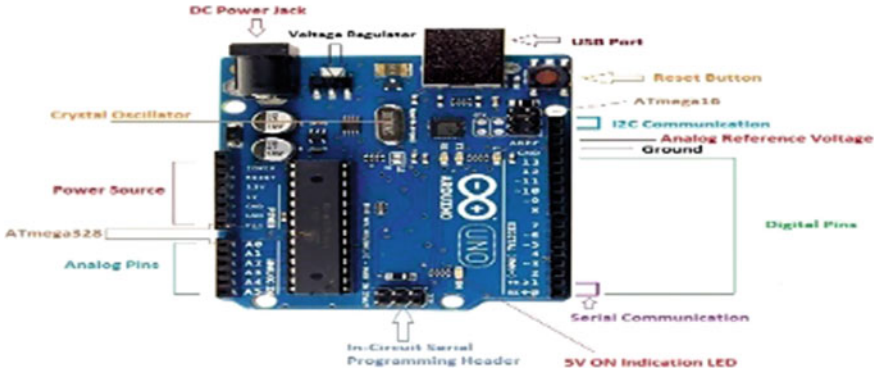


Fig. 5 Arduino UNO board

5.1.2 Arduino ESP8266

You can not import the new code without getting an external hardware developer.

The language of Arduino (APL), which appears to be 'wire,' and the 'technological' Arduino (ADE) environment, enables users to connect to a 'device' by an Usb port or peripheral AC 'to DC' power adapter or battery' to activate Uno function [13]. If the USB 'FTDI is not compatible with the user's device or phone, users may not be connected to all previous FTDI USB boards (Fig. 6).

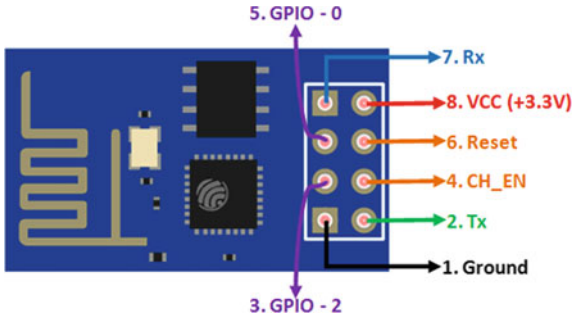


Fig. 6 ESP 8266 Wi-Fi module

This includes a built-in cache for extra device features, portioning of the cache as a Wi-Fi adaptor, remote acceptance of Internet with a more conveniently accessible U-A-R-T interface, which can be integrated onto any network. The ESP8266 Module of Arduino is given in Fig. 2, above.

5.1.3 BreadBoard-400

BreadBoard-400 [14] is a bread boarder with a solder less interface with 400 contact link points, that is to say 400 insertions. The BB400 has 300 IC-circuit tie-downs plus 4 control lines of 25 points (Fig. 7).

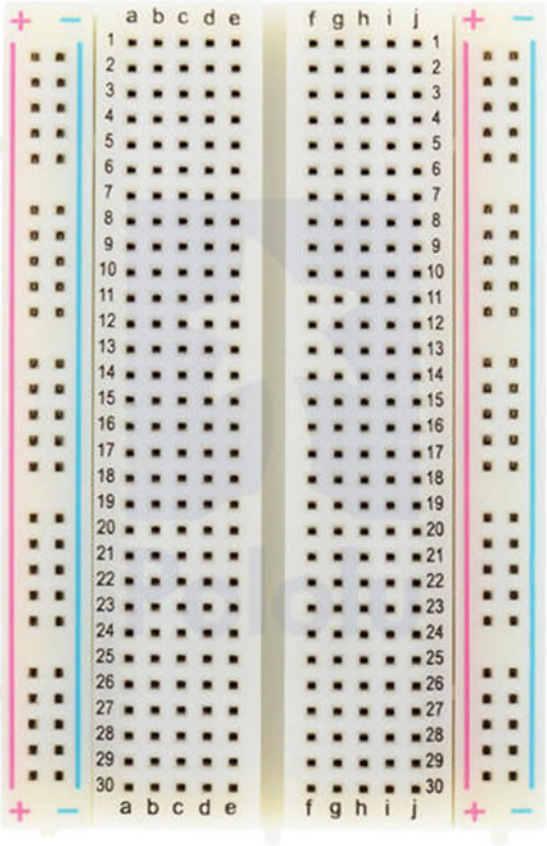


Fig. 7 Bread board

5.2 *Used IOT Sensors*

The project uses five different types of sensors for the measurement and tracking of water, moisture, temperature, brightness, precipitation, atmospheric quality, barometric pressure and marine pressure in the surroundings.

5.2.1 DHT22-Sensor

The Fig. 8 displays a digital sensor of humidity and temperature DHT-22, which is used in a real time sensor [15] the actual location's temperature, humidity and heat.

5.2.2 Light Dependent Resistor (L-D-R) Sensor

The figure above shows the light sensor used for measuring light intensity [16] in the current location by means of the difference in luminance resistance, i.e. if more light, less strength and vice versa (Fig. 9).

5.2.3 MQ-135 Air Sensor

The figure above indicates the pollution sensor used it to observe air quality [17] once the light gas ignition and fire freeze have been released (Fig. 10).

Fig. 8 DHT 22 sensor

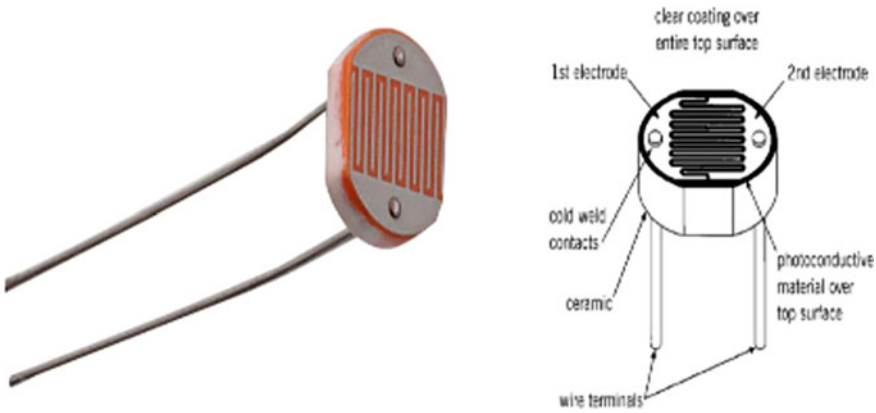


Fig. 9 Light Dependent Resistor (L-D-R) sensor

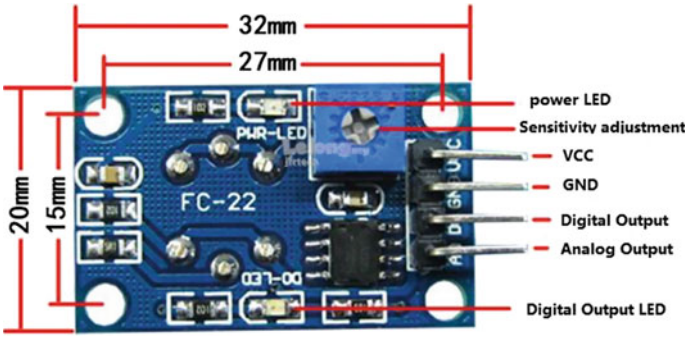


Fig. 10 MQ-135 air sensor

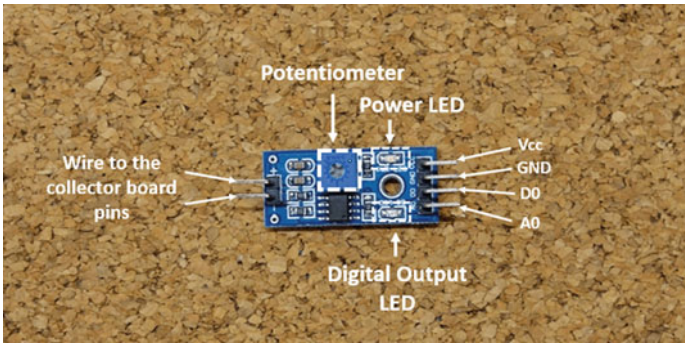


Fig. 11 FC-37 rain-sensor

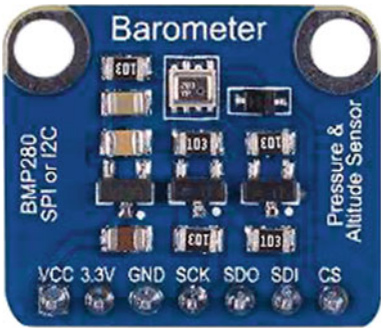


Fig. 12 BMP-280 sensor

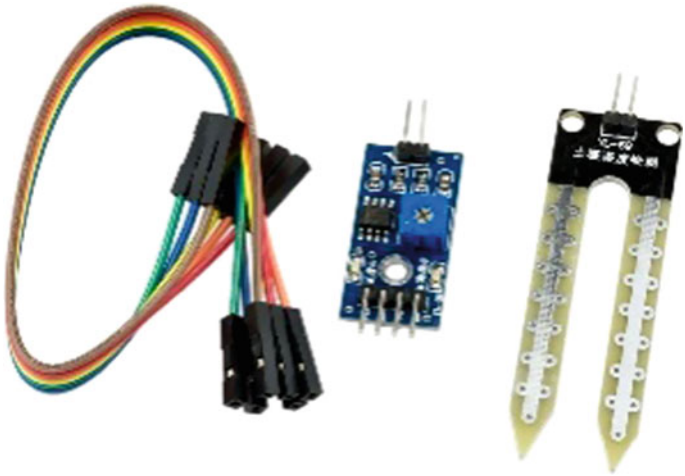


Fig. 13 Soil moisture sensor

5.2.4 FC-37 Rain-Sensor

In the event of precipitation in the atmosphere, the rainfall frequency is measured, i.e. reductions in precipitation intensity [18], compared to non-rainfall. The above figure shows an overhead rain meter (Fig. 11).

5.2.5 BMP-280 Sensor

The above figure illustrates an air pressure sensor that can measure Barometric pressure [19] and Air pressure at sea level at 950, 0 m altitude (Fig. 12).

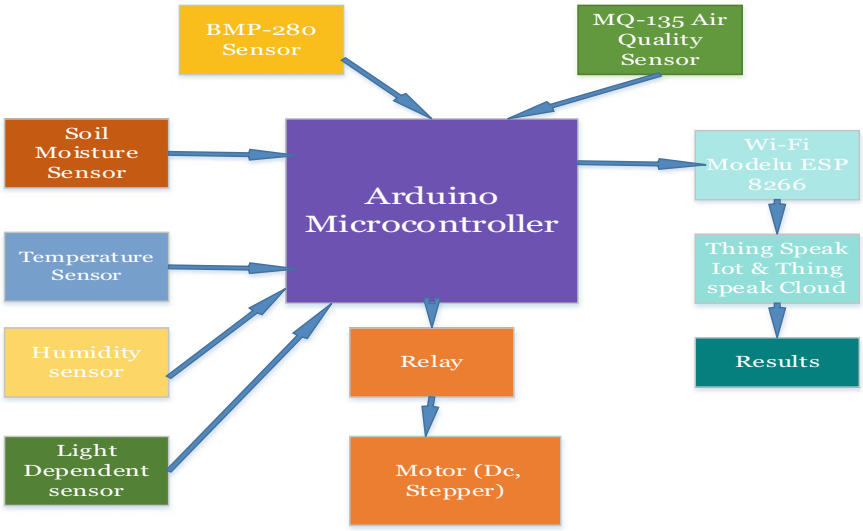


Fig. 14 IoT smart irrigation network

5.2.6 Soil Moisture Sensor

For moisture analysis, the soil Moisture Sensor and similar materials are used. Two wide exposed surfaces, acting as sensor samples and acting as a variable Resistance, provide the detector. The sensor recognizes the level of soil humidity. When the water levels are low within the soil, the analog value is high, and the soil moisture conductivity varies. This sensor can be used to water or automate other plants in a flower field (Fig. 13).

5.2.7 Stepper Motor

Stepper engines are essentially a brushless DC motor, whose rotor turns in response to the input current pulses via a fixed angular phase. This ensures that the rotor's entire rotation is split into the same number of steps and the rotor rotates for each current pulse by one step. The fact that step-motors can directly be controlled by computers, microprocessors or microcontrollers are increasingly popular. The Stepper motors are used without closed loop feedback for precise positioning or accurate speed control of an object.

6 Architecture of the Proposed Model

The design is a Microcontroller as a key processing system for the whole system, with all microcontroller sensors and devices connectable. In order to retrieve information, the sensors could be operated by the microcontroller, which processes analysis through the sensor data and updates to the cloud using the connected Wi-Fi module. We use Arduino microcontroller here because it is compatible with 3.3v Wi-Fi ESP826 6 and also has several on the chip UART so that more serial devices can be attached.

The IoT smart irrigation network Block diagram is shown in Fig. 1. In order to improve output through the automation of an agricultural parameter such as temperature, humidity, and soil humidity, farmers begin to use several controlled system control systems that help farmers improve their output (Fig. 14).

7 Software Used

7.1 Software of Arduino IDE

Arduino IDE is a program which enables Arduino devices to build optimized programming code and allows coding Arduino controls interact and operate on local and global domains utilizing library capabilities.

7.2 Matlab R2019a

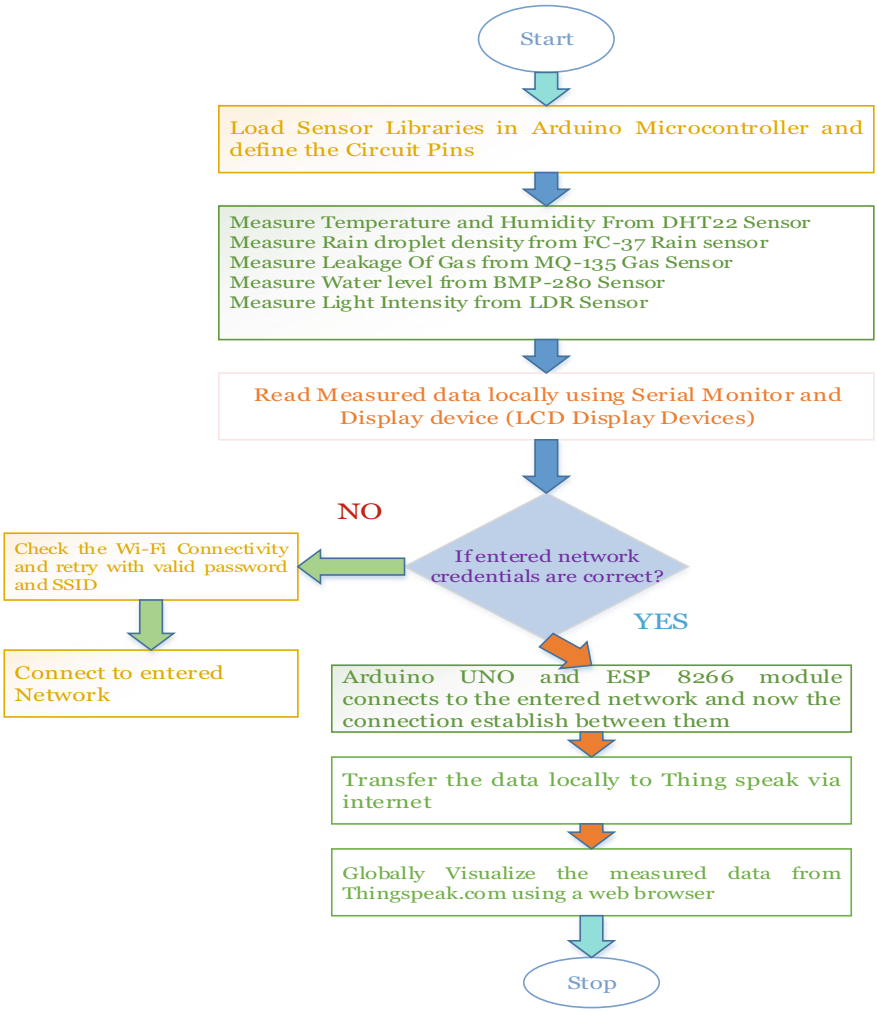
This is the only IoT system that has been thoroughly evaluated on the Matlab R2019 platform, as well as thorough project implementation in the respective fields such as hospitals and the gas industry, and actually Thingspeak is the only IoT service providing comprehensive information on the Matlab R2019 platform.

8 Flow Sensing and Monitoring

See Flowchart 1.

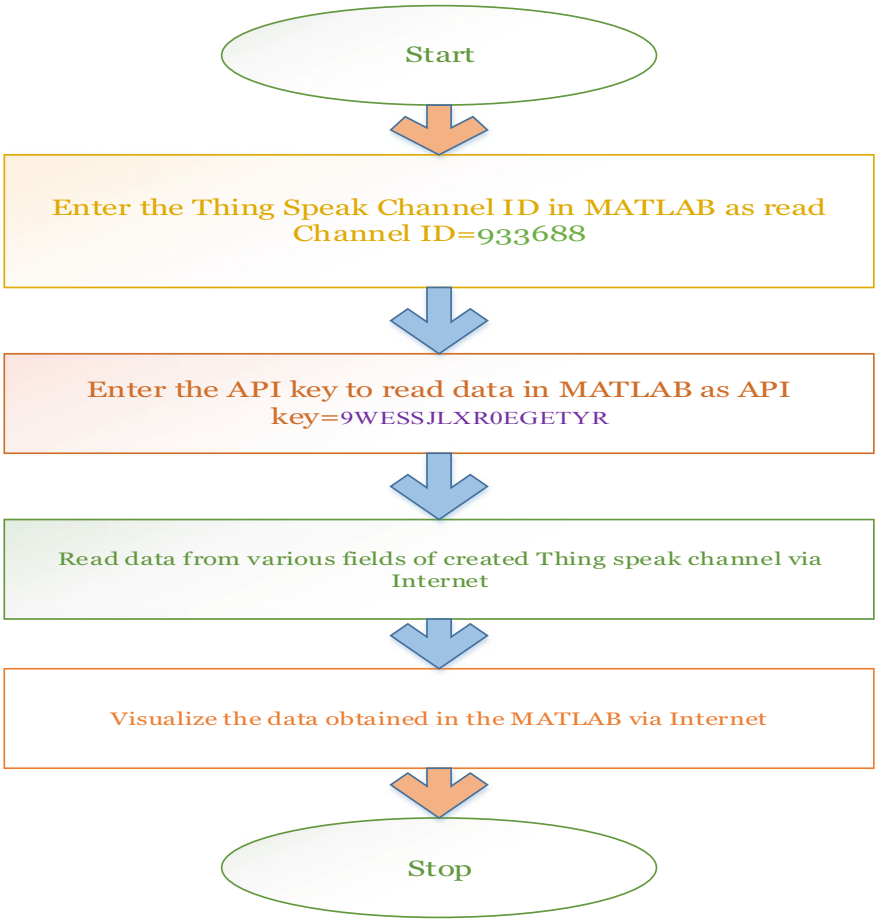
Step 1. Download Arduino IDE Application Sensor Libraries.
Step 2. Execute the program and display sensed LCD data.
Step 3. Enter the network credentials of the IDE and start the application again and view the Thingspeak Cloud performance.

See Flowchart 2.



Flowchart 1 IoT flowchart device sensing based Thingspeak

The data analyzes in the Matlab R2019a can be seen in the above table. The next task is the analysis of the senses in the Matlab R2019a, as the data are visualised in the Thingspeak. To do this, you need to have a tools to help Thingspeak that make the port of the Thingspeak cloud sensitive information easier (Fig. 15).



Flowchart 2 Matlab R2019 for the IoT sensor data review

Step 1: Enter the following Matlab R2019a syntax Channel ID and API Key for Channel ID and API Key read:
ReadChannelID = 933688
readAPIKey = 9WESSJLXR0EGETYR
Step 2: Run Matlab R2019a script, start reading the API Key Channel and the sensitive Matlab R2019 information.

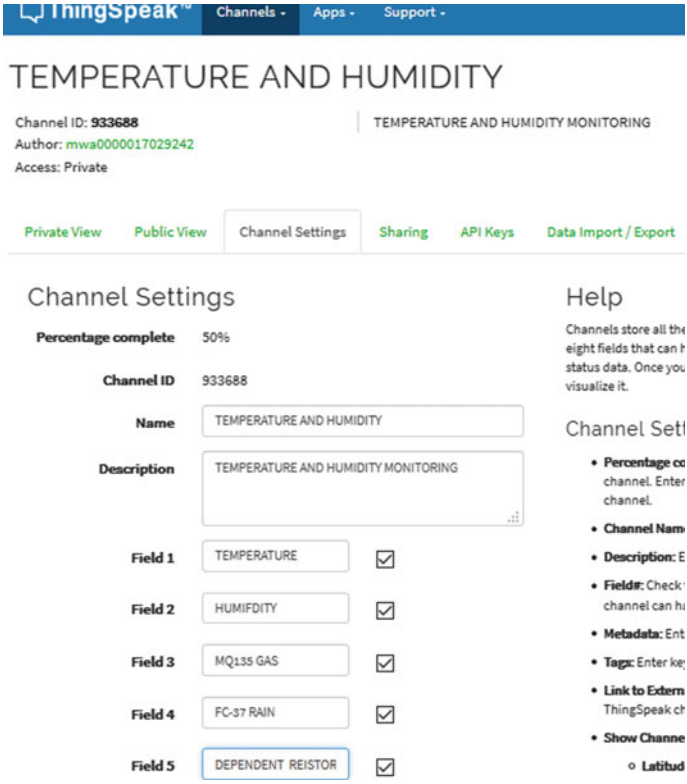


Fig. 15 Matlab R2019a analysis network ID and API key

9 Results

The program was executed once the bug-free program code was created, as well as the higher performance could be viewed on a local screen, including the 16 × 2 Lcd screen, and the local data transported to the Thingspeak Cloud over the Internet and we can view it on the global platform.

9.1 Experimental Setup

The Fig. 16 above indicates the sample for LCD readings for the project and similar output formats are good for other parameters such as temp, moisture, heat, rain, light and air quality.

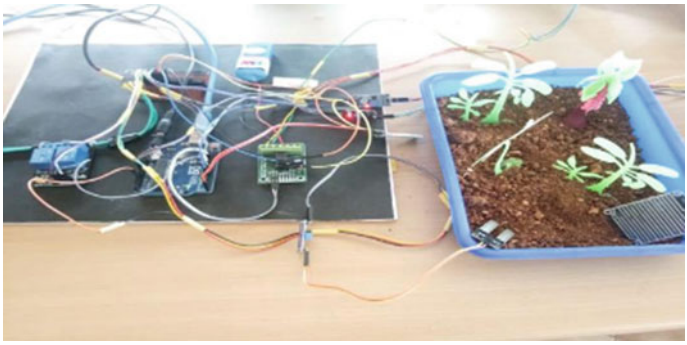


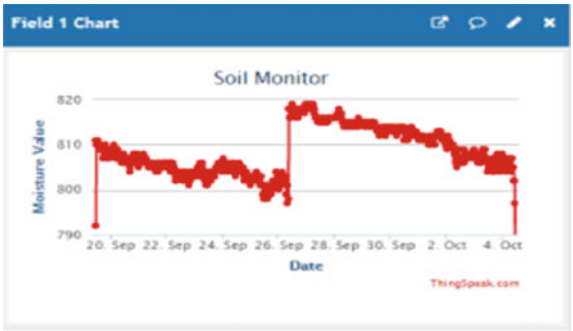
Fig. 16 Experimental setup

9.2 Output Results for Thingspeak IoT

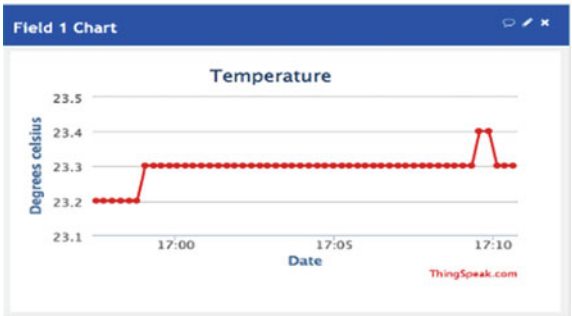
The above Figs. 17 shows a visual output in the Thingspeak cloud and can only be seen when you login to the Thingspeak website and the cloud provides a consistent output using your user name and password.

9.3 IoT Output Results for Matlab R2019

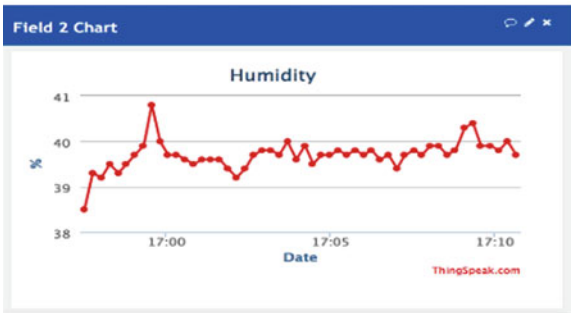
Once we obtain channel ID and read the API key, the IOT analysis sensed in Matlab R2019a can be used, for which purpose we must use the method discussed earlier at the sensory and supervision system site of Matlab R2019a Process. The R2019a quality is shown in Fig. 18. You can find here subplots of various sensed IoT data.



(a)



(b)



(c)

Fig. 17 **a** Graph for soil moisture. **b** Graph for temperature. **c** Graph for humidity

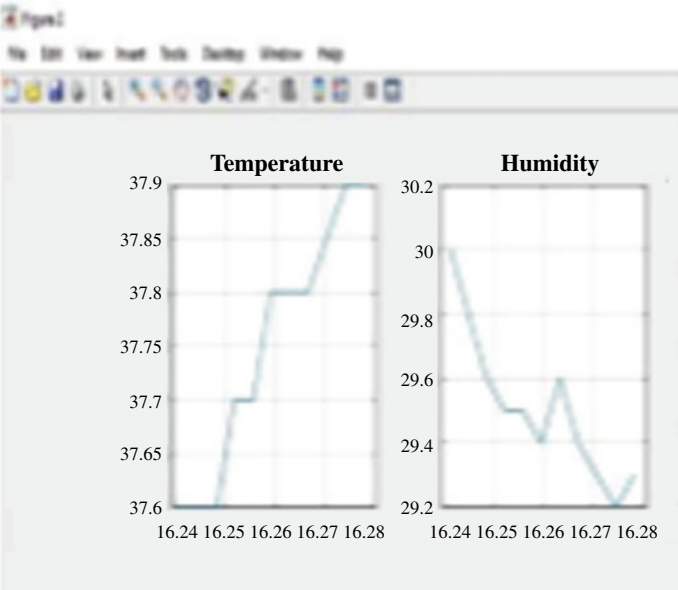


Fig. 18 MATLAB R2019a results

10 Conclusion

The Internet of Things has a vast array of benefits for society and we can offer and demonstrate IoT power from our project using the Thingspeak API to develop and support a large number of IoT applications on a public platform. The Thingspeak and the other way round off offers a clear, profound analysis and assessment of sensitive information at critical level to quantify the parameters in a circumstantial sense. In short, microcontrollers have been minimized and disintegrated and IoT Leads are available universally and Thingspeak IoT Internet Service is certainly an intriguing web-based connection. In summary, the microcontrollers have to be reduced and broken in the world and IoT Leads are accessible globally and widely, and the Thingspeak IoT Internet Service is an interesting web-based technology that determines the standards of engineers.

References

1. Weber RH (2010) Internet of Things–new security and privacy challenges. Comput Law Secur Rev 26(1):23–30
2. Suo H, Wan J, Zou C, Liu J (2012) Security in the Internet of Things: a review. In: 2012 International conference on computer science and electronics engineering (ICCSEE), March 2012, vol 3. IEEE, pp 648–651

3. Ashton K (2009) That 'Internet of Things' thing. RFiD J 22(7):97–114
4. Patil VC, Al-Gaadi KA, Biradar DP, Rangaswamy M (2012) Internet of Things (IoT) and cloud computing for agriculture: an overview. In: Proceedings of agro-informatics and precision agriculture (AIPA 2012), India
5. Atzori L, Iera A, Morabito G (2010) The Internet of Things: a survey. Comput Netw
6. Nayyar A (2016) An encyclopedia coverage of compiler's, programmer's & simulator's for 8051, PIC, AVR, ARM, Arduino embedded technologies. Int J Reconfigurable Embed Syst (IJRES)
7. Smith IG (ed) (2012) The Internet of Things 2012: new horizons. CASAGRAS2
8. ThingSpeak – an API and Web Service for the Internet of Things, a published paper
9. ThingSpeak: Open Source Platform for Connected Products and Services (PR Newswire)
10. The open data platform for the Internet of Things. https://thingspeak.com
11. http://arduino.cc/en/Main/ArduinoBoardUno
12. http://arduino.cc/en/Guide/HomePage
13. https://espressif.com/en/products/esp8266/
14. http://www.busboard.com/BB400T
15. Aosong Electronics Co., Ltd. Your specialist in innovating humidity & temperature sensors Digital-output relative humidity & temperature sensor/moduleDHT22
16. Technology Student, Light Dependant Resistors. http://www.technologystudent.com/elec1/ldr1.htm. Accessed 30 Aug 2010
17. MQ-135 Gas Sensor User Manual
18. Rain Sensor Module user Manual
19. http://www.seeedstudio.com/depot/Grove-Barometer-SensorBMP180-p-1840.html

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Clustering Methods Analysis in the E-Learning

Ravinder Ahuja, Prem Prakash Agarwal, and Tarun Kumar

Abstract In this paper, the analysis of students who were part of the distance learning program has been done using various educational data mining clustering algorithms on the basis of their performance and activities carried out as a part of the process. Clusters have been used to find the relation between attributes (activities involved in the E-learning process such as downloading of study related material, exchange of messages with tutors and colleagues and posting in the discussion forum) and the final grades of students, and to find which characteristics mostly affect the classes. To sort out this, we have used various data mining techniques such as Agglomerative Hierarchical Clustering (using Ward method), and Non-Hierarchical clustering methods such as KMeans, KMeans ++, and CMeans The implementation of these algorithms is done in R language. The comparison of Hierarchical and non-Hierarchical clustering methods is made to find the most efficient algorithm.

Keywords CMeans · Distance learning · Educational data mining · Euclidean distance · Hierarchical clustering method · KMeans · KMeans ++ · Non-hierarchical clustering method · Virtual learning environment

1 Introduction

Education is a significant issue regarding the development and well-being of people. Therefore, it is of great interest to identify and improve the education process and assess its effectiveness, as well as to understand which factors have a

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_118

more significant influence than the others. Higher Education is out of reach of many people for a vast majority of reasons, such as distance from home, cost, living facilities, quality of education provided, fixed timings, commute time, etc. An efficient alternative is Distance Education (DE). Moreover, with the inclusion of advanced technology, DE can be provided with all the perks of traditional education.

The vast reach of the Web all across the world has allowed Distance Education (DE) to play an essential role in access to education. It gives students the possibility of studying, inflexible hours, according to the availability of the student, with enormous geographic scope, less cost expenditure, and without the requirements of a school environment.

Virtual Learning Environments (VLE) is well used for distance education, which allows the one to many resource exchanges to facilitate learning. These environments store user interactions, generating a large volume of behavioral data. This large volume of obtained data can be used to obtain knowledge from the application of Educational Data Mining (EDM) techniques.

It seeks to find and present new methods, techniques, and procedures that improve this relationship, facilitate learning, allow better planning and management of courses, and offer alternatives to overcome challenges and difficulties in diverse educational structures.

The objective of this paper was to perform a knowledge discovery process by using two methods of clustering: hierarchical [1] and non-hierarchical [2]. The agglomerative or bottom-up variation of hierarchical clustering [3] such as Agnes and HClust algorithm (using euclidean distance) is implemented.There are mainly three types or ways in which similarity of two groups can be calculated, namely Single linkage [4], were two clusters whose distance of nearest data points in minimal is united, it tends to produce loose clusters.Four types of Non-hierarchical clustering technique [5] that are, k-means [6], k-means++, c-means [7] and Clara was implemented to compare with the above mentioned methods. The obtained results were compared in their capacities to describe the group's similarities and their formation.

Rest of the paper is organized as follows: Sect. 2 contains dataset and pre-processing, Sect. 3 contains related work, Sect. 4 contains experimental setup, and part 5 contains results and supported by the conclusion

2 Dataset and Preprocessing

The data was collected from the Bachelor's Degree in Public Administration in the distance modality, offered by the Federal University of the São Francisco Valley - Brazil (UNIVASF). There are 169 students enrolled in this course. This data provides information on the student's academic performance and activities carried out by him during the process of learning. The attributes of the dataset are student's grade, his/her details, and all the activities like several useful study material

downloaded by students, the number of posts in the discussion forum and meaningful messages exchanged by students with professors, tutors, and other colleagues, and it was gathered by using institute reports. Details in data is student's id, student's sex, student's age, home address of student, total chats, several downloads, a number of posts in the forum, message send to colleagues, message received from colleagues, message sent to the tutor, message received from the tutor, message sent to professor, message received from professor, total messages sent, full messages received and student's grade.

The attribute student's grade has a strong relation with attributes other than the student's id and his/her personal details like sex, age, and address. Since activities like the exchange of messages, downloading and posting in the forum mostly affect the learning of a student in the distance learning scenario. Therefore, we have taken only these attributes for the clustering process. Also, clustering algorithms work only with numeric data since it involves a calculation of distance or dissimilarity between two data points, so only numeric attributes have been considered. The dataset was pre-processed and cleaned to ensure its accuracy and quality. The process of cleaning involves filtering of outliers and filling in missing values in the dataset. Then as a part of the transformation, the data was then normalized for selected clustering algorithms.

3 Related Work

Cluster analysis in educational contexts has been used in the literature due to the need for researchers to discover characteristics common to different groups of students.

The problem is that there are many clustering methods, but few guidelines on which algorithm to use. The ideal choice is dependent on the nature of the data and can rarely be found directly without any comparison between different methods. In Hämäläinen et al. [8], the authors evaluated the main clustering methods from this perspective. On the basis of their work, they found the most promising ways according to different situations.

The work of Lopez et al. [9] showed a classification from the use of clustering to predict the final grades of beginning college students. The article analyzed whether the participation of students in the course forum can be a good predictor of the final grade and if the classification proposed by grouping can obtain the degree with similar accuracy to traditional classification algorithms.

The comparison of several cluster algorithms using the proposed approach was made with traditional classification algorithms to predict the outcome of student's performances in the course, based on their forum usage data in Moodle.

In Dominguez et al. [10], the authors presented a proposal for a tool that generates tips for students who are completing programming exercises. These tips may be links to topics that are relevant to the problem you are experiencing and may include preventative tips to avoid future errors. From the previous year's data, the

tasks of grouping and classification were used, and analysis is done to generate the tips. The system analyzes the patterns that affect students' performance during their interaction with the system.

The work of France and Amaral [11] focused on the performance of students and presented the use of grouping techniques, aiming at the formation of similar groups of students with learning difficulties in Object-Oriented Programming. Peckham and McCalla [12] conducted an experiment in a learning environment designed to simulate hypermedia courses in order to identify patterns of student behavior in a reading comprehension task. K-means clustering algorithm was used for this identification.

Although there are many studies where comparison of the main clustering methods was made, such as Hämäläinen et al. [8], it is noticeable that there are only a few papers that give practical applications that describe characteristics of comparison between hierarchical, non-hierarchical and other methods of clustering.

4 Experimental Setup

The experiment has been done using the R language. It can be easily downloaded and installed on the computer since it is an open-source [13]. Various packages are readily available on the internet [14], which can be used to implement tasks using R.

Testing and training dataset is not required because clustering algorithms are based on unsupervised learning [15]. All the entries in the dataset are used for grouping, and then the analysis can be done to extract useful information and pattern from these groups.

In the case of hierarchical clustering, the grouping has been done by using Ward's method and Euclidean distance because they are widely used and give much better results. In the case of non-hierarchical clustering, we have used KMeans, KMeans ++ (an advanced version of KMeans), and CMeans algorithms for our analysis. These algorithms can collectively be used to optimize our results and to verify the output of one algorithm with that of others. For the sake of convenience, the dataset has been divided into four groups in all the algorithms, and these groups are then analyzed to find the relation between grades and other attributes.

Four groups can be chosen in hierarchical clustering by visualizing and cutting the obtained dendrogram at a particular height, as shown in Fig. 1. In non-hierarchical clustering, the grouping is comparatively easy because we have to initialize the number of clusters beforehand. The output of non-hierarchical clustering is shown in Fig. 2.

Firstly, we run the algorithms on our dataset to identify the groups and students in each group and then compare the groups of hierarchical clustering with that of non-hierarchical clustering with the help of a comparison matrix. For each algorithm, we then calculate the mean of each attribute of students from the same group and analyze the dependence of student's grades on these attributes.

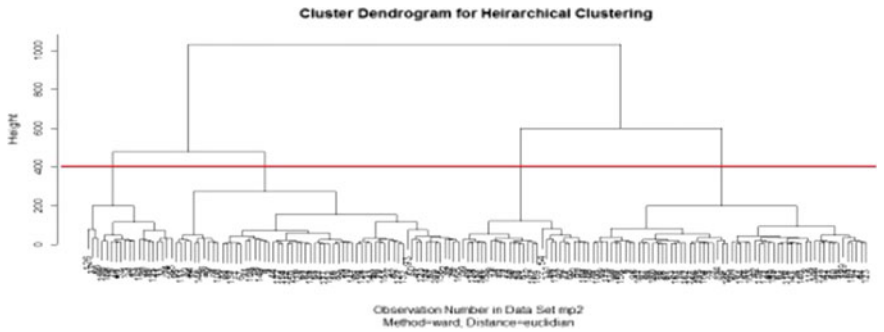

Fig. 1 Dendrogram obtained in Hierarchical clustering

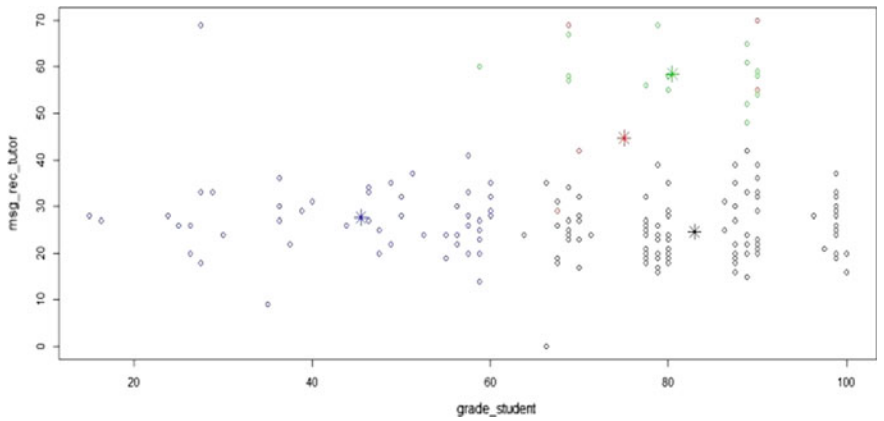

Fig. 2 Non-hierarchical clustering (K-means)

After the process of mining, we will evaluate, interpret, and use the extracted information to visualize the outcomes.

5 Results and Discussion

The results of this experiment were obtained and statistically analyzed. The attributes of students in the distance learning course are given in Table 1, along with their respective minimum, maximum, and average quantities found. It is worth noting the average number of messages exchanged between Students and Tutors, indicating a functional interaction between these actors, and above the professor-student average.

Table 1 Description of Student Data set

Attribute	Description	Min	Max	Average
Grade	Note in the final evaluation of the course	0	100	71.26
Chat	Chats Dates	0	46	6.61
Download	Qtd.downloads made	0	24	4.50
Forum	Qtd.posts in forums	0	50	4.06
Msg_rec_from_professor	Qtd.Msg, received from the teacher	0	13	2.11
Msg_snd_to_professor	Qtd.Msg, sent to teacher	0	12	0.67
Msg_rec_from_students	Qtd.Msg received from students.	0	20	1.57
Msg_snd_to_students	Qtd.Msg, sent to students	0	51	1.62
Msg_rec_from_tutor	Qtd.Msg received from tutors.	0	70	29.39
Msg_snd_to_tutor	Qtd.Msg sent to tutors	0	97	13.67

Table 2 Size of the Clusters in Every Group

	Group 01		Group 02		Group 03		Group 04	
(1) K-means versus Hierarchical								
No. of Instances	H	NH	H	NH	H	NH	H	NH
Students	19	97	60	7	62	15	28	50
(2) K-means ++ versus Hierarchical								
No. of Instances	H	NH	H	NH	H	NH	H	NH
Students	19	60	60	30	62	37	28	42
(3) C-means versus Hierarchical								
No. of Instances	H	NH	H	NH	H	NH	H	NH
Students	19	84	60	50	62	28	28	7

H - Hierarchical Grouping NH - Non-Hierarchical Grouping

From the normalized data, with ten attributes and 169 observed students, the data were clustered into four groups using the hierarchical and the other non-hierarchical algorithms. This resulted in the formation of groups of students whose sizes are given in Table 2.

In case 1, the formation was observed a group small, with 19 (hierarchical) and 7 (non-hierarchical) instances in both, and another much more significant, with 62 (hierarchical) and 97 (non-hierarchical) cases.

In case 2, the formation was observed a group small, with 19 (hierarchical) and 30 (non-hierarchical) instances in both, and another much more significant, with 62 (hierarchical) and 60 (non-hierarchical) cases.

In case 3, the formation was observed a group small, with 19 (hierarchical) and 7 (non-hierarchical) instances in both, and another much more significant, with 62 (hierarchical) and 84 (non-hierarchical) cases.

This observation indicates that the data had a relevant similarity in the formation of these groups.

Table 3 Remarks among groups

(1) K-means						
Hierarchical Groups (H)		Non-Hierarchical Groups (NH)				
		Group 01	Group 02	Group 03	Group 04	Total Instance (H)
	Group 1		6	13		19
	Group 2	38			22	60
	Group 3	59	1	2		62
	Group 4				28	28
	Total Instances (NH)	97	7	15	50	169
(2) K-means ++						
		Non- Hierarchical Groups (NH)				
Hierarchical Groups (H)		Group 01	Group 02	Group 03	Group 04	Total Instance (H)
	Group 1			13	6	19
	Group 2	37	22	1		60
	Group 3	47		14	1	62
	Group 4		28			28
	Total Instances (NH)	84	50	28	7	169
(3) C-means						
		Non- Hierarchical Groups (NH)				
Hierarchical Groups (H)		Group 01	Group 02	Group 03	Group 04	Total Instance (H)
	Group 1			18	1	19
	Group 2	18	2	1	39	60
	Group 3	42		18	2	62
	Group 4		28			28
	Total Instances (NH)	60	30	37	42	169

On comparing the formed groups by both the type of algorithms and verifying if the students of a particular hierarchical group are present in some non-hierarchical group and vice-versa, the number of matching instances per group is obtained and shown in Table 3.

From the results obtained in the matrix, a certain level of similarity between the groups was found. The list below summarizes these similarities:

Case 1: Hierarchical vs. Non-Hierarchical (k-means)

- Group 1 Hierarchical– 68.42% of the students are the same as the Group 3 Non-Hierarchical.
- Group 2 Hierarchical – 63.33% of the students are the same as the Group 1 Non-Hierarchical.
- Group 3 Hierarchical – 95.16% of students are the same as Group 1 Non-hierarchical.
- Group 4 Hierarchical - 100% of students are in Group 4 Not hierarchical.
- Non-Hierarchical Group 1–60.82% of students are the same Of Group 3 Hierarchical.
- Non-Hierarchical Group 2–85.71% of the students are in the Group 1 Hierarchical.
- Non-Hierarchical Group 3–86.67% of students are the same Of Group 1 Hierarchical.
- Non-hierarchical Group 4-56% of students are the same Of Group 4 Hierarchical.

Case 2: Hierarchical vs. Non-Hierarchical (k-means ++)

- Group 1 Hierarchical – 68.42% of the students are the same as the Group 3 Non-Hierarchical.
- Group 2 Hierarchical – 61.67% of the students are the same as the Group 1 Non-Hierarchical.
- Group 3 Hierarchical – 75.81% of students are the same as Group 01.
- Group 4 Hierarchical - 100% of students are in Group 2 Non-hierarchical.
- Non-Hierarchical Group 1–55.95% of students are the same Of Group 3 Hierarchical.
- Non-Hierarchical Group 2-56% of the students are in the Group 4 Hierarchical.
- Non-Hierarchical Group 3-50% of students are the same Of Group 3 Hierarchical, and 46.43% are in Group 2.
- Non-hierarchical Group 4–85.71% of students are the same Of Group 1 Hierarchical.

Case 3: Hierarchical vs. Non-Hierarchical (c-means)

- Group 1 Hierarchical - 94.74% of the students are the same as the Group 3 Non-Hierarchical.
- Group 2 Hierarchical - 65% of the students are the same as the Group 4 Non-Hierarchical.
- Group 3 Hierarchical - 67.74% of students are the same as Group 1.

- Group 4 Hierarchical - 100% of students are in Group 2 Not hierarchical.
- Non-Hierarchical Group 1-70% of students are the same Of Group 3 Hierarchical.
- Non-Hierarchical Group 2-93.33% of the students are in the Group 4 Hierarchical.
- Non-Hierarchical Group 3–48.65% of students are the same Of Group 1 Hierarchical and Group 3 Hierarchical both.
- Non-hierarchical Group 4-92.86% of students are the same Of Group 2 Hierarchical.

Given the similarity found among the formed groups in relation to the distribution of students in the four groups, it can be concluded that the adoption of any of the clustering methods in the given dataset, could produce results and knowledge about the interactions of the students.

From the similarities between the groups presented in the previous section, we sought a deepening of the characteristics representative of these similarities and their possible impacts on the teaching-learning process in the discipline. In each pair of groups with the highest likeness rate, the mean of their attributes was analyzed, and then relevant knowledge about each of them was extracted.

With the groups formed, a summary of the data per group with the respective mean of each attribute in the groups, presented in Table 4, was performed.

In group 3 (Hierarchical) and group 1 (Non-hierarchical), the most outstanding variables were the high average grades, the second-lowest in the forum interaction, and messages sent to tutor. Lowest is the message received from a tutor (Msg_rec_from_tutor). Moreover, the signal received from a professor (Msg_rec_frm_professor) was high, and the message sent to the professor (Msg_send_to_professor) was low. All other variables were insignificant.

Table 4 Average of Variables in Each Group

Variables	Group 01		Group 02		Group 03		Group 04	
	H	NH	H	NH	H	NH	H	NH
Chat	11.1	7.7	4.0	8.7	9.3	11.1	3.1	2.8
Download	6.2	4.3	4.6	7.1	4.3	5.5	3.4	4.2
Forum	8.4	4.1	2.7	13.1	4.8	6.0	2.4	2.1
Msg_rec_frm_professor	2.3	2.1	1.9	3.3	2.2	1.7	2.2	2.1
Msg_send_to_professor	1.4	0.6	0.3	3.7	0.8	0.3	0.6	0.5
Msg_rec_frm_colleague	2.5	1.6	0.7	1.9	2.1	2.7	1.7	1.1
Msg_send_to_colleague	3.1	1.5	0.5	3.9	2.2	2.6	1.8	1.2
Msg_rec_frm_tutor	55.9	24.7	24.6	44.7	26.3	58.5	28.5	27.6
Msg_send_to_tutor	28.7	12.2	9.9	58.8	14.0	13.5	10.7	10.4
grade	77.6	82.9	67.7	75.0	88.8	80.4	36.1	45.4

Through these exploratory results, we can affirm that there are indications that these variables had a strong influence on the performance of the students of these groups, who obtained satisfactory scores in the discipline.

In group 4 (Hierarchical) and 4 (Non-hierarchical), the variables that stood out were: low interaction through chat, low interaction through the discussion forum and low interaction among professor, tutor, and students through the exchange of private messages. So, we can verify that the low interaction of the student and less participation in the forums had indications of influence in the decrease of the student's performance since, in both groups, the grades are lower compared to any other group, on average.

6 Conclusions and Future Work

In this paper, we have used different clustering algorithms to build our cluster models from the provided dataset. This mining process uses ten attributes of a student that includes all the activities carried out by him/her during the learning process. The main motive of this analysis is to find those parameters that are highly affecting the grades of a student in the E-learning process. As a result of the analysis, we can conclude that all the methods have shown almost similar results. The groups formed by one of the methods were similar to the groups formed by the other in terms of characteristics. Therefore, it can be stated that the results obtained by anyone of the clustering technique for this scenario could be used for the analysis and knowledge extraction. By observing the groups formed by the algorithms, we can say that some characteristics play an important role, such as the interaction between student and professor, the quantity of material downloaded, and participation in the discussion forum. This can be concluded by observing group 1 of hierarchical, group 2 of KMeans, group 3 of CMeans, and group 4 of KMeans + +. In these groups, the performance of the students is really good since the average grade scored by the students is approximately in the range of 75 to 80. After analyzing the groups, the teachers or the course coordinators will be able to know which characteristics are affecting the students' grades and can introduce certain adjustments in the course to increase the performance and the groups that are performing very poor like group 4 of hierarchical and KMeans and group 2 of KMeans ++ and CMeans can be better studied to know why they lack behind and what measures need to be taken to bring them into the track.

The major challenge which needs to be taken care of in the future is that as the learning process becomes more complex, we need a more advanced grouping technique to verify if the performance factors are actually influenced by other attributes or not. Future work also includes applying this process to different scenarios, like classroom learning programs, to discover new behavior and pattern.

References

1. Rabia I, Sharifullah K (2016) Evolving the taxonomy based on hierarchical clustering approach. In: 2016 international conference on frontiers of information technology (FIT), December 2016
2. Stekh Y, Lobur M, Sardieh FME, Dombrova M, Artsibasov V (2011) Research and development of methods and algorithms non-hierarchical clustering. In: 2011 11th international conference the experience of designing and application of CAD systems in microelectronics (CADSM), February 2011
3. Masoud M (2016) Hierarchical agglomerative clustering using common neighbours similarity. In: 2016 IEEE/WIC/ACM international conference on web intelligence (WI), October 2016
4. Mohamed AM (2016) Efficient single-linkage hierarchical clustering based on partitioning. In: 2016 11th international conference on computer engineering and systems (ICCES), December 2016
5. Ramos JLC, e Silva RED, Silva JCS, Rodrigues RL, Gomes AS (2016) A comparative study between clustering methods in educational data mining. IEEE Lat Am Trans 14(8):3755–3761
6. Kusuma I, Anwar Ma'sum M, Habibie N, Jatmiko W, Suhartanto H (2016) Design of intelligent k-means based on spark for big data clustering. In: 2016 international workshop on Big Data and information security (IWBIS), October 2016
7. Abdallatif M, Schramm S, Götze J (2016) Application of fuzzy c-means for proactive clustering of electrical power systems. In: 2016 IEEE 16th international conference on data mining workshops (ICDMW), December 2016
8. Hämäläinen W, Kumpulainen V, Mozgovoy M (2015) Evaluation of clustering methods for adaptive learning systems. In: Kose U, Koc D (eds) Artificial intelligence applications in distance education. Global Book series advances in mobile and distance learning (AMDL)
9. Lopez MI, Luna JM, Romero C, Ventura S (2012) Classification via clustering for predicting final marks based on student participation in forums. In: Proceedings of the 5th international conference on educational data mining
10. Dominguez AK, Yacef K, Curran JR (2010) Data mining for individualized hints in e-learning. In: Proceedings of the international conference on educational data mining. Carnegie Learning, Pittsburgh, pp 91–100, June 2010
11. France RS, do Amaral HJC (2013) Data mining in the identification of groups of students with learning difficulties in programming teaching. RENOTE 11(1):1–2
12. Peckham T, McCalla G (2012) Mining student behavior patterns in reading comprehension tasks. In: Proceedings of 5th international conference on educational data mining, pp 87–94
13. The Comprehensive R Archive Network (CRAN). Download R-3.3.2 for Windows (32/64 bits). https://cran.r-project.org/bin/windows/base/
14. The Comprehensive R Archive Network (CRAN). Available CRAN packages by name. https://cran.rproject.org/web/packages/available_packages_by_name.html
15. Sathya R, Annamma A (2013) Comparison of supervised and unsupervised learning algorithms for pattern classification. Int J Adv Res Artif Intell 2(2):34–38

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Optimized KFCM Segmentation and RNN Based Classification System for Diabetic Retinopathy Detection

K. Loheswaran

Abstract Finding and diagnosis of various eye illnesses for ophthalmologist to helpful by using Human retinal image. Automated blood vessel segmentation diagnoses numerous eye infections like diabetic retinopathy, retinopathy of prematurity or glaucoma. In this work, we propose the Optimized Kernel-based Fuzzy C-Means (OKFCM) Segmentation and Recurrent Neural Network (RNN) based Classification system for Diabetic Retinopathy detection. In the proposed segmentation section consist of two main stages such as optic disc removal and Modified Ant Colony Optimization (ACO) based KFCM Segmentation. For the Diabetic Retinopathy classification, GLCM and moment built features are used. The proposed system is also named as an OKFCM-MACO-RNN. The OKFCM-MACO-RNN classification assessment process is complete on the diaretDB1 dataset by manipulative the value of features like accuracy, sensitivity, and specificity of the OKFCM-MACO-RNN method respectively 99.33, 81.65 and 99.42%. The OKFCM-MACO-RNN method is predictable to be able to notice exudates well. The OKFCM-MACO-RNN Segmentation performance is analyzed in terms of jacquard coefficient, dice coefficient and accuracy respectively 85.65, 72.84 and 93.15.

Keywords Blood vessel segmentation · Diabetic retinopathy · Optimized Kernel-Based Fuzzy C-Means (KFCM) · Recurrent Neural Network (RNN) · Modified Ant Colony Optimization

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_119

1 Introduction

Varieties in retinal vascular bodies are checked parcel of foundational sicknesses contain as diabetes, hypertension, cardiovascular disease and stroke. For test, adjustments in vessel bore, parting point or vessel bending are results of hypertension [1, 2]. The beginning of neovascularization is an indication of diabetic retinopathy [3], an inconvenience of diabetes which prompts reason of sightlessness in people groups. The occurrence of arteriovenous scratching is a central forerunner of stroke [4, 5]. The first identify of these deviations is very basic so as to make early intercession and secure the harmed individual from significant loss of vision. To evaluate these highlights for medicinal determination, right vessel division assumes a genuine job. Albeit a significant number of these methodologies have been proposed, and have a significant improvement and it is still requirement for the breaking points in best in class techniques, which include: poor division within the sight of vessel focal light reflex (i.e., splendid strip along the focal point of a vessel). Poor division at bifurcation and hybrid locales. The unification of close vessels and the missing of minor vessels. The bogus vessel recognition at the optic circle and obsessive districts. Among the damages referenced above, significant are the initial three because of their incredible effect on the nature of the vascular system expanded. For tests: if focal reflex pixels are not perceived as a feature of a vessel, the vessel might be misconstrued as two vessels. In the event that two close vessels are consolidated, they will be estimated as one broad vessel.

Poor division, for example, the separation at vessel hybrid areas will mess up the vessel following methodology [6]. These will prompt the exactness less in vascular system concentrate, for example, the distinguishing proof of individual vessel fragments, vessel bore estimation, or vascular variation from the norm (i.e., arterio venous scratching) revelation [7]. The division aftereffects of some overarching techniques on a trimmed retinal picture with the event of focal reflex, close vessels and hybrid focuses are appeared to approve the confinements of current impact, in vessel blending [8]. Missing of focal piece of vessels because of vessel focal reflex are start in both Staal and Soares et al. The issue with the division delivered by Ricci-line [9] strategy is the fractional converging of two close vessels and the false division at the hybrid point. Despite the fact that the Ricci-SVM [10] technique gives precise division at these locales, identifying of little vessels is fizzled [11].

We composed this studies keen on five additional areas. In Sect. 2, we review the related works. In Sect. 3, we portray the procedure of OKFCM-MACO-RNN framework. In Sect. 4 we present test results. At long last, in Sect. 6, we finish up the paper and talk about conceivable upcoming task.

2 Related Works

In below section, we takes five recent year studies to analysis the methodologies, advantages and performance measure.

Author and Year	Method	Advantage	Limitation	Performance measured
Pires et al. (2019)	Build the clarification based on CNN	Additional boost strategies has improve performance	CNN training has taken more time consumption	ROC curve
Nazir et al. (2019)	Tetragonal local octal patterns (T-LOP) and Classification based on extreme learning machine (ELM)	T-LOP has improve the classification performance of the diabetic retinopathy detection	Low-resolution and noisy images are untaken in these proposed system	Accuracy, Precision and Recall
Verbraak et al. (2019)	ICDR classification based diabetic retinopathy detection	The ICDR had high diagnostic accuracy	It achieved better accuracy, but still it need to be improve	Accuracy, sensitivity, specificity, and negative predictive value (NPV)
Hagos and Kant (2019)	Transfer deep Learning based Detection of Diabetic Retinopathy	In Deep Learning insufficiency data problem is treated	The system has been investigated with help of small data set but larger dataset to be investigated	Accuracy
Chakraborty et al. (2019)	Back-propagation neural network for Detection of Diabetic Retinopathy	Customized ANN architecture has created for classification purpose	If Feature extraction and feature selection (FS) techniques will used to be increase the performance of proposed system	Accuracy, Specificity, Sensitivity and F-scores

In above section, we analysis [1–26] studies, they used numerous techniques to perform in Diabetic Retinopathy detection section. But segmentations and FS technique used to achieve better performance. So now we approach proposed methodology of OKFCM-MACO-RNN system to succeed in Classification system for Diabetic Retinopathy detection.

3 OKFCM-MACO-RNN System

The main reason of vision loss in people is diabetic retinopathy. Health specialists identify some clinical, geometrical and haemo-dynamic structures of diabetic retinopathy. These features contain the blood vessel zone, exudates, micro-aneurysm, hemorrhages and neovascularization, and more. In CAD systems, these features are noticed in fundus images using pc vision techniques. In this task, we propose the OKFCM Segmentation and RNN established Classification system for Diabetic Retinopathy detection. In segmentation section contain 2 main stages called optic disc removal and Modified ACO based KFCM Segmentation. For the Diabetic Retinopathy classification, GLCM and instant based features are used. The OKFCM-MACO-RNN block drawing is exposed in below Fig. 1.

3.1 Pre-processing

In this pre-handling segment, at first the info picture is changed over into a HSV picture after that the HSV picture is given to the Hybrid LOG channel. For the most part, the laplacian channels are subordinate channels and it is utilized for finding the

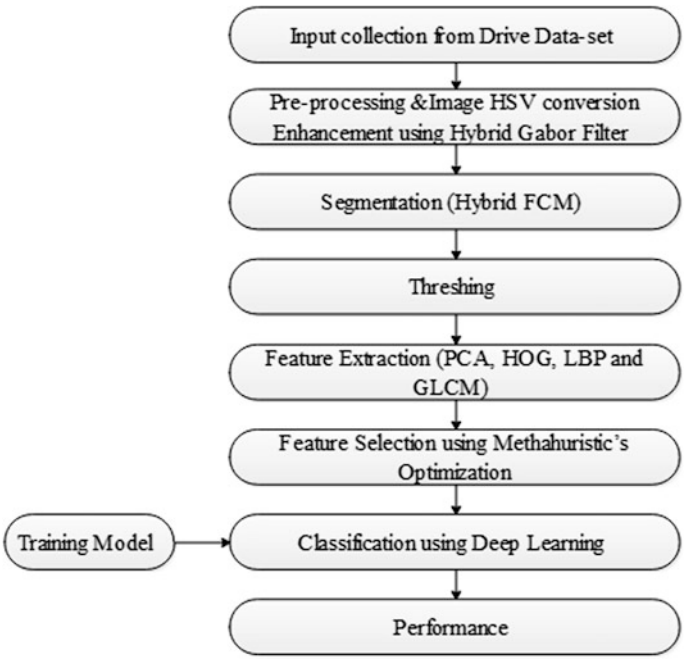


Fig. 1 OKFCM-MACO-RNN block diagram

pieces of edges in pictures. This subsidiary channels are precise touchy to clamor, so here the Gaussian channels are utilized for smoothening the picture. The Gaussian separating (GF) is executed before the laplacian sifting. After these two procedure, some other time the GF is applied to smoothen the pictures. Along these lines, knobs on lung area had the option to be recognized all the more precisely. Moreover, histogram evening out was likewise utilized in upgrade step so as to diminish differentiate contrasts which happen because of filtering deficiencies and to take out superfluous grains. The sifting of LOG is introduced in the condition (7) and the GF of LOG is exhibited in condition (8).

The LoG scale space representation is

$$\nabla^2 G(x,y) = \frac{x^2+y^2-2\sigma^2}{\pi\sigma^4} exp\left(\frac{-x^2+y^2}{2\sigma^2}\right) \tag{1}$$

$$G(x,y;\sigma) = \frac{1}{\sqrt{2\pi\sigma^2}} exp\left(\frac{-x^2+y^2}{2\sigma^2}\right) \tag{2}$$

OKFCM Segmentation

The brain tumor (BT) can be identified using segmentation techniques. The OKFCM-MACO-RNN system consider OKFCM framework is represented as OKFCM. In this system first, we compute the Flexible parameter φ_a associated with every pixel to control the contextual information using (1). The impartial meaning is defined as

$$J_{\mathrm{OKFCM}} = 2\left[\sum_{a=1}^{i}\sum_{b=1}^{c} u_{ab}^{m}(1-K(m_a,v_b)) + \sum_{a=1}^{i}\sum_{b=1}^{c} \varphi_a u_{ab}^{m}(1-K(\bar{m}_a,v_b))\right] \tag{3}$$

The minimization of $J_{\mathrm{HKFCM}}(m,v)$ can be calculated through an alternate optimization procedure using

$$u_{ij} = \frac{((1-K(m_a,v_b)) + \varphi_a\left(1-K\left(\bar{m}_a,v_j\right)\right)^{-1/(m-1)}}{\sum_{a=1}^{N} u_{a,b}^{m}\left(K\left(m_a,v_j\right) + \varphi_a\left(1-K\left(\bar{m}_a,v_j\right)\right)\right)^{-1/(m-1)}} \tag{4}$$

$$v_a = \frac{\sum_{a=1}^{N} u_{a,b}^{m}\left(K(m_a,v_b)m_a + \varphi_a K\left(\bar{m}_a,v_j\right)\bar{m}_a\right)}{\sum_{a=1}^{N} u_{a,b}^{m}\left(K(m_a,v_b)m_a + \varphi_a K\left(\bar{m}_a,v_j\right)\right)} \tag{5}$$

when $\bar{x}$ is substituted with the monochromic of the average filter of the idea image, the algorithm is represented as OKFCM. When $\bar{x}_i$ is changed with the weight image $\bar{\varepsilon}_i$ defined. The algorithm is represented as OKFCM$_\omega$. The main step for the OKFCM is mentioned below:

OKFCM **algorithm**

(1) Initialized threshold $\varepsilon = 0.001, m = 2$, loop counter t $t = 0, v \; and \; u^{(0)}$
(2) Calculate the Flexible regularization parameter φ_i.
(3) Calculate $\bar{x}_i$ for OKFCM
(4) Calculate cluster centres$v_j^{(t)}$ using $u^{(t)}$ as in (5).
(5) Calculate the membership function $u^{(t+1)}$ within (4)
(6) If max $||u^{(t+1)} - u^t| < \varepsilon \; or \; t > 100$ then stop; otherwise, update $t = t + 1$ and go to step (4).

3.2 Feature Extraction (Hybrid Feature Extraction)

After division process, highlights extraction is a noteworthy stage in any characterization precarious. Highlights comprise of pertinent data basic to recognize different classes. Surface properties of a picture can be used for grouping reason. Surface contains data about the auxiliary plan of surfaces in a picture. In this work, GLCM—based highlights, dark level surface highlights, shading based highlights, shading dim level surface highlights, and wavelet highlights are expelled from every single cartography pictures. These highlights are extricated and given as a contribution for FS practice.

3.3 Feature Selection (ACO)

In this section issues can be signified as ACO optimization difficult as surveys:

The problematic can be labelled as a graph with a fixed of vertices signifying d features and edges denote the next feature to be designated.

- Heuristic desirability h_i and pheromone trail intensity τ_i are associated with each feature $f_i \epsilon F(f_1, \ldots, f_d)$. Where F the original feature set is.
- A set of m ants search through the feature space to build a subset $S = (f_1, \ldots f_p)$ where p is much less than d.
- Each ant k, utilizes both the heuristic desirability h_i and pheromone trial τ_i as a probabilistic transition rule to a probable feature.
- The accuracy of classification C_k is used to estimate the builtkey of k ant.
- Refreshing pheromones stage is acknowledged by diminishing all that esteems related with all highlights through pheromone dissipation and by developing the pheromone esteems related with better.

We propose to utilization a half breed choice strategy that is able to compute the total nature of the developed highlights subsets just as the different significance of

highlights. The standard ACO calculation appeared in calculation 1 is consumed in this effort. ACO-TOFA FSA is appeared in Algorithm. A characterization calculation is utilized to compute the exhibition of the element subsets. Then again, the distinguishable hugeness of a given element is estimated utilizing TOFA. After introduction, m ants would develop diverse likely subsets. Every single insect k will choose arbitrarily the underlying component to assemble its element subset $\llbracket S \rrbracket \_k$. At that point every subterranean insect will choose freely the component to be chosen next up awaiting the all subset is developed. The likelihood of subterranean insect k to comprise highlight f_i in its answer is assumed by:

$$P_i^k = \begin{cases} \frac{\tau_i^z \eta_i^\beta}{\sum_{l \epsilon notincluded_k} \tau_i^z \eta_i^\beta}, & if\ i\ \in not\_included_k \\ 0, & otherwise \end{cases} \tag{6}$$

A tale include determination way to deal with build up the presentation of content classifier dependent on a coordination of (ACO) and TOFA. ACO is metaheuristic search calculation determined by the investigation of scavenging conduct of genuine ants, absolutely the pheromone correspondence to discover the briefest way to the nourishment premise. TOFA is a unified advancement structure built up to coordinate and bind together a few best in class measurement markdown calculations through enhancement system. It has been uncovered in before inquire about that ACO is the hopeful methodologies for streamlining and highlight determination issues. TOFA is equipped for managing huge scale content information and can be applied to a few book examination applications, for example, content arrangement, bunching and recovery. For grouping execution yet in productive, the OKFCM-MACO-RNN frame of mind makes utilization of TOFA and classifier execution as experiential data of ACO.

RNN

It is additional season of a show FFN system. In contrast to these neural systems, RNN have cyclic links constructing them winning for displaying successions. We take up that an info grouping, the concealed vector succession, and yield vector arrangement implied by X, H and Y respectively. Input sequence is given by $X = (x1, x2, \ldots, xT)$. A customary RNN computes the hidden vector sequence $(H = (h1, h2, \ldots, hT))$ and output vector sequence $(Y = (y1, y2, \ldots, yT))$ with $t =$ 1 to T as follows:

$$ht = \sigma(Wxhxt + Whhht - 1 + bh) \tag{7}$$

$$yt = Whyht + by \tag{8}$$

The show RNN used to BPT Time to take a differ-length grouping input. In BPTT, the model is first prepared with the preparation information. At that point the yield flaw inclination is put something aside for every period step. The RNN is

difficult to prepare, be that as it may, it makes the slope is detonating or evaporating while at the same time instructing with BPTT calculation.

4 Results and Discussion

The OKFCM-MACO-RNN technique was fulfilled in the MATLAB stimulator software version 2018b. The whole work implemented by consuming I3 processor system with 4 Gigabyte RAM. The DRIVE database contains 60 shading retinal pictures which are taken by fundus "Canon CR5 3CCD camera with 45° of field view." It is used in training and testing the images by two experts. The enactment of the OKFCM-MACO-RNN technique was instigated in terms of specificity, accuracy, sensitivity, and F-measure. To calculate the cataloguing efficiency of the OKFCM-MACO-RNN method, the presentation of the OKFCM-MACO-RNN technique is associated with conservative approaches with the same reputed dataset: DRIVE database (Fig. 2).

Performance Analysis

The challenge evaluation metrics is recycled for assessing the both classification and segmentation presentation of our method. For the segmentation, the evaluation standards comprise sensitivity (SE), specificity (SP) and accuracy (AC). The performance criteria are defined is as:

$$SE = \frac{tp}{tp + fn} \tag{9}$$

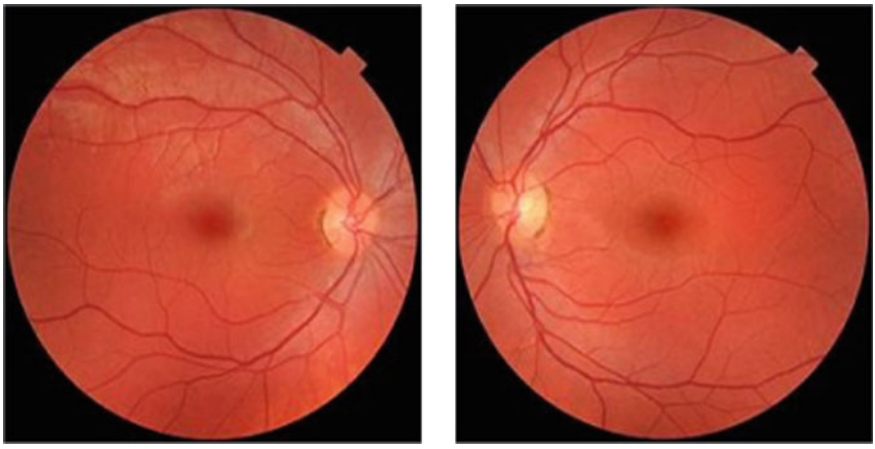


Fig. 2 DRIVE database sample image

$$SP = \frac{tn}{tn + fp} \tag{10}$$

$$\mathrm{AC} = \frac{tp + tn}{tp + fp + tn + fn} \tag{11}$$

$$DSC = \frac{2TP}{(2TP + FP + FN)} \tag{12}$$

$$JSI = \frac{TP}{FP + FN + TP} \tag{13}$$

where tp, tn, fp and fn denote the quantity of a true positive, true negative, false positive and false negative. As for the ordering, there are four evaluation criteria, including sensitivity SE, SP and AC. The meaning of SE, SP and AC is the alike as the metrics for segmentation, but here they image level instead of pixel level is slow. In the classification task, the amounts of tumor and non-tumor lesions in the analysis dataset are quite unfair. In this case, the fp rate should be relatively lesser and tn rate should be relatively big. The OKFCM-MACO-RNN performance analysis is tabulated in Fig. 3.

The OKFCM-MACO-RNN segmentation analysis are shown in Fig. 3. The results shows that the proposed OKFCM technique archive better results in terms of jaccard coefficient, dice coefficient and accuracy. Compare to KFCM method our OKFCM-MACO-RNN OKFCM technique provide better results.

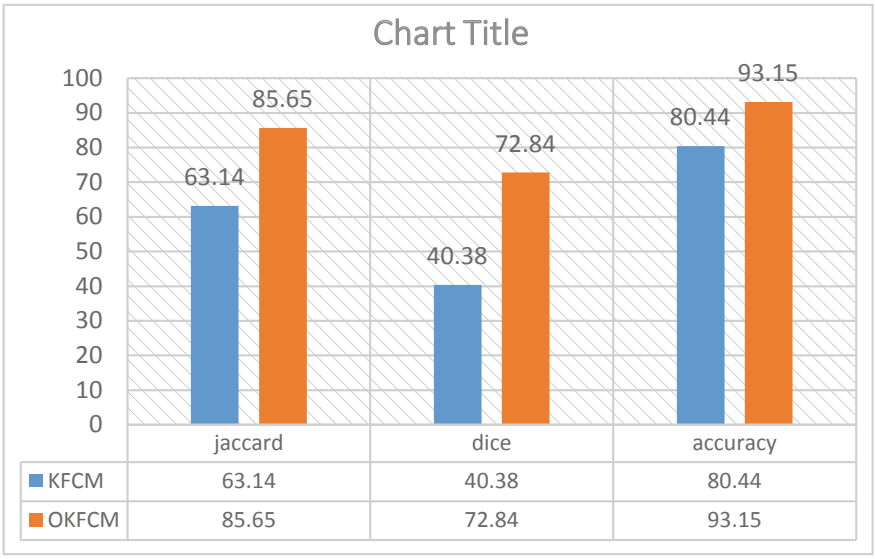


Fig. 3 Segmentation performance analysis

5 Comparative Analysis

Sinthanayothin, Chanjira, et al. [17] has presented the PC based calculations were utilized to preprocess retinal computerized pictures, limit the significant retinal tourist spots and perceive diabetic pathologies, with no intercession from an administrator. And afterward give a marker of the capacity of mechanized discovery in diabetic retinopathy. Osareh, Alireza, et al. [18] has explored SVM and NN classifiers to get great class particularly among EX and non-EX classes. The results by the two grouping approaches are practically equivalent to, in any case, we accept that SVMs are an additional solid key to our application: they have a critical bit of leeway related to NNs as they can succeed an exchange off among bogus positives and negatives utilizing lopsided delicate edges. Xiaohui, et al. [19] in this paper, in preprocessing stage, two-advance Upgraded FCM is applied in Luv shading space to section applicant splendid sore zones. The yields are powerful in managing the inhomogeneous light of the fundus pictures while dropping the impact of commotions. (SVM) grouping structure is decidedly applied to classify splendid non-injury regions. Lin, et al. [20] a robotized calculation of distinguishing exudates in diabetic retinopathy picture. The calculation joins districts utilizing k closest neighbor chart, and arranges exudates as per shading proof and pixel areas. The calculation is quick however achieves a typical level explicitness of 95.42% with the normal affectability of 91.08% in discovery of the exudates in an experiment with 8 diabetic retinopathy pictures. Harangi et al. [21] A technique for the programmed location of exudates in computerized fundus pictures. And furthermore present a compound dynamic form based technique. For this assignment, we consider various area based highlights, and concentrate a proper element subset to prepare a Naïve–Bayes classifier improved further by a versatile boosting practice.

Osareh et al. [22] the chose highlight vectors are then characterized utilizing a multilayer neural system classifier. The calculation was actualized utilizing a huge picture dataset comprising of 300 physically marked retinal pictures, and could discover influenced retinal pictures with affectability has 96.0% however it perceived 94.6% of the typical pictures, that is particularity. Blend of computational knowledge strategies and shading retinal picture investigation is exceptionally positive in finding exudates. Asha et al. [23] the exhibitions of the NB and the Extreme Learning Machine classifiers are assessed dependent on the 2 criteria, the forecast exactness, affectability and explicitness. Ravivarma, et al. [24] the advanced shading fundus pictures for assessing the introduction of our proposed framework was hyperbolic middle channel, FCM and SVM classifier are utilized… To improve differentiate and diminish clamor are accomplished, A compelling pre-preparing step is applied. In the Preprocessing stage, the shading fundus pictures are changed to HSI shading space. Gulshan et al. [25] ML has been utilized for an assortment of grouping undertakings with automated characterization of diabetic retinopathy. This system utilizes an improvement calculation got back to spread to indicate how a machine ought to modify its inside parameters to best foresee the ideal yield of a picture. Pratt et al. [26] these technique to show a

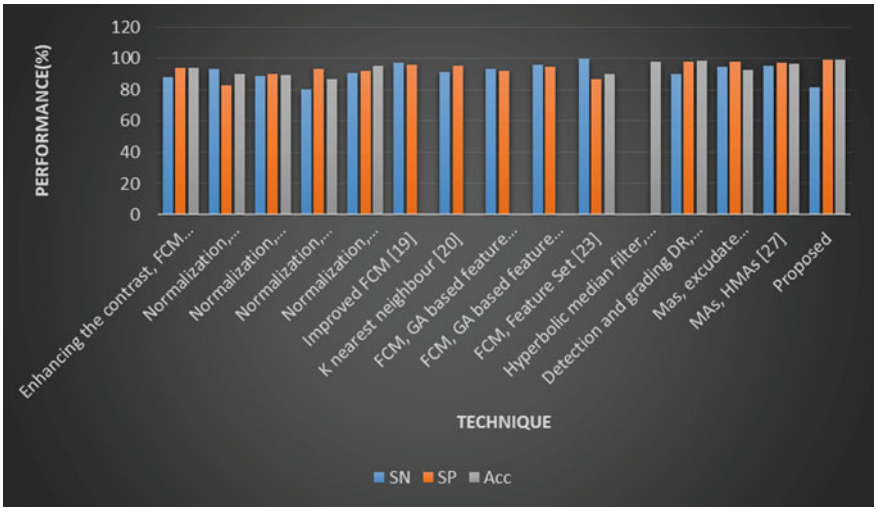
profound learning-based CNN strategy for the troublesome of characterizing DR in fundus symbolism. This is a clinical imaging work with developing analytic significance. The exactness and timing of this safety measure is of huge importance to both the cost and productivity of dealing with. Whenever identified early adequate, successful treatment of DR is empty, creation this a crucial procedure. Jen et al. [27] these strategy for calculations are performed on visit fine-standard databases while explicit calculations are tried on a little nearby database. The field of picture preprocessing on medicinal pictures need is more consideration, because of its essentialness for precise recognition of diabetic highlights in diabetic screening calculations.

The OKFCM-MACO-RNN comparative analysis to the performance of by using the different techniques are distinguished in the below tabular column Table 1.

In others works, they achieved the output sensitivity and accuracy by using the SVM algorithm in [18, 19, and 26] by achieve the averagely highest of 97% sensitivity and the highest accuracy is 95.5%. And then by using ANN algorithm [27] to achieve the most accuracy is 96.87 and the higher sensitivity is 97.3%. In [19] using KNN algorithm used to achieve 80.2% sensitivity and 87.1% accuracy level. By which are compared with our OKFCM-MACO-RNN system is better sensitivity and high accuracy than others works. The OKFCM-MACO-RNN system by using RNN algorithm to achieved sensitivity is 95.71% and the accuracy is 99.2%.

Table 1 OKFCM-MACO-RNN method comparative analysis

Method	Classifier	SN	SP	Acc
FCM, Enhancing the contrast [17]	NN	88.2	94.1	93.8
Normalization, enhancement, FCM [18]	NN-SCG	93.4	82.7	90.1
Normalization, enhancement, FCM [18]	BPNN	89	89.8	89.6
Normalization, enhancement, FCM [18]	KNN	80.2	93.1	87.1
Normalization, enhancement, FCM [18]	SVM	90.7	92.4	95.5
Improved FCM [19]	SVM	97	96	–
K nearest neighbor [20]	–	91.1	95.4	
FCM, GA based FS [21]	Multilayer NN	93.5	92.1	–
FCM, GA based FS [21]	Multilayer NN	96.0	94.6	
FCM, Feature Set [23]	ELM	100	87	90
Hyperbolic median filter, FCM [24]	SVM	–	–	98
Detection and grading DR, Deep learning [25]	Deep learning	90.3	98.1	98.5
Mas, excudate hemorrhages [26]	SVM	95	98.1	92.68
MAs, HMAs [27]	ANN	95.5	97.3	96.87
OKFCM-MACO-RNN	**RNN**	81.65	99.42	**99.33**



6 Conclusion

A huge scope of approaches have displayed for programmed exudates identification yet haven't an unadulterated partition among exudates sorts. A speculation of discrete results is intense as these detailed frameworks are very streamlined with separate research retinal pictures. Regularly, most extreme retinal pictures have classified by being little balance and plagued with picture antiques which tracker extra investigation of programmed identification and division of exudates. This studies suggests a novel element determination disposition to expand the exhibition of content classifier established on a reconciliation of ACO calculation and TOFA. The show RNN used to BPTT to take a variable-length request input. The test assessment measurements is reprocessed for surveying the both division and characterization execution of our strategy. By given a superior exactness and better affectability is come to. For example, 81.65% affectability and the exactness is 99.33%. The essential objective of medicinal investigations with the worry of both the angles i.e., to rise the adequacy of mechanized evaluating conclusion through definite discovery approach for these variations from the norm and the treat handling related with these for hinder the movement of this vision undermining trouble of diabetes with the extended haul impacts to battle with this sickness which radically developing step by step in everywhere throughout the world.

References

1. Stanton AV, Wasan B, Cerutti A, Ford S, Marsh R, Sever PP, Thom SA, Hughes AD (1995) Vascular network changes in the retina with age and hypertension. J Hypertens 13(12 Pt 2):1724–1728
2. Wong TY, McIntosh R (2005) Hypertensive retinopathy signs as risk indicators of cardiovascular morbidity and mortality. Br Med Bull 73(1):57–70
3. Quillen DA, Harper RA, Haik BG (2005) Medical student education in ophthalmology: crisis and opportunity. Ophthalmology 112(11):1867–1868
4. Wong TY, Klein R, Couper DJ, Cooper LS, Shahar E, Hubbard LD, Wofford MR, Sharrett AR (2001) Retinal micro vascular abnormalities and incident stroke: the Atherosclerosis Risk in Communities Study. Lancet 358(9288):1134–1140
5. Wong TY, Klein R, Sharrett AR, Duncan BB, Couper DJ, Klein BE, Hubbard LD, Nieto FJ (2004) Retinal arteriolar diameter and risk for hypertension. Ann Intern Med 140(4):248–255
6. Staal J, Abràmoff MD, Niemeijer M, Viergever MA, Van Ginneken B (2004) Ridge-based vessel segmentation in color images of the retina. IEEE Trans Med Imaging 23(4):501–509
7. Soares JV, Leandro JJ, Cesar RM, Jelinek HF, Cree MJ (2006) Retinal vessel segmentation using the 2-D Gabor wavelet and supervised classification. IEEE Trans Med Imaging 25 (9):1214–1222
8. Ricci E, Perfetti R (2007) Retinal blood vessel segmentation using line operators and support vector classification. IEEE Trans Med Imaging 26(10):1357–1365
9. Fraz MM, Remagnino P, Hoppe A, Uyyanonvara B, Rudnicka AR, Owen CG, Barman SA (2012) Blood vessel segmentation methodologies in retinal images–a survey. Comput Methods Programs Biomed 108(1):407–433
10. Liu I, Sun Y (1993) Recursive tracking of vascular networks in angiograms based on the detection-deletion scheme. IEEE Trans Med Imaging 12(2):334–341
11. Zhou L, Rzeszotarski MS, Singerman LJ, Chokreff JM (1994) The detection and quantification of retinopathy using digital angiograms. IEEE Trans Med Imaging 13 (4):619–626
12. Pires R, Avila S, Wainer J, Valle E, Abramoff MD, Rocha A (2019) A data-driven approach to referable diabetic retinopathy detection. Artif Intell Med 96:93–106
13. Nazir T, Irtaza A, Shabbir Z, Javed A, Akram U, Mahmood MT (2019) Diabetic retinopathy detection through novel tetragonal local octa patterns and extreme learning machines. Artif Intell Med 99:101695
14. Verbraak FD, Abramoff MD, Bausch GC, Klaver C, Nijpels G, Schlingemann RO, van der Heijden AA (2019) Diagnostic accuracy of a device for the automated detection of diabetic retinopathy in a primary care setting. Diabetes Care 42(4):651–656
15. Hagos MT, Kant S (2019) Transfer learning based Detection of Diabetic Retinopathy from Small Dataset. arXiv preprint arXiv:1905.07203
16. Chakraborty S, Jana GC, Kumari D, Swetapadma A (2019) An improved method using supervised learning technique for diabetic retinopathy detection. Int J Inf Technol 12:1–5
17. Sinthanayothin C, Boyce JF, Williamson TH, Cook HL, Mensah E, Lal S, Usher D (2002) Automated detection of diabetic retinopathy on digital fundus images. Diabet Med 19(2):105–112
18. Osareh A, Mirmehdi M, Thomas B, Markham R (2002) Comparative exudate classification using support vector machines and neural networks. In: International conference on medical image computing and computer-assisted intervention, 25 September 2002. Springer, Heidelberg, pp 413–420
19. Xiaohui Z, Chutatape A (2004) Detection and classification of bright lesions in color fundus images. In: International conference on image processing, ICIP 2004, 24 October 2004, vol 1. IEEE, pp 139–142

20. Lin W, Liu H, Xu M, Zhang J (2008) Automated detection of exudates on color fundus image using region merging by k-NN graph. In: 7th Asian-Pacific conference on medical and biological engineering. Springer, Heidelberg, pp 216–220
21. Harangi B, Hajdu A (2014) Automatic exudate detection by fusing multiple active contours and region wise classification. Comput Biol Med 54:156–171
22. Osareh A, Shadgar B, Markham R (2009) A computational-intelligence-based approach for detection of exudates in diabetic retinopathy images. IEEE Trans Inf Technol Biomed 13 (4):535–545
23. Asha PR, Karpagavalli S (2015) Diabetic retinal exudates detection using extreme learning machine. In: Emerging ICT for bridging the future-proceedings of the 49th annual convention of the computer society of India CSI, vol 2. Springer, Cham, pp 573–578
24. Ravivarma P, Ramasubramanian B, Arunmani G, Babumohan B (2014) An efficient system for the detection of exudates in colour fonts images using image processing technique. In: 2014 IEEE international conference on advanced communications, control and computing technologies, 2 May 2014. IEEE, pp 1551–1553
25. Gulshan V, Peng L, Coram M, Stumpe MC, Wu D, Narayanaswamy A, Venugopalan S, Widner K, Madams T, Cuadros J, Kim R (2016) Development and validation of a deep learning algorithm for detection of diabetic retinopathy in retinal fundus photographs. JAMA 316(22):2402–2410
26. Pratt H, Coenen F, Broadbent DM, Harding SP, Zheng Y (2016) Convolutional neural networks for diabetic retinopathy. Procedia Comput Sci 90:200–205
27. Salamat N, Missen MM, Rashid A (2019) Diabetic retinopathy techniques in retinal images: a review. Artif Intell Med 97:168–188

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Review on Predicting Student Performance

Monagari Swathi, K. L. S. Soujanya, and R. Suhasini

Abstract In the present educational system, student performance prediction is very useful. Predicting student performance in advance can help students and their teacher to track the performance of the student. Many institutes have adopted continuous evaluation system today which is done manually. Such systems are beneficial to the students in improving performance of a student. In data mining applications, it is seen that neural networks are widespread and has many successful implementations in a wide range. The goal is to know whether neural networks are right classifiers to predict the student performance in the domain of educational data mining. Neural network surpass many algorithms which are tested on particular dataset and can be used for successful prediction of student performance. Classification is used as a popular technique in predicting student performance. Several methods are used under the classification such as decision tree, naïve bayes tree, support vector system, k nearest neighbor, random forest and logistic regression.

Keywords Deep learning · Deep neural network · Education data mining · Classification · Students · Performance

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_120

1 Introduction

Student's academic performance is a major part in determining career of the students and institutions prestige. Educational data mining application helps to predict the student's performance in academics such as model development. Based on the student's background and examination performance the applications of machine learning methods are helpful to foretell the performances at various level. Such machine learning methods are used to predict the students who have a chance of failing and the guidance will be given by the teacher to the students. The machine learning algorithm such as decision tree and naïve bayes are mostly used in educational data mining.

The conception of machine learning is something which is born out of the environment. Digital data can be analyzed to find laws and patterns which are complex for human to do. Machine learning is defined as the machine learns from past experiences. Even applications of machine learning vary, the general function is same throughout the applications. Large amount of data will be analyzed by computer and finds rules and patterns in the data which are hidden. Such patterns and rules can be easily processed by a machine. Those rules can be used by computer which can characterize the new data purposely.

Deep learning is defined as the state of art tool for artificial intelligence research. It is applied for various applications. Deep learning is classified into deep neural network, recurrent neural network, convolutional neural network and Q-learning. Basically, deep learning is used for sound/voice recognition, natural language processing.

The paper used deep neural network classifier model which was proposed to predict the performance of the students. This model focus on student's pass or fail category by logistic classification analysis. In education system, student's history i.e., roll number, course eligibility and academic performance is an important criterion and analyze them in various ways as they are computer based. The data will be available. Modification and up dation are done commonly. All the effort of the student improves the quality of education. The data set contains continuous or numerical values and also categorial or discrete values. Classification technique will be used to divide the given data based on the attributes from training set. There are such classifiers i.e., decision tree, support vector machine, naïve bayes, random forest, k nearest neighbor and logistic regression.

2 Literature Review

As a part of research work, more than 15 papers are been explored, few of them are related to educational data mining and also highlighted. Chi-squared Automated Interaction Detector (CHAID) was suggested by M. Rama swami et al. to analyze the higher secondary students' performance. The study confers few parameters like

school type, location, family background educational organization, medium of teaching are key elements to predict the student performance. Bayesian networks was proposed by Cortez, et al. which is based approach for student data classification. As a part of research, student performance evaluation was proposed by cross industry standard process for data mining (CRISP-DM) based on classification model.

In 2008, 'Prediction model for performance of students based on data mining methods with behavioral characteristics of the student' proposed by Amreih, et al. Three separate classifiers, i.e., naïve Bayesian, artificial neural network and decision tree, were used for this model. 22.1% accuracy was attained by the model when the behavioral features are removed. After using ensemble methods, the accuracy was raised up to 25.8%.

In 2010, [1] Based on their experiments, it is found that the artificial neural network performs better classification related to other classifiers. The accuracy is 76%.

In 2011, 'A hybrid technique has been applied on clustering of k-means and artificial neural network' by Moucary et al. who are pursuing higher education. On the other hand, then pursuing students took up a foreign language for communication and course of instruction. Initially, the neural network was used to predict student performance and to adapt it to a suitable cluster formed by the use of k-means algorithms. Clustering offers mentors a powerful tool to identify the student's capability in the academic's early stage. The accuracy is up to 79%.

In 2012, [2] Surjeet Kumar Yadav from Shri Venkateshwara University. Decision tree algorithms such as C4.5, Id3 and CART are applied for performance prediction in final examination on student data. The precision is 67,7778%.

In 2013, [3] Ajay Kumar Pal, a researcher scholar and Saurabh pal, Head department of MCA. Data mining techniques used to enhance academic performance at educational institutions are described in paper. This paper featured a real-world experiment at VBS Purvanchal University, Jaunpur, India. This benefits the students who need special teacher support and who have the quality education. The classifiers used in this paper are ID3, C4.5, bagging and discovery of information in Databases (KDD), educational data mining. The algorithm which have given the best accuracy is ID3 and the accuracy is 78%.

In 2015, [4] Amirah Mohamed Shahir by Elsevier B.V. The purpose of this paper is to provide an analysis of data mining techniques used to predict output of the students. Educational data mining is used to collect useful information from an educational database from large volumes. The highest predictive accuracy using decision tree approach is 91%.

In 2015, [5] O. Folorunso proposed this paper. 'Here, artificial neural network is used to predict student's performance based on previous datasets. CGPA is determined as final grades. The actual CGPA used three feed-forward neural networks. Artificial neural network predicted correctly and the evaluations are done for final grade of the students with 91.7% of accuracy.

In 2016, [6] Amjad Abu Saa from the university of science and technology of Ajman united Arab Emirates. The study of this paper is to find out the connection between social factors and the performance factors of the students in the field of education. Here, educational data mining is a trend in data mining and the discovery of knowledge in databases that is focused and useful for extracting information from educational systems.

In 2017, [7] Murat Pojon published a thesis on from the university of Tampere. The main objective of the paper is to improve the prediction performance by comparing machine learning methods and feature engineering techniques. The machine learning methods used to predict success of the student are linear regression, decision tree and classification of naïve Bayes. Here, two datasets are taken. The accuracy of first dataset is 93% and the accuracy of second dataset is 78%.

In 2017, [8] Jun Shuai Feng published this paper from B.S. Florida gulf coast university. Educational data mining associates with many techniques which explore data related to educational background. To implement educational data mining, the classification algorithms used in machine learning fields are decision tree, k nearest neighbor, naïve bayes, support vector machine and neural network. The Centre of interest of this paper is on decision tree and neural network to predict academic performance of the student. The paper's accuracy is 91%.

In the year 2018, [9] Alaa Khalaf Hamoud, Ali Salah Hashim, Wid Awadh proposed this paper and it is based on decision tree algorithms. The built classifiers are J48, random forest and REP tree. The survey has been done with 60 questions which covers the areas such as health, social activity, relationships and academic performances. To constrict the model Weka 3.8 tool was used. J 48 algorithm is considered as best algorithm compared to random forest and REP tree.

In 2018, the paper 'predicting student performance using machine learning approach' was published by S.S. Rathi computer engineering VIIT, Pune. In this system, college student data is used in predicting student performance. C4.5, artificial neural network and reinforcement are the algorithms used for classification. Here, artificial neural network is used for approval of teacher.

In 2019, [10] E. T. Lau, L. Sun, Q. Yang proposed this paper and it buzzes with both traditional statistical analysis and student performance modeling of neural networks. The neural network consists of eleven input variables, with two layers of hidden neurons and one layer of output. The model of the neural network has achieved good precision, i.e., 84.8%.

Comparative study of existing techniques:

Sl. no	Author name	Paper title	Methods	Published year	Accuracy
1.	Ioannis E. liveries'	To predict performance of the in mathematics	K-nearest neighbor	2010	76%
2.	Surjeet Kumar Yadav	A prediction for performance improvement of engineering students using classification	Decision tree algorithms such as C4.5, ID3 and CART	2012	67.77%
3.	Ajay Kumar pal	Analysis and mining of educational data for predicting the performance of students	ID3, C4.5, bagging and knowledge discovery in data bases (KDD)	2013	78.00%
4.	Amirah Mohamed Shahir	A review on predicting student performance using data mining techniques	Decision tree	2015	91%
5.	B.A. Kale Jaye, O. folorunso	Predicting students grade scores using training functions of artificial networks	Artificial neural network	2015	91.7%
6.	Amjad Abu saa	Educational data mining and student's performance prediction	Knowledge discovery in data bases (KDD)	2016	86.7%
7.	Murat pojon	Using machine learning to predict student performance	Linear regression, decision trees and naïve Bayes	2017	93%
8.	Junshuaifeng	Predicting student's academic performance	Decision tree and neural network	2017	91%
9.	Alaa Khalaf hamourd	Predicting student performance in higher education institutions using decision tree analysis	Decision tree algorithms such as J48, random tree and REP tree	2018	Not specified
10.	E.T. Lau, L. Sun, Yang	Prediction of student and classification of student performance using ANN	Artificial neural network	2019	84.8%

3 Methodology

Acquire Data Set: Data analyst should pick up the set of data and start the machine learning implementation. The role of data analyst is to find the ways and sources to collect relevant data.

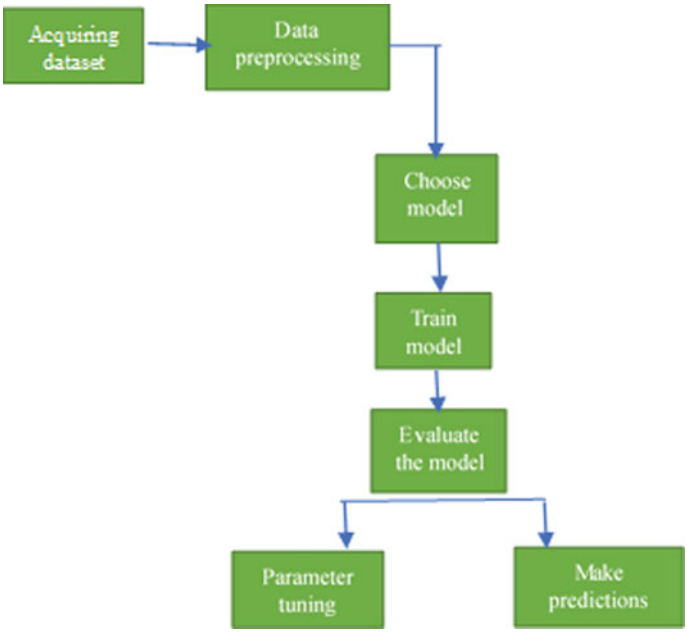
Data Preprocessing: The data which is collected should be converted from raw data into the form which fits in machine learning. The data cleaning is a procedure to remove noise and fixing inconsistencies in data.

Choose Model: The data analyst chooses and trains the model to define which of them will give most accurate predictions.

Train the model: The preprocessed data should be collected and split it into three subdivision, to proceed for model training.

Evaluate the Model: The evaluation of model is done after an algorithm process the data for accuracy. If the model gets less accurate prediction the parameters will be tuned. If the accuracy is more. Then analyst can make prediction.

Flowchart: Framework representing proposed approach



4 Conclusion

In this paper, the researcher reviewed earlier studies on predicting student performance using different analytical methods. Some investigators used cumulative grade point average (CGPA) and internal assessment as data sets. The classification method is mostly used for statistical techniques in the area of educational data mining. Neural network and decision tree are the two approaches widely used by the researchers to predict student performance. In conclusion, the quantitative analysis on student performance prediction has prompted us to conduct more work to be implemented in our community. This will help the education system track the success of the pupil in a systematic manner.

Acknowledgements We thank center of intelligence Artificial Intelligence and Deep Learning, Department of computer science and engineering, CMRCET for the support and especially thankful to our project coordinator Dr M.D. Ansari whenever needed.

References

1. Yadav, SK, Pal S (2012) Data mining: a prediction for performance improvement of engineering students using classification ArXiv preprint arXiv:1203.3832
2. Pal AK, Pal S (2013) Analysis and mining of educational data for predicting the performance of students. Int J Electron Commun Comput Eng 4(5):1560–1565
3. Shahiri AM, Husain W (2015) A review on predicting student's performance using data mining techniques. Procedia Comput. Sci. 72:414–422
4. Kalejaye BA, Folorunso O, Usman OL (2015) Predicting students'grade scores using training functions of artificial neural network. J Natl Sci Eng Technol 14(1):25–42
5. Saa AA (2016) Educational data mining & students' performance prediction. Int J Adv Comput Sci Appl 7(5):212–220. https://thesai.org/Publications/IJACSA
6. Pojon M (2017) Using machine learning to predict student performance (Master's thesis)
7. Lau ET, Sun L, Yang Q (2019) Modelling, prediction and classification of student academic performance using artificial neural networks. SN Appl Sci 1(9):982. https://doi.org/10.1007/s42452-019-0884-7
8. Hamoud A, Hashim AS, Awadh WA (2018) Predicting student performance in higher education institutions using decision tree analysis. Int J Interact Multimedia Artif Intell 5:26–31
9. Rathi SS (2018) Predicting student performance using machine learning approach. VJER-Vishwa Karma J Eng Res 2(4)
10. Arsad PM, Buniyamin N (2013) A neural network students' performance prediction model (NNSPPM). In: 2013 IEEE International Conference on Smart Instrumentation, Measurement and Applications (ICSIMA), pp 1–5. IEEE

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A Novel Association Approach to Generate Patterns for Multi-valued Data in Efficient Data Classification

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Abstract The real-world applications increased demand for heterogeneous data classification for text, pictures, music, movies and medical data sets. The complexity of the learning class for an object that is associated with the set of values is a key issue for multi-value data sets. The present learning approaches are based on the features characteristics favouritism observed for similar sets of class values, but favouritism characteristics measured an object deviation value instead of association class. Such methods may be unfavourable for classification as each value is made up of specific features of characterization. However, few studies have tried to solved the problem through associating values learning over multi-value data sets. This paper presents a Multi-Value Association (MVA) Approach for efficient data classification based on associated pattern generation using binary multi-value association among the data. The objective of the proposal is to identify a Single-Class-Value (SCV) which can be most suitable along with the additional features patterns which can describe it most. To evaluate the efficiency we compare with some existing proposals using multi-value datasets which shows an improvisation.

Keywords Multi-Value association · Single-Class-Value · Pattern · Classification · Multi-value datasets

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_121

1 Introduction

In the era of distributed real-world applications of various heterogeneous data are there who have been identified as multi-value items. These data can be from various fields such as education, sports, multimedia, politics or medicine [7, 23, 25]. Content and data can show several meanings, but also may be associated with several classes for identification with multi-value. Even high dimensional data usages can be used in the application of data processing [20, 26] and machine learning [11, 17, 18] faced hurdles in the correct classification. However, in all cases it is found that the cause of the problem is due to the multi-value. We deal with this problem through one-to-multi-value classification by learning association rules consist in the multi-value datasets which improvise the multi-value classifiers accuracy.

This is a daunting activity in mining the data related research and learning to construct an efficient classifier for heterogeneous data sets that have more value annotations.In the literature, most works are targeted to the feature selection [11, 12, 27], reducing the feature [8, 19] and associative classification [2, 22] to build a classifier. Classifiers mostly predicts data objects class based on a set of training data. However, in case of more value impact on classifier construct not been investigated enough to have a high impact on the prediction class value, and even in literature, this problem is poorly explored so far.

Methods of selection and reduction of features [8, 12] have been used in previous proposals to identify multi valued attributes [10]. Some of these proposed methods are to examine the similarity features among them and to minimize those features that do not provide useful information to predict the class. These reduced or selected features used by the classifier to train and organize support for improvisation. But complexity is for objects that are multi-value and how it transforms these structures suitable for classification of improvisation. Although, this method of selection work well for some classifiers to the multi-value learning [4], but for each class values may not be optimal its peculiarities. For example, text classification in a series of documents which have word terms could be related to entertainment, politics, sports, stocks, etc.

This paper aims at examining and proposing a modern, multi valued data method depending on learning data objects multi-values characterized by the association rules algorithm for improvisation classification. It associates the values of the multi-value association by calculating the values density and associationalgorithm. It emphasize to find a Single-Class-Value (SCV) primarily which will be highly suitable for class suggestion among the data object classes, and in second stage, we learn multiple-values binary association among the multi-values to construct a patterns for the classification.

The techniques and methodologies to be discussed are arranged as follows in the following article. Sect. 2 explains the research related to multi value categories, and Sect. 3 addressed the multi-valued data association approach which describes the problem description and Multi-Value Association Learning, Sect. 4 describes the

databases used for evaluation and the measurement measures furthermore Sect. 5 presents experimental evaluation using multi-value datasets. Finally, conclusion of the paper is discussed in Sect. 6.

2 The Related Works

Precise description of data sorting is the key objective of the in-detail and depth data analysis that will provide the required information [1, 5, 9, 16]. Categorization is often achieved through all the properties of objects classifier checking features and assigns levels of qualified skills to be set in the classes [21]. For instance, a data set consisting of a record array, and each record component has a number of attributes that will be regarded as an attribute from the identification class set. Classification of unidentified data objects is performed based on the existing class information classifier. The classification objective is to construct an effective classifier to precisely serve unnoticed data for needs that accord in real time.

Supervised learning effectively used to classify unobserved artifacts in several learning activities. But it is not well in the current real-time data facilities fit for multiple semantic meaning of the data object. The text of the document associated with the news may be related policy, sports, economy, drawing, etc., is building a multi-value has the complexity of the classification of traditional supervised learning system.

Tsoumakas and Katakis [15] identifies the problem of classification multi-value and proposed solution for data transformation and multi-value classification algorithm adaptation. Data transformation deals with the problem of data with more value transform from one to more value. The proposal to use common off-the-shelf one value classifier which limits the classification request. The classification algorithm is amended to suit the specific areas of classification more value in a particular context and achieves high complexity of computation.

Dembczynski et al. [24] discusses formalization and explanations about the value of addiction in the classification of multi-value. It mainly focus on the value of addiction through the difference between conditional and unconditional value. It has been noted that the classification of more value through unconditional dependence modeling show good results, where as in the case of conditional dependencies it shows low efficiency in comparison. Kong et al. [3] also explores the classification of more value on the basis of various types of addiction among objects and their values known as PIPL. The proposal mainly focus on heterogeneous data to facilitate classification. The assessment shows improvisation in performance, but its limited to a heterogeneous network information data sets.

Charte et al. [1] introduces a technique of multi value classification to deal with objects with different data values. The strategy is to solve the conventional high-dimension data classification problem, which has a large range of elements. Selecting feature extraction using the instance of data transformation and association rules detected on the basis of the addiction to labels. Expending on the label

value the selection features are identified with multi value in the classification model. In the scenario of a linear variation in the data items, this framework could be effective in revealing the addiction value, although in the case of high variance data in a multi-label data object, it could attain inaccuracy.

Zhang and Wu [6] concentrated in feature extraction on the problem of multi - label classification learning. It manipulates a strategy for learning the key characteristics of the code to distinguish various classes of significance. Another name algorithm LIFT submitted to learn more values that build clusters based on specific characteristics of the application of value analysis clustering of positive and negative examples. Base classification skills training are examined grouped results characteristic of the group. However, this approach appears promising direction in multi-label value of learning to classify, but the importance of the characteristics of an association other characteristics should be explored for further optimization.

Based from the above perspectives and methods, the importance of multi valued data in the classification area is understandable. This emphasizes the importance of selecting features in classification accuracy. But learning the most characteristic features of the classification of the challenging questions. In the construct above opinions and limitations we propose a new approach to the categorization of more value data sets using multi-value Association (MVA) approach based on the rules of the Association for the multi-value data sets. This learning algorithm generalize selection characteristic of addiction is based on the requirements and needs domain. The details of the system explained in the next section.

3 Multi-value Association Approach

3.1 Defining the Problem

Conventional methods of learning are studied extensively during the supervised scheme of machine learning. The data object related mostly with value of the supervised learning analysis methods, in these structures to learn the collection of data features of a function being used for classification which is shown in Fig. 1.

This training is well equipped for single word, but when the object has a multi valued, the difficulty comes up. Improvisation of traditional supervised learning to adapt multi-value data objects are found in the literature [4, 12, 20]. However, by taking into account their similarity between two, most of the solutions offered are based on the features of learning about dependence or associated value. However, it might be not related to the domain where this kind of information values are

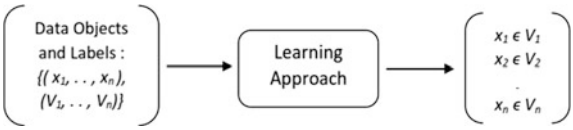


Fig. 1 Conventional supervised analysis

unavailable. In some cases, the basic dependence of the correlation value and identified by the association rules algorithm, but does not facilitate changing the multiple sets of data values and in different domains. Our goal is to build a classifier based on a new multi-value Association (MVA) approach that can be implemented in different domains of multi-value data sets and enable us to provide accurate and speed classification.

3.2 Multi Valued Association Learning

Classification is based on the precision of the collection and identifying value of the feature. a Two or more different values in the object domain have been observed and suggesting some level of coordination among them. This association of analysis can become very useful in data classification at multilevel. We propose a two-phase learning method to classify the Single Class Value (SCV) which is very appropriate for class suggestions, in the second phase we will find other multiple values that support the SCV for the construction of the class samples useful for various queries classification.

Let's assume a training set D consisting of instances of n objects having vectors of k values that describe as, $D = \{d_1, \ldots, d_n\}$ and the values denoted are $V = \{m_1, \ldots, m_k\}$. Currently, the initial function of multi-value learning system is to use the V vector to locate the SCV. To do so, we are creating a SC-Table which consists of the domain parental class value as shown in Table 1.

We calculate the associated value density compared to the Single Class-Table to learn SCV for an instance. The value density (VD) is calculated using Eq. 1. The VD value ranges from 0 to 1, the more the value the stronger the class relationship is.

$$Value\,Density\,(VD) = \frac{\sum_{i=1}^{k}(v_k \in V)}{|V|} \tag{1}$$

In the Algorithm it has been given that the method for finding an instance SCV Class which uses the Single Class table and VD_value presented.

Table 1 Single class-table

Class	Values associated
Scene	Beach, Sunset, Fall Foliage, Field, Mountain, Urban, etc.
Birds	Dark-eyed, Pacific Wren, Brown Creeper, Red-breasted Nuthatch, Pacific-slope Flycatcher, etc.
Bibtex	architecture, education, article, children, community, computer, dynamics, book, eLearning, games, social, socialnets,etc.

Algorithim_1: discovering *SCV* Class For illustration

The Input given to the algorithm:

D, thesingle dimensional' database used as training data set
SCT, the two dimensional and the singleClassTable

Output:*C,*TheInstance value of the parent.
Method:

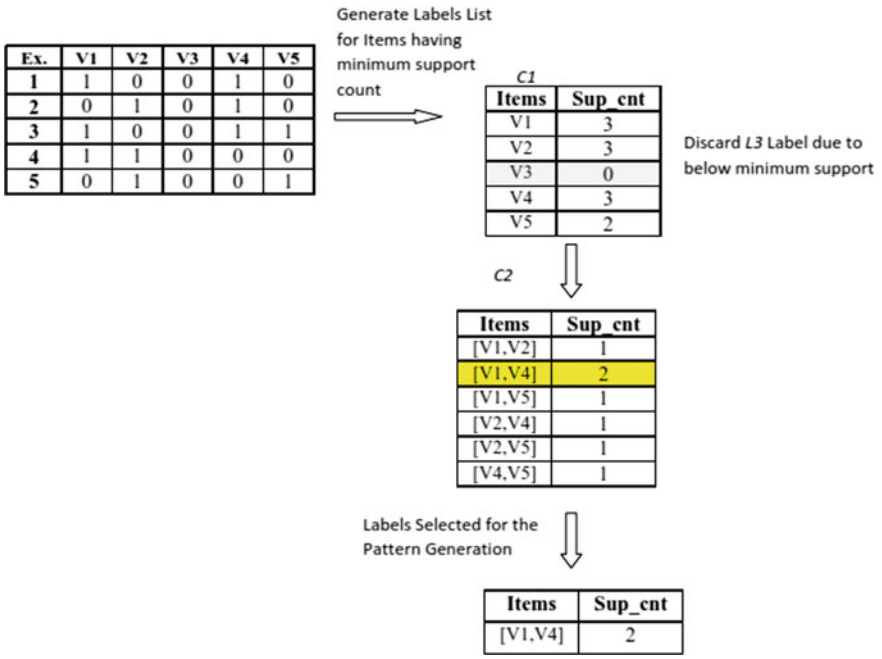
```
for i=0, i<the number of instances that are present in D
    d_i= D[i];
    V[]=getValues(d_i);
    for t=0, t<the number of tuples that are present in SCT
        C_t = SCT[t][0]; // which is theclassvalue
        A_t[] = SCT[t][0]; // which is the Association value
        VD = computeVD (V[], A_t []);
        VD_Value[t][] = [C_t][ VD];
    End for
    // whichFinds the largestVD value that is from the VD_Value[ ][ ]
    // which Gets the class valuethat has the largest amongthe values of VD
    C = get_Class (VD_Value[ ][ ]);
End for
```

Selection of a class of multi-value, for example, causes huge information loss [11, 20]. To solve this problem it extends, class learning SCV with multiple values to construct patterns through the rule of accession to diminish the Hamming loss in the knowledge that is produced from classification.

Let's consider the training dataset $D = \{ (d_1,l_1), (d_2,l_2), \ldots, (d_n,l_k)\}$, where $d_i \ D$, $v_k \subseteq V$. We find a binary meaning of the instances values to classify the multiple values that could be highly important to the class accuracy construction.

The Fig. 2 Shows the importance of an association instance having several values for the construction of a classification sample. All binary values, such as the D, are created by the learning process, a set of value systems that endorse the minimum number of support counts. Let's consider an example where $V = \{v_1, v_2, v_3, v_4, v_5\}$and $D = \{(1,0,0,1, 0), (0, 1,0, 1,0), (1,0,0,1,1), (1,1,0,0,0), (0, 1, 0, 0, 1)\}$.

Here we use an absolute support count as 2, so that the corresponding relative minimum support is 2/5 = 40%. The list obtained as C1 will consist of products that fulfill the minimum support and will ignore others. In addition, in order to identify the most frequently obtained and related values from the C1 we enter the C1 to produce C2 consists of 2-value item sets. The iteration is continuous until we have the minimum support matching multiple-values. The final multiple-values obtained will be regarded as being most important and strongly connected. Now we produce the classification rules by using the SCV class, C and the multiple-value items (Table 2).



Ex.	V1	V2	V3	V4	V5
1	1	0	0	1	0
2	0	1	0	1	0
3	1	0	0	1	1
4	1	1	0	0	0
5	0	1	0	0	1

Items	Sup_cnt
V1	3
V2	3
V3	0
V4	3
V5	2

Items	Sup_cnt
[V1,V2]	1
[V1,V4]	2
[V1,V5]	1
[V2,V4]	1
[V2,V5]	1
[V4,V5]	1

Items	Sup_cnt
[V1,V4]	2

Fig. 2 Multiple_values data generation from instance value

Table 2 Rules obtained from Multi-Value Association

SCV	Multiple-values	Rules
C_t	*{V1,V4}*	*{(C_t,V1), (C_t,V4), (C_t,V1,V4)}*

Table 3 Datasets used for experiment evaluation with L_{Card}

Datasets	Domain	Instances	Attributes	Values	L_{Card}
Scenes	images	2407	294	6	1.074
Birds	audio	645	260	19	1.014
Bibtext	text	7395	1836	159	2.402

4 Datasets and Evaluation Measures

To evaluate the effectiveness of the proposal to purchase three popular measures proposed by Tsoumakas et al. [14] to organize more such values, Hamming loss (HL) and accuracy. The datasets is used for the analysis is downloaded from MULAN [25] data repository as categorized in Table 3.

4.1 Multi Valued Datasets

Multi valued classification difficulties occur in a wide array of real-world conditions and implementations. For data sets involved in the Experimental configuration to address the three major application areas where multi valued data is commonly noticed: Multimedia supervised analysis, classification techniques and computational biology. All data sets are mostly taken from the repository of MULAN [25] data, as outlined in Table 3. It displays the properties of the field data sets, and their number of observations, characteristics, values and LCard.

L_{Card} -means the value that measures the number average of values for each test data. The L_{Card}measured[1, 6] for each datasets $D = \{ (d_n, V_k) \mid 1 \leq n \leq k\}$ are denoted as,

$$L_{Card} = \frac{1}{N}\sum_{i=1}^{n} |V_k| \ldots\ldots\ldots\ldots \tag{2}$$

4.2 Evaluation Measures

(1)Hamming Loss: It is the most accepted ranking metric for further significance calculation of misclassification of data values for classification. It evaluates the instance and value pair misclassification in terms of relevant and irrelevant values that are predicted by using this When HL = 0, the result is deemed perfect

$$Hamming\,Loss(HL) = \frac{1}{N}\sum_{i=1}^{N}\frac{1}{V}|h(d_i)\delta l_i| \tag{3}$$

Where, δ is used when evaluating the symmetrical (proximity) dissimilarity between two examples of the datasets, N is assumed to be a number of test datasets, and V determines the class values likely to be used by the datasets.

(2) Accuracy (A): It measures the percentage actually determined values within a given data set determined values. The calculation of accuracy is performed as,

$$Accuracy(A) = \frac{1}{N}\sum_{i=1}^{N}\frac{1}{V}\left|\frac{h(d_i) \cap l_i}{h(d_i) \cup l_i}\right| \quad (4)$$

4.3 Algorithm Evaluated

The proposed method is implemented in Java integrated with Weka and MULAN [25] open-source Java library. We applied multi-value classification using the proposed Multi-Value Association (MCA) method on the standard multi-valued classification approaches are, Binary Relevance method, Label Power set, Calibration_Label_Ranking and finally the Random_k_Labelset [13, 15]. Results of application of the proposed model using different multi-value method of classification on a given data sets are compared with traditional learning more value, without division into more value data sets. Experiments conducted with Weka and MULAN Libraries using the 10-fold cross-validation methodology.

5 Experimental Evaluation

This section discusses the findings of the evaluation-led experiments. At first it is learned SCV using a class table, and later discovered multiple values using value association data sets instance.MVA classifier learning awareness is contrasted with the traditional methods of multi-valued classifiers. The results obtained on applying in Table 3 to each dataset are described in the following Tables 4.

The generation results are presented in Table 4. The identified results will be used for the classification with the traditional multi-value classifiers. The evaluation results comparison are presents Hamming Loss(HL) in the Table 5 and Accuracy in the Table 6.

Table 4 Number of MVA Pairs identified for the classification

Datasets	Labels	Associated multiple-values	Non-Associated	MVA Classification Pairs
Scenes	6	3	3	8
Birds	19	13	6	38
Bibtext	159	114	45	386

Table 5 Classifier HL performance (The lower the better)

Datasets	*MVA*	BR	*MVA*	LP	*MVA*	CLR	*MVA*	RAkEL
Scenes	***0.0841***	0.0973	*0.0951*	0.1437	*0.0994*	0.1121	*0.1012*	0.0962
Birds	*0.0462*	0.0561	*0.0599*	0.0735	*0.0452*	0.0506	*0.0437*	0.0489
Bibtext	*0.0125*	0.0151	***0.0117***	0.0161	*0.0098*	0.0144	*0.0132*	0.0151

Table 6 Classifier accuracy performance (The higher the better)

Datasets	*MVA*	BR	*MVA*	LP	*MVA*	CLR	*MVA*	RAkEL
Scenes	*0.799*	0.553	***0.839***	0.5893	*0.7918*	0.5265	*0.6247*	0.6841
Birds	*0.6708*	0.4666	*0.7189*	0.5295	***0.7319***	0.528	*0.727*	0.5452
Bibtext	***0.7204***	0.4187	*0.6437*	0.3869	*0.5015*	0.4089	*0.3854*	0.3657

In single-third of instances, we consider changes in measuring results in terms of HL. The difference to either direction is marginal in many situations. The importance of those variations is questionable, but in any case, very significant improvement. In the same way, a significant improvement is observed in determining the accuracy.

6 Conclusion

Multi-Value Association (MVA) approach is proposed in this paper using value association among multiple-values. Firstly, the learning process defines the Single-Class-Value (SCV) that is highly appropriate for class recommendation and in the second stage we consider the other multiple-values that help the SCV to build a class template that's useful for evaluating various classification. We measure the associated value density that has been compared to the produced SC-Table to learn SCV for a case. The contribution made in this proposal will be used for studying different multi-valued datasets. The experiment evaluation shows potential way for learning multi-value for the efficient classification using different algorithm. The statistical values conclude the usefulness and enhancement in the multi-value classification. In future, it can further investigated to exploits the value of association in addition with fuzzy and Bayes factors to get faster and enhancement in multi-value classification.

References

1. Lnc Prakash K, Anuradha K (2017) Optimal feature selection for multivalued attributes using transaction weights as utility scale. In: Proceedings of the second international conference on computational intelligence and informatics, ICCII- 2017, Advances in Intelligent Systems and Computing, vol 712
2. Passent El-Kafrawy M, Amr Sauber M, Khalil A (2015) Multi-label classification for mining big data. In: International conference on advances in big data analytics
3. Kong X, Cao B, Yu PS (2013) Multi- label classification by mining value and instance correlations from heterogeneous information networks. In: Proceedings of the 19th ACM SIGKDD KDD 2013, pp 614–622. ACM, New York
4. Ling Zhang M, Zhou Z.-H (2014) A review on multi- label learning algorithms. IEEE Trans Knowl Data Eng 26(8):1819–1837
5. Prakash K LNC, Anuradha K, Vasumathi Dr V (2016) A survey on clustering techniques for multi- valued data sets. Global J Comput Sci Technol Softw Data Eng 16(1). Version 1.0 Year 2016
6. Ling Zhang M., Wu L (2015) LIFT: multi-label learning with value-specific features. IEEE Trans Pattern Anal Mach Intell 37(1)
7. Rubin TN, Chambers A, Smyth P, Steyvers M (2012) Statistical topic models for multi-label document classification. Mach Learn 88(1–2):157–208
8. Prakash K LNC, Anuradha K (2018) A Laplacian probabilistic graph model for clustering multi-valued datasets. J Adv Res Dyn Control Syst 10(04-Special Issue)
9. Cesa-Bianchi N, Re M, Valentini G (2012) Synergy of multi- label hierarchical ensembles, data fusion, and cost-sensitive methods for gene functional inference. Mach Learn 88(1/2):209–241
10. Chekina L, Gutfreund D, Kontorovich A, Rokach L, Shapira B (2013) Exploiting value dependencies for improved sample complexity. Mach Learn 91(1):1–42
11. Cabral RS, De la Torre F, Costeira JP, Bernardino A (2011) Matrix completion for multi-label image classification. In: Shawe-Taylor J, Zemel RS, Bartlett P, Pereira FCN, Weinberger KQ (eds) Advances in neural information processing systems vol 24, pp 190–198. MIT Press, Cambridge
12. Mitra P, Murthy CA, Pal SK (2002) Unsupervised feature selection using feature similarity. IEEE Trans Pattern Anal Mach Intell 24(3):301–312
13. Read J, Pfahringer B, Holmes G, Frank E (2009) Classifier chains for multi-label classification. In: Proceedings of the ECML PKDD 2009: Part II. Springer, Heidelberg, pp 254–269
14. Tsoumakas G, Zhang ML, Zhou Z-H (2009) Tutorial on learning from multi-label data. In: European conference *on* machine learning and principles and practice of knowledge discovery databases, Bled, Slovenia
15. Tsoumakas G, Katakis I (2007) Multi label classification: an overview. Int J Data Warehouse Min 3:1–13
16. Elisseeff A, Weston J (2002) A kernel method for multi- labelled classification. In: Dietterich TG, Becker S, Ghahramani Z (eds) Advances in neural information processing systems vol 14. MIT Press, Cambridge, pp 681–687
17. Wang M, Zhou X, Chua T-S (2008) Automatic image annotation via local multi-label classification. In: Proceedings of the 7th ACM International Conference on Image Video Retrieval, Niagara Falls, Canada, pp 17–26
18. Barutcuoglu Z, Schapire RE, Troyanskaya OG (2006) Hierarchical multi-label prediction of gene function. Bioinformatics 22(7):830–836
19. Sung Ferng C, Lin H-T (2011) Multi-label classification with error-correcting codes. In: 20th Asian conference on machine learning. pp 281–295. Journal of Machine Learning Research
20. Boutell MR, Shen X, Luo J, Brown CM (2004) Learning multi label scene classification. Pattern Recognit 37(9):1757–1771

21. Read J, Pfahringer B, Holmes G, Frank E (2011) Classifier chains for multi-label classification. Mach Learn 85(3):333–359
22. Sasirekha D, Punitha A (2015) A comprehensive analysis on associative classification in medical datasets. Indian J Sci Tech 8(33). https://doi.org/10.17485/ijst/2015/v8i33/80081
23. Schapire RE, Singer Y (2000) Boostexter: a boosting-based system for text categorization. Mach Learn 39(2/3):135–168
24. Dembczynski K, Waegeman W, Cheng W, Hullermeier E (2010) On value dependence in multi-label classification. In: Workshop proceedings of learning from multi-label data. Citeseer, pp 5–12
25. McCallum A (1999) Multi-label text classification with a mixture model trained by EM. Presented at the AAAI 1999 workshop on text learning, Orlando, FL, USA
26. Tsoumakas G, Spyromitros-Xioufis E, Vilcek J, Vlahavas I (2011) MULAN: a JAVA library for multi- label learning. J Mach Learn Res 12:2411–2414
27. Prakash KLNC, Anuradha K (2017) Clustering multivalued attribute data using transaction weights as utility scale. J Adv Res Dyn Control Syst 9(sp– 18)

Social Media Analytics: Techniques, Tools, Platforms a Comprehensive Review

Ravinder Ahuja, Anupam Lakhanpal, and Surendra Kumar

Abstract To determine which social media analytics tools, techniques, and platforms were developed in recent times, this paper reviews tools, techniques, and platforms related to social media analytics. In this paper, we talk about the tools used to deal with various social media data (social networking, media, etc.). In the past decade, there has been advancement in the technologies used to deal with social media as there has been an increase in the number of people using social media to share information and also the development of the new social media platforms that have let to increase in the amount of data that we have to deal with. Social media platforms have a considerable number of users across the world, which is overgrowing. These people are sharing information through these sources. There is a large quantity of social data comprising of data related to users, videos, web-based relations, and interactions, etc. which needs to be analyzed. Therefore analyzing social media data has become a significant activity for researchers, mainly due to the availability of the web-based API from social media platforms like twitter, facebook [1], Gmail, etc. This has also led to the development of data services, software tools for analyzing social media data. In this paper, there is a detailed review of the leading software tools and techniques that are used for scraping, cleaning, and analyzing social media data.

Keywords Social media · Scraping · Social media platforms · Unstructured data · Data review · Social network

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_122

1 Introduction

Social media is defined as the content that is generated by users through interactions between them, like sharing information in the form of photos, videos, documents, and expressing their views through comments. This technology has helped users to put out their information to the greater world in many different forms. There has been a rapid increase in the number of users of social networking sites. We will be using the general term - social media instead of social networking sites as this will include social networking sites and RSS feeds, blogs, and news sources. The data is being analyzed by researchers at an increasing rate. Subject areas like anthropology, psychology, linguistics, and medicine are being researched using social media data. This data has also provided advantages to artists, authors, and journalists. Such varied fields using social media data demonstrates its value.

So, to deal with this data, there has been the development of various data services, tools, and techniques. However, the problem faced in the research of this field is that many social media platforms do not provide their data quickly as they have partnered with the companies that provide limited access to their data after paying them. Social media offers many benefits to business owners, as it allows them to satisfy their customers and also to increase their customer base. There is a wide range of tools that are available to the business corporations that will enable them to extract data from the social media platforms and gain valuable insights into what is the social standing of their brand and plan what needs to be done in the near future.

1.1 Terminology

Now we talk about technologies helping to analyze unstructured data:

- Text mining [2, 3]: the process of analyzing unstructured, amorphous, and complicated text to extract useful information by devising patterns with methods like statistical pattern learning. Text is the standard method for the exchange of information.
- Natural language processing: natural language processing (NLP) [4–6] deals with how computers understand human languages. It is a field that is studied in computer science, artificial intelligence, and computational linguistics.
- Artificial intelligence: AI [7–9] diagnostic methods measure trends and business scenarios by analyzing data in the past. It has also been used for research in industries like medicine, robot control, defense, and remote sensing industries.
- Machine learning: It is used for processing of a large amount of data customer data like chats, calls, and emails. Companies can analyze a large amount of data without reducing the accuracy of the result due to the ability to handle large amounts of data by machine learning [10]. It is being used to construct a view of clients to build the next best offer by the companies.

- Sentiment analytics [11]: using social media and cutting-edge algorithms, analysts are able to decode interactions between humans and have come up with languages to understand customer conversation. Algorithms and computational models can also be used by movie directors to tap into the mindset of the audience so as to produce a script with the most impact.
- High-performance computing: most of the organization's data is unstructured due to which boundaries between analysis and computation is blurred. It can handle a large amount of data in real-time. There is a large amount of unstructured data with an ever-increasing speed, which makes the companies move away from traditional computing systems. The sophisticated algorithm that is developing these days requires to be executed with higher computing power (higher processing rates) to be effective.

1.2 Research Challenges

Social media analytics provides many challenges to social and computer scientists and funding organizations. These problems are:

- Too much qualitative data: if there are large numbers of views about a company's product, it is difficult for them to learn the sentiment. Applications are there that can automatically guess the emotion. But, to get a better view, one has to analyze deeply so as to obtain a better solution. This is a time-consuming task.
- Visualization: it is another important element involved in developing insights that matter. Graphical interpretations of values are necessary for making decisions with real-time data, but to obtain deeper insights, we need to use more complex algorithms and models during visualization.
- Increasing noise: there is noise in social media data. Reducing noise, too, is a challenging task in real-time. Analytical tools need time to obtain meaningful information from social networks, but there are only a few tools that can handle data in real-time.
- Scraping: APIs provided by social media platforms are used for accessing social media data, but there are many platforms that are making this task difficult. These platforms have partnered with companies that provide access to their data by paying the fee. One such platform is twitter, which allows access to its public and historical data through the application process.
- The proliferation of tools: no single tool can answer all your questions and support all your analysis. Multiple devices are needed to support all the analysis. A unique tool alone cannot do all the work. These tools should work together to get data. Experiment and tracking of more latest tools are required.
- Data cleansing: with a large amount of data, judging quality within a reasonable amount of time is a difficult task. Also, cleansing of the unstructured data presents numerous problems.

- Data protection: data that is obtained from social media needs to be secured so that it cannot be accessed by anyone. Users should be given a different level of access so that they cannot view all the valuable data that is stored in the database.
- Data analytics: social media data analytics faces various challenges like the use of different languages, words, and spelling errors that need to be dealt with while analyzing data.

2 Social Media Analytics Techniques

2.1 Analytics Techniques

Sentiment analysis [11] uses machine learning techniques such as latent semantic analysis [16], support vector machines, and semantic orientation for digital text. Methods employ broad areas such as:

2.2 Computational Science Techniques

- Machine learning technique: it is the process of teaching knowledge [17] to any machine to learn about a system with a set of input variables and the desired output. Machine learning [18] can be employed in order to carry out and produce results as part of predictive analytics. Machine learning techniques are classified under the categories of the decision tree, linear and logistic regression-based, and neural network-based. It is helpful in processing massive datasets obtained from social networks during critical decision making. The essential aspect of any machine learning technique is iteration that makes the system independently adapt to new sets of input as they are being subjected to a variety of datasets. There has been a revolution in the machine learning domain due to the advent of technologies like big data. The complex mathematical calculation can be used for substantial heterogeneous datasets. Machine learning algorithms that play a significant role in social media analysis include decision tree learning, naïve Bayes, nearest neighbor classifier, maximum entropy method, dynamic language model classifier, linear regression, logistic regression, simple logistic classifier, and multilayer preceptor.

2.3 Deep Analytics

It involves the use of data mining [21] so as to extract useful information from massive data sets. It is helpful to deal with targeted or highly complex queries with unstructured and semi-structured data. The financial sector, the scientific community, the pharmaceutical industry, and biomedical industries use analytics frequently. Deep analytics is also being used by enterprises and firms needing business data from expansive sets of consumer data.

2.4 Sentiment Analysis

Sentiment analysis is achieved by two methods: 1) sentiment analysis based on supervised machine learning technique, 2) sentiment analysis by using the lexicon-based technique.

Machine learning based on sentiment analysis or categorization can be performed in two ways: 1) sentiment analysis with the help of supervised machine learning techniques and 2) sentiment analysis by using unsupervised machine learning techniques [16]. Two types of data sets are required for this technique: training and test dataset. Categorization factors of the document from the training set are learned by the automatic classifier, and the test dataset is used for evaluating accuracy in classification. Various machine learning algorithms used to classify the documents are support vector machine (SVM), naive Bayes (nb), and maximum entropy (me). These algorithms are widely used as they provide better output for sentiment classification. The initial step is to select the training set and then choose the suitable classifier. After selecting the classifier, it gets trained with the help of the collected training set. The primary step of this technique is feature selection.

2.5 Lexicon Based Methods

It is an unsupervised approach as it does not need a prior training dataset. In this method, features of sentiment polarity are determined by comparing these with semantic lexicons. The semantic lexicon consists of words with their sentiment orientation already known. Documents are classified by combining sentiment orientation of all opinion words in the text. The material with higher positive word lexicons is categorized as positive, while those with more negative word lexicons are classified as a negative document.

2.6 Data Reduction Techniques

- *Basic coding:* Developing and applying a series of "structural" codes to the data is the method that is used to construct manageable datasets for content analysis. The structural system refers to question-based codes, and this approach works for data collected using structured or semi-structured interviews. The problem and its associated solutions are assigned a code that is then linked to the problem and succeeding response texts in each data file. It is used as a labeling and indexing device that helps researchers to have faster access to the relevant data of a bigger dataset. In this way, the analysis of data is more efficient. Structural codes are helpful in combining data related to the development of data-driven systems, but as they are built without consulting the data, these codes are not data-driven. Large pieces of text on broad topics are identified by structural coding, which forms the basis for an in-depth analysis.
- *Graph-theoretic data reduction techniques:* These techniques use the graph to show the relationship between semantic items using co-occurrence matrices as input. Software programs for the statistical analysis of qualitative data allow models to be analyzed with higher precision. The standard graph-theoretic techniques are multidimensional scaling and hierarchical cluster analysis. They provide a wider, more complete view. These methods recognize the "structures" of categories that fit a group of observations. These techniques permit the analyst to discover the "natural groupings" within the data set instead of beginning with emerging categorical structures and filling them with data. An important technique is constituted by these approaches that help to produce hypotheses about relationships that exist between concepts or ideas or confirm initial ideas about how the data fit together.
- *Hierarchical clustering techniques:* It is a method that discovers clusters of observations in the dataset. It sorts data into groups so as to increase the natural association between members of the same group and decrease between those of different groups. Qualitative data needs to be displayed using similarity matrices by the analyst before performing cluster analysis. A similarity matrix is used to express numerical distances between data points. There are two types of these matrices - binary and valued. Word count, pile sort, and code frequencies are sources of data for these matrices depending upon which item best addresses the analysis objectives. Researchers are able to recognize a pattern in large data sets using these matrices. Cautious selection of the words to be incorporated in this case helps to redefine context to be included in a similarity matrix.

3 Social Media Analytics Tools

Textual analytics can be performed by many devices. Some of these are open-source while some are not. This part is focused on tools used for analytics. The usage of the tools is different depending upon the needs of the people. Tools used for social media analytics are -:

- Social Mention - it is a search platform. It helps the companies to record and analyze the feedback of the customers about their new product and also any topic in real-time. Twitter, Facebook [14], youtube, Digg, google are monitored by this tool simultaneously.
- Mention - these tools helps to extract data in various languages from social networks (Facebook, Gmail, etc.), news sites, and another web page so that every person will get data in their native language. Social accounts can be connected using this tool, and it helps in reacting without leaving the application. Push notifications are used by it to alert the users.
- Topsy - a real-time search engine powered by the social web that helps in indexing and ranking of search results influenced by the conversations of people going around the world about specific terms, topics, pages, or domain queried.
- Sprout Social - areas of focus of this tool are engagement, publishing, and reporting (analytics). It helps in tracking the activity owned in a great deal of depth. Providing scores for websites like twitter and WhatsApp is one of its particular features, providing information on how effectively people are communicating with their communities.
- Tailwind - major features include finding industry-specific conversations and also to analyze growth in the form of followers, retweet, and likes. It is reliable in terms of optimizing content and setting a benchmark for fan engagement levels against competitors.
- Crowd booster - natural navigation of this tool helps companies to get instant visual feedback regarding its performance. It can be used to count a number of likes, reviews, repins, retweets in real-time.
- Social bakers - this tool helps companies like WhatsApp, twitter [17], Gmail, LinkedIn, youtube, and yahoo to evaluate the success of their social media activity. Industrial and regional benchmarking is allowed by this tool, and one can monitor and analyze anything without the needs of admin rights.
- Gephi - this tool is used by data analysts [12] and scientists to explore and understand graphs. It allows the user to communicate with representation, manipulating the structures, shapes, and sizes to reveal secret patterns. The tool helps data analysts to conclude and identify trends, separate structure singularities, or faults during data sourcing. Interactive interfaces, along with visual thinking, are recognized to facilitate reasoning. This tool is used as a complementary tool to traditional statistics.
- Pajek - it is a program to analyze and visualize networks with a large number of vertices. After investigating, it was concluded that there are many sources of large systems that are already in the machine [13] -readable form. It provides

tools for analysis and visualization of networks such as collaboration networks, organic molecules in chemistry, protein-receptor interaction, genealogies, internet, citation, diffusion networks, data-mining [20], etc.

- Geoda - it manages spatial data analysis, geo-visualization, spatial autocorrelation, and spatial modeling. It has the capability to perform spatial analysis, multivariate exploratory data analysis, and global and local spatial autocorrelation. It also performs basic linear regression. Both the spatial lag model and the spatial error model are included in the spatial models estimated by maximum likelihood.
- Kmine: it is a data analytics, reporting, and integration platform. Components for machine learning and data mining are integrated using its modular data pipelining concept. A GUI is used for the gathering of nodes for data pre-processing, modeling, data analysis, and visualization.

4 Social Media Analytics Platform

In this section, we look at the social media platforms that provide data through APIs for the analysis. The social media platforms usually include blogs, a news feed, and social networking sites. These are the platforms that are used by millions of people to communicate with each other, share things, and express their views. The data generated on these platforms is useful for companies to know the opinions of people about them and their products. Also, the researchers can use this data for their study. The different social media platforms are:

4.1 News Platforms

Computers read real-time news to provide automatically key indicators and meaningful insights. These indicators enhance quantitative strategies, risk management, and decision making. Specific examples are Thomson Reuters, machine-readable news, alpha flash, etc. They use natural language processing [19] to store items of companies and energy topics.

A set of content APIs is provided by users that are used to get useful information on various categories like books, movies, and music reviews, census data, and articles. There are several other categories that can be accessed with a non-commercial license. These APIs provide us with data in the current decade. One-liners can be accessed from a broader range of classification, which includes trending as well as a community of many blogs, but full-text feeds aren't currently offered.

4.2 Social Network Media Platforms

There are many social networking sites that are available these days for users to share information and express their views about a particular topic. Here we discuss the various social networking sites that provide their data through apis. Table 1 above shows details about these social networking sites that are being used widely.

- GetGlue: this social networking service is used by the users to "check-in," share videos and television series they are watching. API provided by getting glue allows users to access information from it. Some example API methods include checking in, liking or disliking an object, accessing user information, searching by categories, adding friends to the user's network, and much more.
- Instagram: API provided by Instagram allows the user to explore user info, images, videos, likes, comments, tags. It also allows the user to like and comment upon specific media. A person can search for media filtered by location and time. Uploading media is a functionality that is also supported. API endpoints documentation contains detail about the full functionality of the API that can be used by the user. Instagram API can be used to make two API calls: unauthenticated and authenticated. Unauthenticated API calls only need the client id, and authenticated API calls use OAuth, specifically OAuth 2.0.
- Pinterest: just as people pin things on bulletin boards, they can "pin" things online using Pinterest. These pins are on user account so that they can be accessed easily. Pinterest uses a restful API to provide access to users' data, like their boards, pins, followers, and more. The Pinterest API uses OAuth to authorize the application and allows both read and write permissions when interacting with a user's content.
- Twitter: social networking website which allows its users to broadcast tweets and follow other users' tweets. By default, twitter setting is public. Twitter's tweets are in JSON format, and its search API used to retrieve the tweets.

Table 1 Various social media tools

Social media tools	Launch date	Founder(s)
Mention	April, 2012	Eduoard de la,Jonquiere,Arnaud le Blanc, Didier Forest, Quentin Nickmans
Social Mention	September 2008	Jon Cianciullo
Topsy	2007	Vipul Ved Prakash, Rishab Aiyer Ghosh, Gary Iwatani, Justin Fouts
Sprout Social	2010	Justyn Howard, Aron Rankin, Gil Lara, PeterSoung
CrowdBooster	April 2010	David Tran, Mark Linsey, Ricky Yean
Social Bakers	October, 2008	Jan Rezab, Lukas Maxiner, Martin Homolka
Gephi	July 2008	Students of the University of Technology of Compiegne
Kmine	January 2004	Software Engineers at University of Konstanz

Table 2 Various social media platforms

Social media platform	Launch date	Founded By
GetGlue	June 2010	i.TV, LLC
Instagram	October 2010	Kevin Systrom & Mike Kreiger
Google Plus	December 2011	Google
Pinterest	March 2010	Paul Sciarra, Evan Sharp and Ben Sibermann
Twitter [15]	March 2006	Jack Dorsey, Noah Glass, Biz Stone, Evan Williams
Tumblr	February 2007	Davin Karp

This API used for batch requests of previous data and streaming API used to retrieve nearby real-time data.

- Search API: it used to search tweets with a particular keyword. It is a module of the twitter rest API v1.1 and requires an authorized application before fetching results from the API.
- Streaming API - a real-time stream of tweets, filtered by user id, keyword, geographic location or random sampling.
- Tumblr: a social platform that allows users to share text, photos, audio/video. Blog posts, posted media, information about users and metadata about blog titles, etc. can be retrieved using the API. The API does not allow the content to be searched. The URLs of the blogs being searched need to be known (Table 2).

5 Conclusion

There is a vast amount of data that is available on the web, and tools and techniques are required to analyze this data so that it can be useful for the organization to develop their plan. Today the company which is not using social media data for the improvement of its practices is way behind other companies. In this paper, we discussed the tools and techniques that can be used to gain deep insights from the data. Social media platforms are also being developed day by day, which is making it more important for organizations to shift to a data analytics approach. Many social media sites have their data available through APIs while there are still many which do not allow their data to be freely accessed so as to monetize their content. So this is an essential concern as the researchers need to have access to social media data for experimentation.

The research in this area is not over and still needs to be done to discover new tools and techniques that can make the analysis of social media data easier.

References

1. Alm CO, Roth D, Sproat R (2005) Emotions from the text: machine learning for text-based emotion prediction. In: Proceedings of the conference on human language technology and empirical methods in natural language processing. Association for Computational Linguistics, pp 579–586

2. Harabagiu S, Hickl A, Lacatusu F (2006) Negation, contrast and contradiction in text processing. AAAI 6:755–762
3. Karthik P, Saurabh M, Chandrasekhar U (2016) Classification of text documents using association rule mining with critical relative support based pruning. In: 2016 International Conference on Advances in Computing, Communications and Informatics (ICACCI). IEEE, pp 1219–1223
4. Hanni AR, Patil MM, Patil PM (2016) Summarization of customer reviews for a product on a website using natural language processing. In: 2016 International Conference on Advances in Computing, Communications and Informatics (ICACCI). IEEE, pp 2280–2285
5. Liu CC, Stefanov A, Hong J (2016) Artificial intelligence and computational intelligence: a challenge for power system engineers. In: Advanced Solutions in Power Systems: HVDC, FACTS, and Artificial Intelligence, pp. 721–729 (2016)
6. Chen JH, Huang CW, Cheng CW (2016) The monitoring system of Business support system with emergency prediction based on machine learning approach. In: 2016 18th Asia-Pacific Network Operations and Management Symposium (APNOMS). IEEE, pp 1–4
7. Singh PK, Sachdeva A, Mahajan D, Pande N, Sharma A (2014) An approach towards feature specific opinion mining and sentimental analysis across e-commerce websites. In: 5th International Conference-Confluence The Next Generation Information Technology Summit (Confluence). IEEE, pp 329–335
8. Rodrigues AK, Batista TV, Moraes RM, Machado LS (2016) A new exponential Naive Bayes classifier with fuzzy parameters. In: 2016 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE). IEEE, pp 1188–1194
9. Tong L, Li Y, Gao W (2016) A hierarchical edge cloud architecture for mobile computing. In: IEEE INFOCOM 2016-The 35th Annual IEEE International Conference on Computer Communications. IEEE, pp 1–9
10. Yaqi W, Yonghai X, Jinhao W (2016) The maximum entropy probability distribution and the improvement of its solving method for negative sequence current of a traction substation. In: 2016 China International Conference on Electricity Distribution (CICED). IEEE, pp 1–5
11. Hu T, Wang T, Li J, Wang X, Zhu X (2016) Binary linear regression and statistical learning of behavior model for human teleoperator. In: 2016 IEEE International Conference on Mechatronics and Automation. IEEE, pp 1113–1118
12. Jindal A, Kumar N, Singh M (2018) A unified framework for big data acquisition, storage, and analytics for demand response management in smart cities. In: Future Generation Computer Systems
13. De Bie T, Lijffijt J, Mesnage C, Santos-Rodríguez R (2016) Detecting trends in twitter time series. In: 2016 IEEE 26th International Workshop on Machine Learning for Signal Processing (MLSP). IEEE, pp 1–6
14. Thangaraj M, Amutha S (2018) Mgephi: modified gephi for effective social network analysis. Int J Sci Res Comput Sci Eng Inf Technol 3(1):39–50
15. Pandey K, Mittal A (2016) User profiling on Tumblr through blog posts. In: 2016 International Conference on Computational Techniques in Information and Communication Technologies (ICCTICT). IEEE, pp 85–89
16. Costa BSJ, Bezerra CG, Guedes LA, Angelov PP (2016) Unsupervised classification of data streams based on typicality and eccentricity data analytics. In: 2016 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE). IEEE, pp 58–63
17. Robak S, Bogdan F, Marcin R (2016) Business process optimization with big data analytics under consideration of privacy. In: 2016 Federated Conference on Computer Science and Information Systems (FedCSIS). IEEE, pp 1199–1204
18. Vilic A, Petersen JA, Hoppe K, Sorensen HB (2016) Visualizing patient journals by combining vital signs monitoring and natural language processing. In: 2016 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC). IEEE, pp 2529–2532

19. Han D, Ohno T (2016) A case study on experimental-data validation for natural language processing. In: 2016 11th International Conference on Computer Science & Education (ICCSE). IEEE, pp 165–168
20. Brindha S., Prabha K, Sukumaran S (2016) A survey on classification techniques for text mining. In: 2016 3rd International Conference on Advanced Computing and Communication Systems (ICACCS), vol 1. IEEE, pp 1–5
21. Dastanwala PB, Patel V (2016) A review on social audience identification on twitter using text mining methods. In: 2016 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET). IEEE, pp 1917–1920

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A Novel Approach for Detecting Near-Duplicate Web Documents by Considering Images, Text, Size of the Document and Domain

M. Bhavani, V. A. Narayana, and Gaddameedi Sreevani

Abstract Web mining is a part of data mining in which the web consists of enormous amount of data. The search engines faces large amount of problems due to the presence of Near duplicate documents in web which leads to irrelevant answers. The performance and reliability of search engines are critically affecting since the near duplicate documents present in web. For detection of near duplicate web documents two attempts are found in the literature. The former considered domain and size of the document and the later considered text and image as the search parameters. This article proposes a novel approach combining the parameters such as text, image, size and domain of the document to detect near duplicate documents. The approach extracts the keywords and images of the crawled document and compares them with the existing documents for similarity measure. If the similarity score measure value is less than 19.5 and image comparison value is greater than 70%, then it is detected as near duplicate document.

Keywords Duplicate · Near-duplicate · Text · Images

1 Introduction

There are more number of multiple copies of same content in the web. Due to the enormous amount of information the search engines faces large problems in which it leads to irrelevant answers. To overcome this replicate and near replicate documents have produced an extra information for search engines by considering their presentation.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_123

Web Mining:
Web burrowing is a part of data digging technique to clipping the information from web. It burrow the web papers and discovering the patterns from it. Web mining is mainly divided into 3 categories such as follows,

Web Content Mining:
Web content mining can be used for gathering valuable information from web. Web content consists of several types of data text, image, audio etc. It accommodate the effective and interesting patterns about user requirements.

Web Usage Mining:
Web utilization mining is the function of data mining means to find out interest usage patterns from web data in order to enhanced understanding of retrieval information.

Web Crawler:
Web crawler is an automated program which is used to extract the information from web. Web consists of large number of multiple copies of similar content. Web crawler is used to extracting the documents and its information from web by using various URL's or websites.

Web Structure Mining:
Web architecture mining is a process of discovering structure report from web. The main aim of web architecture mining is to make structural outline about websites and web pages. In which the structure mining involves the focus on link information which is essential aspect of web.

String Tokenization:
String tokenization is a process of dividing sentences into small tokens is called as string tokenization. In which token is a sentence of paragraph or word is a token of sentence.

Stop Words Elimination:
In natural language processing useless words are presented that we call it as stop words. The commonly used stop words such as ("the, as, a, an, in).

Stemming:
Stemming is a procedure to reduce a word into one or more stems. In stemming two words are occurred from same root word not different stems, Stemming is used in information retrieval systems such as search engines: Google, chrome, fire fox etc.

For Example:
takes, taking → take
buying, bought → buy
writes, writing, wrote → write

2 Literature Survey

Liu, Yue Lu, and Ching Y. Suen [1]:- The changeable time-span name is used for detecting near-replicate picture matching. In this approach an image represented by a signature., means image is depend on the signature. An image which consists of large number of patches, the span of the name is vary based on the number of patches presented in the image to find out the correspondence between two images, we can use the soil mover's detachment which is good at handling variable-length signatures. In this paper they proposed two dissimilar applications such as near duplicate document image recovery and near-duplicate usual picture detection. In which a new chart descriptor is named as PCS LBP is then presented to distinguish the manifestation of each patch in the image.

Amruta Landge, pranoti Mane [2]: Near replica photo recognition requires the mapping of a small piece authentic image to the innovative image. Which will be useful in recognition of forged images. In which digital images are changed and adapted outstanding to the great performance of image processing software.

Junping Qiu, Qian Zeng [3]: Web consists of massive amount of data. In which the search engines plays a main role because the users can access information from search engines. That's why we said that browser is vital device for users. Web consist of more number of replicate and near- replicate documents added then customers face load presently search engines only remove replica pages, but detection of non replica pages is a hard task. So detection of near duplicates pages reduce the search space and time complexity of the users.

Arun PR, Sumesh MS [4]: Nowaday's people are very interested to use the internet. In heterogeneous platform the web contains millions of web pages. Near replica pages in the internet are increased due to the absence of standard mechanism. The context of near replica pages can be presented by intentional or accidental. The database can involve the subject of research in which the main task is identifying the near replica pages. In which the information burrowing method collected phrase established procedure, an issue of conversation synonym and big number of comparison. In this paper they proposed a phase efficient method for identifying the near replicas using 1. Sentence level Features, 2. Words mapping technique, 3. Term document weighting scheme and 4. Modified simhash technique.

Rasia Naseem, Sheena Anees, Muneer K, Syed Farook K [5]: Near duplicate webpages are pages in which the content of pages are distinct only some extent. Detection of near duplicate documents in a large database is an important problem with wide spread applications. In this they proposed a four level algorithm for locating close to duplicates of an input web site from a big repository. The proposed phrase is term document weight (TDM) matrix based calculation for four stages as 1) preprocessing 2) Feature weighting 3) Filtering and 4) verification.

*Yang Hu*1*, Mingjing Li*2, *Nenghai Yu*1 [6]: In this methodology a novel plan is proposed for detecting near duplicate images. Which is a huge problem in variety of applications. Content material primarily based photo retrieval an image should be

much like the question photo in infinitely numerous approaches, in which close to reproduction pictures deviate from the reference image are very constrained. Based totally in this statement theyb are proposed to apply examplar close to duplicates which can be acquired routinely to improve the overall performance of examplar near duplicate image retrieval.

Burak Yıldız, M. Fatih Demirc*i* [7]: Near duplicate image detection is important in two cases such as 1. The query time decreases reasonably Using the various subset of the interest points for near duplicate detection better than the ordinary subsets. In this journal they designed a new interest point section method. In this technique the particular subset is made with a thickness map which is calculated from the interest points to rank them.

Manni Duan, Xing Xie, Xiuqing Wu, Wei-Ying M [8]: Bag of words model is the most popular technique for recognition of near duplicate image retrieval. In which near duplicate image retrieval task is to find all images that are duplicated or near duplicated to a query image. In this paper they proposed a weighting method for distance based co-location visual patterns. In which view the usage of TF-IDF respectively in this weighting function.

Lei Wu, ing Liu, Nenghai Yu, Mingjing Li [9]: Near reproduction picture detection is a hard assignment in copyright safety. It is a challenging task than the common similarity search, In which it calls for no longer most effective the peak similar images but also the whole near replica group from the internet. The ordinary parallel investigate algorithms are not able to agree to the second demand. This document designed the question adapt subspace shifting algorithm. In which the adaptive threshold value is produced consequently to filter the near duplicates in each subspace.

Zhonghua Sun, Chun Wang, Kebin Jia [10]: Near duplicate. Video is described as an equal video, but as a transformed video such as body exceptional degradation. In which there are increasingly more challenging task. In this paper a video fingerprinting based scheme is proposed to detect the close to reproduction video-clips. Number of near duplicate video clips are spread over the web, which could cause the problem of reduce the retrieval efficiency but also wastes the network bandwidth and storage space. For effective and efficient detection of near duplicate video clips become a challenging Video finger print includes motion features such as movement size and movement action.

V.A. Narayana, Sreevani Gaddameedhi, Vijaya Kumar Koppula, K. Srujan raju [11]: To identify the duplicate or Near replica pix or picture unwanted mail's within an image collection by using high-recognizable picture sections. In which image distances are recognized. picture spans with at least one idiosyncratic topography in common, the idio syncratic topographics Photo span is connected to modify conform or not the pair is duplicate or near duplicate.

Yahao He, Jin Gao [12]: Detection of short near duplicates is a fundamental job in data recovery system. In this paper they proposed a novel semantics-encoded technique to improve word semantic representation learning and apply it on improved hash strategy to detect short near duplicates. In this evaluate the model in SICK dataset and shows the result.

Qinsheng Du, Wei Liu, Guolin Li and Yonglin Tang [13]: Near duplicate detection problem is broadly existed in the real world. This paper proposed a vector based calculation to recognize near duplicate in MapReduce. In which given a text set and a similarity threshold. The calculation can restore the comparability combines whose likeness degree is not exactly the edge. Depend on the experimental results the real datasets shows that the algorithm is effective.

Xidao Luan, Yuxiang Xie, Yanming Guo, Jingmeng He, Lili Zhang, Xin Zhang [14]: The quicker near duplicate detection is one of the problem area in the field video examination. The conventional neighborhood feature based near reproduction keyframe detection methods have a few shortcomings such as excessive complexity and problem in actual time applications. Fast near duplicates can be detected by combining the strategies of quick and concise is planned in this document.

Tang-You Chang1, Shen-Chuan Tai1, Guo-Shiang Lin [15]: Based on invariant features a near duplicate video recovery technique was created. After change detection, zernike moments are extracted as of every edge of video because invarious features. The Key body similarity by means of computing the distinction of zernike moments among key frames of the query and check films. To gain near duplicate video retrieval every key body is taken into consideration as an man or woman sensor and then comparing all of keyframes is careful as several sensors.

Chien-Li Chou, Hua-Tsung Chen, Suh-Yin Lee [16]: This paper introduce a spatiotemporal example based methodology under the various leveled channel and refine frame work for near replica film recovery and determination. Model based indexing tree is proposed in this filter stage to efficiently filter Out non close to duplicate videos and considerably reduce the search space.

Harbin, P.R.China [17]: picture close to replication finding and recovery be together helpful techniques in a variety of functions. In this paper there are few identifiers are existed which is having both usefulness and competence in IND finding and recovery such as extent Invariable aspect change (SIFT) detector and histograms of oriented gradients (HOG) detector. This paper proposes a technique for looking through any book from various books dependent on IND retrieval. one of the application is choosing a book from a few comparative once. means consumer can take photos of any book they want to include a universal thought of by their cellphones to get few fundamental in sequence by probing the equivalent book.

Merih Seran Uysal, Christian Beecks, Daniel Sabinasz, and Thomas Seidl M. Vidyulatha, V.A. Narayana [18]: close to copy web archives are bountiful. Two such records vary from one another in a little bit that shows promotions such contrasts are insignificant for web search. The search engines faces large amount of problems for giving relevant answers for user queries due to the vast amount of data presented in the web. The performance and reliability of search engines are crucially effecting since the duplicate and near duplicate web documents are presented in web. Narayana et al proposed an approach. A Novel and efficient approach for near duplicate page detection in web crawling. In this perspective at first the keywords are extracted from the crawled web pages and the similarity score between two pages is calculated based on extracted keywords. There after the

similarity score is calculated with documents which are belonging to that particular domain only. This approach reduces search space there by reducing the search time. This paper examines the effectiveness of various space based correspondence calculate with mover's distance(EMD), and the recently introduced self-governing minimization for marks on enormous-scale signature databases. They conduct experiments on eight different databases constitute near duplicate video cuts created through different alter undertakings. Near duplicate video signatures generated via several film change odd jobs. Near duplicate video signatures generated via numerous video edit tasks.

Ichiro Ide, Yuji shamoto [19]: This paper proposed a grouping technique for NDVS depend on their appearance patterns. Although some classes were well classified unexpected contents such as a teleshopping program. This result indicates that we need to define more classes that were not considered in this paper.

Merih Seran Uysal, Christian Beecks, Daniel Sabinasz, and Thomas Seidl [20]: In this paper recently introduced a new independent minimization technique for signatures on major mark databases. They perform experiments on eight distinct databases establish close to replica videotape clips produced via various edit tasks. In which examines the effectiveness of various distance based similarity measure with Earth Mover's Distance(EMD).

Xiao Niu, Yuxiang Xie, Chen Li, Xidao Luan [21]: The exponential growth of online videos forces urgent requests on close copy video location. Near duplicate keyframe recognition is at the base of near duplicate video recognition. In this paper, in view of the examination of the cutting edge of close copy keyframe location, Dim Scale Pyramid (GSP) is handled for improving the worldwide highlight of shading histogram. By building the spatial pyramid of luminance and cutting range, the calculation upgrades light and cutting scale change heartiness of world wide include.

Gurmeet Singh Manku [22]: The near duplicate documents means the web consists of multiple copies of similar content for some extent. In this paper the main goal of the project is to detect the near duplicate documents. To detecting the near duplicate documents the singh make two contributions such as 1. Charikar's handle printing method which is suitable meant for this target. 2. current on algorithmic method designed for recognizing obtainable f-bit fingerprints.

V.A. Narayana, P. Premchand, A. Govardhan [23]: In this paper Dr V.A. Narayana proposed a NPG standard strategy for detecting near duplicate documents. Firstly crawle the document from web and extracting the keywords from crawled document and comparing them with the existing documents and find out the similarity score measure value (ssm threshold value: 19.5). If ssm < 19.5 then it is detected as near duplicate documents other wise it is not detected as near duplicate documents.

V.A. Narayana, Premchand, Govardhan [24]: The web contains enormous amount of data. The search engines face critical problems due to the large amount of data presented in web. To avoid this problem this paper obtainable an well-organized advance for the identification of close to replica documents In net crawling which makes use of key phrases and distance measure. In this paper

implemented the both Techniques and conducted an comparative study among similarity rating based method and G.S. Manku et al. mark established advance. The results are considered in the form of point difficulty, recollection usage and the uncertainty template parameters.

Bingfeng Pi, Shunkai Fu, Weilei Wang, and Song Han [25]: Detecting near duplicates with in big Repository of short message is understood as challenging task. In this document talk about the actual trouble occurred in a actual function and attempt to find out the appropriate method to crack this trouble. This paper Evaluate how SimHash works, and its possible deserves for finding near-duplicates. Finally, display a chain of findings, inclusive of the hassle itself and the benefits introduced by means of SimHash-based totally technique, based totally on experiments with 500 hundreds of real short messages crawled from Internet. Removing each reproduction and near replica contents has some blessings especially in mobile programs include allow greater beneficial information to give on the small display screen, keep the time and bandwidth and decrease the garage requirement.

Caichun Gong, Yulan Huang, Xueqi Cheng, Shuo Bai [26]: Near-replicates are rich in small content directory. Recognizing and rejecting the near duplicate documents is the great importance. In which simfinder proposed a quick machine to recognize every near duplicate in great range small content databases. SimFinder generates several fingerprints for every textual content, and best texts with at the least one fingerprint in not unusual are in comparison with every other. Simfinder is An effective solution for brief text duplicate detection with nearly linear time and storage complexity.

Rajendra Kumar Roul, Sahil Mittal, Pravin Joshi [27]: There are huge quantity of replica network papers. In this paper they proposed an approach combine the two strategies such as Duplicate detection algorithms like Shingling and Simhash to stumble on and put off near duplicate net pages even as thinking about some vital factors like word order. It employs Latent Semantic Indexing (LSI) to locate conceptually comparable files which can be often no longer detected by way of textual based reproduction detection techniques like Shingling and Simhash. In this paper apply the hamming distance and cosine similarity between two files as their similarity measure. The F measure of proposed method is as compared with the traditional simhash approach.

J. Prasanna Kumar, P. Govindarajulu [28]: replica and near duplicates network papers are the leading Concerns for internet search engines like google and yahoo. To find out the close to replica web pages to use the Sentence level capabilities along with fingerprinting method. Whenever a huge variety of documents are taken into Consideration for the detection of internet pages at the beginning use k-mode clustering and sequently Sentence feature and fingerprint comparison is used. By following the above steps Sentence characteristic and fingerprint evaluation is used.

Sravanthi, Dr. V.A. Narayana [29]: The performance and reliability of search engines face critical problems due to the presence of duplicate and near duplicate documents which leads to irrelevant answer. To detect The near replica report by considering both document text and image. Crawle the document and separate the image and text data and stored it in different tables. Extracting the keywords and

images from the crawled document and compare with existing documents. If ssm value <19.5&& image score value >70% then it is detected as near duplicate documents else it is not detected an near duplicate documents. This is the best approach for detecting near duplicate documents compare to above papers.

V.A. Narayana, Zaheer [30]: In this paper The primary purpose of this task is to detect near duplicate documents by considering both the domain and size of the document. The first step is Crawle the document from web and find out the document domain which it belongs to and extract the keywords from document and compare them with existing one. The ssm value of the documents greater than the threshold value then it is not detected as near duplicate document otherwise it is detected as near duplicate documents. This is better approach for compare to above papers.

Lavanya Pamulapartya, Dr. C.V Guru Raob, Dr. M. Sreenivasa Raoc [31]: The web contains huge amount of data which cause large number of problems because near duplicate documents are presented in web. To avoid this problem to recognize the near replica documents. In which there are two algorithms are designed to recognize and handling the near replicate documents. the first algorithm is 1. Unsupervised probabilistic clustering of documents 2. Detect near duplicate documents that can handle in offline processing of search engines. By doing of this the performance and reliability of search engines amy increase. In this paper proposed a frame work named as extensible near Replica detection framework(XNDDF). Which gives special additives that offer room for bendy replica detection solutions consists of viewing offline and online processing required by means of a seek engine. In destiny can be implement framework components through a prototype programs.

Phuc-Tran Ho1 and Sung-Ryul Kim2 [32]:

Social networking is widely used by millions of people around the world. Nowaday's people are communicate with each other in online. Presently there are many social networking websites such as facebook, twitter, youtube, instagram with a large number of active users. Recently many proposed methods are implemented to come across junk mail feedback on social network with various types of methods. In which the paper proposed a similarity method which combines the Fingerprinting approach with trie-tree datastructure And meet inside the center technique in order to achieve a higher accuracy in junk mail detection. By the use of proposed approach capable of locate around ninety eight % of spam comments in dataset.

3 Methodology

Similarity Score Estimation

From the once more crept web archive, if the main 10 watchwords are not associated with the catchphrases of the as of now slithered reports, again add to the vault. In the event that the catchphrases of the crept declaration are associated with the total archive, again the comparability score estimation (ssm) is influenced as underneath:

Let the catch phrases taken from the two archives be put away in Tables Table 1 and Table 2 with their comparing term frequencies.

Table 1:

The following formula is used to calculate the ssm of keywords presented in both the tables

A= △ (1)

B= △ (2)

$$SDC = \log(\text{count}(a)/\text{count}(b)) * \text{Abs}(1 + (a - b)) \ldots \quad (3)$$

The 'a'& 'b' is the table's keyword index number

The following equation is used to determine the similarity of keywords in T1, but not in T2, as

NT1

$$SDT1 = \log(\text{count}(a)/\text{count}(b)) * (1 + |T2|) \ldots \quad (4)$$

The following equation is used to determine the similarity of keywords in T2, but not in T1, as NT2

$$SDT2 = \log(\text{count}(a)/\text{count}(b)) * (1 + |T1|) \ldots \quad (5)$$

To determine similarity score measure (SSM), the following equation is

$$SSM = SDC + SDT1 + SDT2/N \ldots \quad (6)$$

$$N = (|T1| + |T2|)/2$$

Great Deluge Algorithm

- Content is an computer vision based image retrieval application of computer vision techniques to the picture recovery.
- Content-primarily based means instead that the path evaluation the content material of the picture as opposed to the meta facts including key phrases, tags, or discriptions associated with the photo.
- Content in this context would possibly confer with the colors, shapes, textures, or any other records that may be derived from the image itself.

Calculating Image File Size
FORMULA:

Horizontal *Vertical*bitdepth%8*1024

Our Approach:

1. Crawle the document from web which contains both the images and text data.
2. Separate the text and image data and store them in different files.
3. Take the text data based on document size and store it in a repository file and find out the document domain in which it belongs and then extract the keywords from crawled document and compare them with existing document keywords and find out the SSM value by using NPG standard strategy(SSM-Threshold value 19.5).
4. Next we select the images' data from crawled document and compare the images data with existing images data and find out the image score value by using the great deluge algorithm (threshold value 70%). If the SSM value <19.5 then it is detected as near duplicate documents otherwise it is not detected as near duplicate documents.
5. In the image comparison if the score value of the image data >70% then it is detected as near duplicate documents else it is not detected as near duplicate documents.
6. The last step is combining both the strategies such as SSM value of the NPG standard strategy with Image score value by using great deluge algorithm. In the Great deluge algorithm if the SSM <19.5&& image score value >70% then it is detected as near duplicate document otherwise it is not detected as near duplicate documents.

References

1. Liu L, Lu Y, Suen CY (2015) Variable-length signature for near-duplicate image matching. IEEE Trans Image Process 24(4):1282–1296
2. Landge A, Mane P (2016) Near duplicate image matching techniques. In: 2016 international conference on information communication and embedded systems (ICICES)
3. Qiu J, Zeng Q (2010) Detection and optimized disposal of near-duplicate pages. In: 2010 2nd international conference on future computer and communication
4. Arun PR, Sumesh MS (2015) Near-duplicate web page detection by enhanced TDW and simHash technique. In: 2015 international conference on computing and network communications (CoCoNet'15), 16–19 December 2015, Trivandrum, India
5. Naseem R, Anees S, Muneer K, Syed Farook K (2013) Near duplicate web page detection with analytic feature weighting. In: 2013 third international conference on advances in computing and communications
6. Hu Y, Li M, Yu N (2018) Efficient near-duplicate image detection by learning from examples. In: 2008 IEEE international conference on multimedia expo
7. Yıldız B, Demirci MF (2016) Distinctive interest point selection for efficient near-duplicate image retrieval. In: 2016 IEEE southwest symposium on image analysis and interpretation (SSIAI)

8. Duan M, Xie X, Wu X, Ma W-Y (2008) Visual pattern weighting for near-duplicate image retrieval. In: 2008 IEEE international conference on multimedia and expo
9. Wu L, Liu J, Yu N, Li M (2008) Query oriented subspace shifting for near-duplicate image detection. In: 2008 IEEE international conference on multimedia and expo
10. Sun Z, Wang C, Jia K (2011) Near-duplicate video clips detection with motion based video fingerprinting. In: 2011 4th international congress on image and signal processing
11. Narayana VA, Gaddameedhi S, Koppula VK, Raju KS (2018) Framework for proficient proof of identity of duplicate and near-duplicate images and image distances using high-disguisable image fragment. In: 5th IEEE international conference on parallel, distributed and grid computing (PDGC-2018), 20–22 December 2018, Solan, India
12. He Y, Gao J (2018) Detecting short near-duplicates with semantic relations. In: 018 IEEE 9th international conference on software engineering and service science (ICSESS)
13. Du Q, Liu W, Li G, Tang Y (2012) Near duplicate detection using MapReduce. In: 2012 2nd international conference on computer science and network technology (ICCSNT)
14. Luan X, Xie Y, Guo Y, He J, Zhang L, Zhang X (2017) A fast near-duplicate keyframe detection method based on local features. In: 017 17th IEEE international conference on communication technology
15. Chang T-Y, Tai S-C, Lin G-S (2015) A near-duplicate video retrieval method based on zernike moments. In: Proceedings of APSIPA annual summit and conference
16. Chou C-L, Chen H-T, Lee S-Y (2015) Pattern-based near duplicate video retrieval and localization on web-scale videos
17. Harbin, P.R. China (2012) Book retrieval based on near-duplicate image matching. In: 2012 9th international conference on fuzzy systems and knowledge discovery (FSKD 2012)
18. Vidyulatha M, Narayana VA (2018) Detection of near duplicate documents by considering the domain to which the documents belongs. Int J Emerging Trends Technol Sci 9(4):629–639. (ISSN: 2348–0246 (online))
19. Ide I, Shamot Y (2010) Classification of Near duplicate video segments based on their appearance patterns. In: 2010 international conference on pattern recognition
20. Uysal MS, Beecks C, Sabinasz D, Seidl T (2015) Effective content-based near-duplicate video detection. In: 2015 IEEE international symposium on multimedia
21. Niu X, Xie Y, Li C, Luan X (2016) Near-duplicate keyframe detection based on gray-scale pyramid. In: 2016 IEEE international conference on signal and image processing
22. Manku GS, Jain A, Sarma AD (2007) Detecting near-duplicates for web crawling. In: Proceedings of the 16th international conference on world wide web, pp 141–150
23. Narayana VA, Premchand P, Govardhan A (2009) A novel and efficient approach for near duplicate page detection in web crawling. https://doi.org/10.1109/iadcc.2009.4809238
24. Narayana VA, Premchand P, Govardhan A (2012) Performance and comparative analysis of the two contrary approaches for detecting near duplicate web documents in web crawling. Int J Comput Appl 59(3):22–29
25. Pi B, Fu S, Wang W, HanS (2009) SimHash-based effective and efficient detecting of near-duplicate short messages
26. Gong C, Huang Y, Cheng X, Bai S (2008) Detecting near-duplicates in large-scale short text databases
27. Roul RK, Mittal S, Joshi P (2014) Efficient approach for near duplicate document detection using textual and conceptual based techniques. In: Kumar Kundu M, Mohapatra D, Konar A, Chakraborty A (eds) Advanced Computing, Networking and Informatics - Volume 1. Smart Innovation, Systems and Technologies, vol 27. Springer, Cham
28. Prasanna Kumar J, Govindarajulu P (2013) Near-duplicate web page detection: "an efficient approach using clustering, sentence feature and fingerprinting. Int J Comput Intell Syst 6 (1):1–13
29. Sravanthi G, Narayana VA (2018) An efficient approach for detection of near replicas documents by considering both the text & the images. J Adv Res 10(03-Special Issue):417–424

30. Zaheer MD, Narayana VA (2019) A strategy for near-deduplication web document considering both domain &size of the document. Int J Comput Appl (2278–3075) 8(4S2)
31. XNDDF (2015) Towards a framework for flexible near-duplicate document detection using supervised and unsupervised learning. In: International conference on intelligent computing, communication, & convergence (ICCC-2015)
32. Ho P-T, Kim S-R (2014) Fingerprint-based near-duplicate document detection with applications to SNS spam detection. Int J Distrib Sens Netw 2014, 8. Article ID 612970

Comparative Analysis of Horizontal and Vertical Etched Fiber Bragg Sensor for Refractive Index Sensing

Azhar Shadab, Yadvendra Singh, Sanjeev Kumar Raghuwanshi, and Mohd Dilshad Ansari

Abstract Etching of Fiber Bragg Grating (FBG) section is necessary process to make the FBG sensitive with the external environment changes. Hence, HF solution is used for this purpose. In the present work, a real time monitoring based system for the vertical and horizontal etching of Fiber Bragg Grating (FBG) in a solution of hydrofluoric (HF) acid is designed. In our experiment we used 40% concentrated HF solution at room temperature, which is corrosive in nature and it capable for dissolving different materials. Because of its reactive nature with glass, we used Teflon container to carry out HF solution. It is easy to analyze the results through the variation of the shifting of wavelength with respect to the etching time response of FBG for horizontal and vertical etching process when dipped in HF solution. The result shows the comparison between vertical etching and the horizontal etching process.

Keywords FBG · HF solution · Horizontal etching · Vertical etching

1 Introduction

Optical Fiber sensors are one of the most versatile sensor which has tremendous advantages based on different applications, (FBG) Fiber Bragg grating based sensors are one of them which has been proposed for various applications, FBG sensors have so many advantages over other conventional optical sensors due to their mechanical robustness, simplicity in fabrication, compactness, fast response, high sensitivity, and inherent immunity with (em) electromagnetic noise and most

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_124

important is their wavelength encoded signal [1, 2]. (FBG) Fiber Bragg grating based sensors were used for the measurement of physical, biological and chemical changes and also it measures these parameters in industrial processes and some medical treatments. By partially removing the clad section around the grating region it is possible to increase the sensitivity of FBG with respect to the changes in surrounding refractive index, so FBG is possibly used as refractive index sensors [11]. We have proposed two different setup for vertical and horizontal etching process with HF using two different FBGs respectively whose Refractive Index is same and monitored its real time responses on Interrogator [3–5]. We conclude that Vertical etching process takes less time to etch the same amount of clad portion. In literature survey, it observed that some authors was demonstrated the etching process to enhance the Refractive Index sensitivity of FBG as the clad portion of FBG was removed [7, 8].

2 Experimental Setup

The setup was manually created for horizontal and vertical etching process. The stripping of fiber was done by sharp blades, cleaned the Fiber (by Tissue Paper & Isopropanol), cleaved the Fiber (by SKL-60S) and spliced the Fiber (by Fusion Splicer). Interrogator-FS22DI was used for getting real time response about etching of FBG with respect to their central wavelength variation which can easily be observed on the screen of Bragg Monitor DI by the help of Bragg Meter DI (Interrogator-FS22DI). For etching purpose 40% concentrated Hydrofluoric acid was used to remove the required part of the cladding. HF was used to achieve the reduced diameter of fiber; it is also advantageous to analyze the refractive index parameter of the Hydrofluoric acid used in the etching process. In literature, it has been analyzed that there are so many experimental reports for measuring the parameters of refractive index of Hydrofluoric acid by the using Refractrometric measurement techniques and Mach-Zehnder Interferometric [9, 10]. The experimental setup of etching contains an optical interrogator connected with a 10 m fiber spool and the grating portion of fiber is dipped into the HF solution for 40 to 50 min to achieve reduced clad diameter. The proposed diagram for vertical and horizontal etching process is shown in Figs. 1 and 2 respectively. An electric arc based fusion splicer was used to melt two optical fibers together at their end faces, to form a single fiber. The splicer have capable to automatically aligns a pair of fibers in both (horizontal and vertical) planes and then fuses them together through heat from an electric arc to make a low loss splice (0.02 db).

We were using four channel interrogator, shown in Fig. 3 with the help of this it is easy to see the variation of graph with respect to the physical change in the sensors. As the physical parameters changes, the graph of the sensors will also change with respect to their reference parameters of that sensor. This interrogator helps to analyze the graph of four different sensors parameter at a same time.

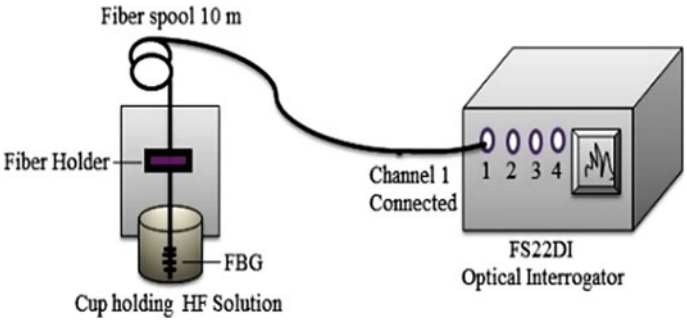

Fig. 1 Vertical etching setup

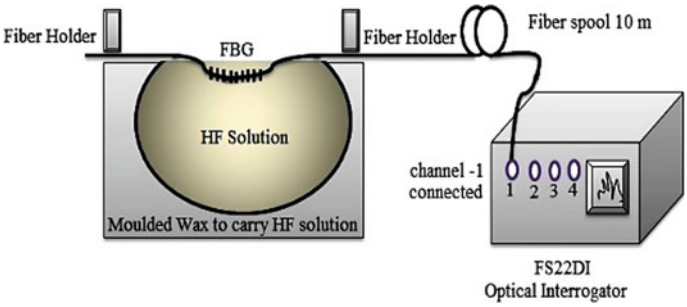

Fig. 2 Horizontal etching setup

3 Experimental Process

To analyze the experimental results of sensing characteristics, it is estimated for shifting in Bragg wavelength with the small changes in the surrounding medium refractive index. The parameter Bragg wavelength of Fiber Bragg Grating is calculated from the given (Eq. 1) where n_{eff} is effective refractive index of propagating mode and Λ is grating period. At initial level the shifting of Bragg wavelength was insensitive with the surrounding medium refractive index [6]. As FBG was dipped in the solution of Hydrofluoric acid its cladding diameter reduces and their shifting can easily be obtained by Bragg wavelength

$$\lambda_B = 2n_{eff}\Lambda \tag{1}$$

Bragg Monitor DI helps to monitoring the calculated graph of central wavelength which varied in accordance with time of etching process. It takes around 35 min to remove cladding, when Grating section dipped in HF solution but time may be vary depend on different setup.

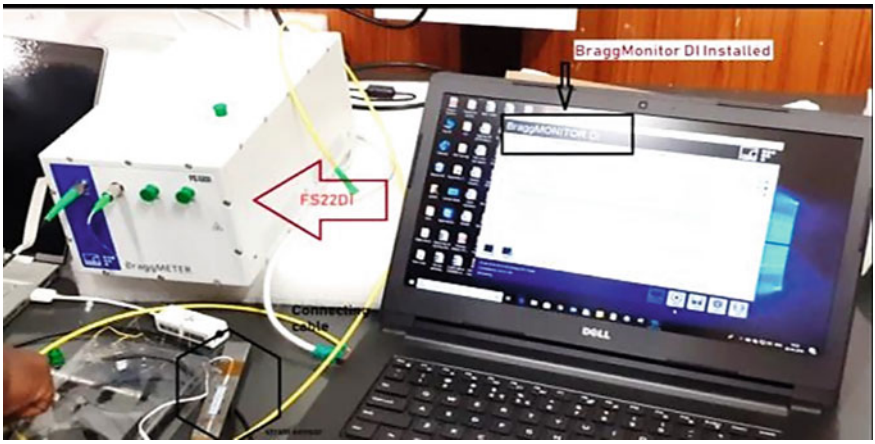

Fig. 3 Complete setup of FS22DI Bragg Meter DI with Installed software

4 Results

We experimentally proposed two etched FBG results in which one was vertical and other was horizontal etching results. The entire reflectance curve obtained from the Optical Interrogator and the plot that we got are the real time analysis. The HF of concentration 40% were used in our experiment to remove cladding of grating section and keep the temperature constant throughout the etching process. The dissolution process rate becomes significantly more in Vertical position due to the Gravitational driven force on mass transport inside the solution [12].

4.1 Vertical Etching

Etching process started at t = 0 where the initial Bragg wavelength was at 1546.435 nm. As the time increases we get Red shift of the Bragg wavelength up to 34 min and after that we get Blue shift within span of 4 min but the rate of Blue shift increases in last 2 min. The Bragg peak wavelength traces in Optical Interrogator versus etching time is shown in Fig. 4 and Bragg Shift changes versus etching time with respect to their initial value of Bragg wavelength shown in Fig. 5 along with data measured mentioned in the Table 1.

Table 1 Bragg wavelength (nm) shifted with respect to their time for vertical Etching

Time in mins	Bragg wavelength shift (nm)
0	0
10	0.005
29	0.03
34	−0.013
39	−0.57

4.2 Horizontal Etching

In this case, etching process started at t = 0 again where the initial Bragg wavelength was at 1546.370 nm. As the time increases we get the Red shift of the Bragg wavelength up to 47 min of etching and after that we get Blue shift in the remaining time but the rate of Blue shift increases in last few mins. The Bragg peak wavelength traces in Optical Interrogator versus etching time is shown in Fig. 6 and Bragg Shift changes versus etching time with respect to their initial value of Bragg wavelength shown in Fig. 7 along with data measured mentioned in the Table 2.

The reason behind the shifting of Bragg wavelength initially toward the right side due to the chemical reaction between HF and cladding of the fiber generates heat and then toward left side is governed by [3]

$$\delta\lambda_B = 2\Lambda\eta_{po}(n_{cl} - n_{sur}) \tag{2}$$

Where parameter Λ is used for grating period, η_{po} is fraction of total power for the unperturbed mode that flowing in their etched part, n_{cl} is the refractive index of clad and n_{sur} is refractive index of surrounding medium.

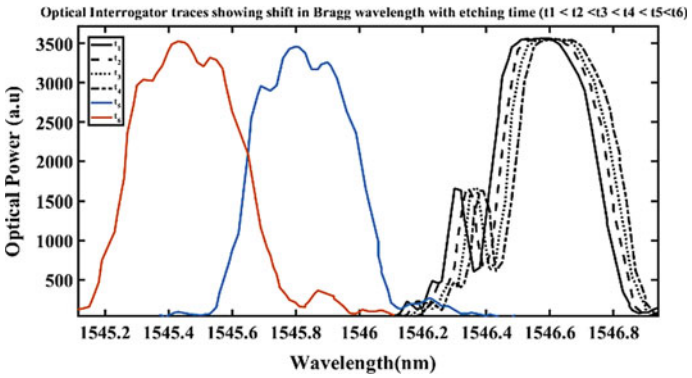

Fig. 4 Traces that showing their shifting of Bragg wavelength in accordance with the etching time (t_1 = 0 min, t_2 = 10 min, t_3 = 20 min, t_4 = 29 min, t_5 = 37 min, t_6 = 39 min)

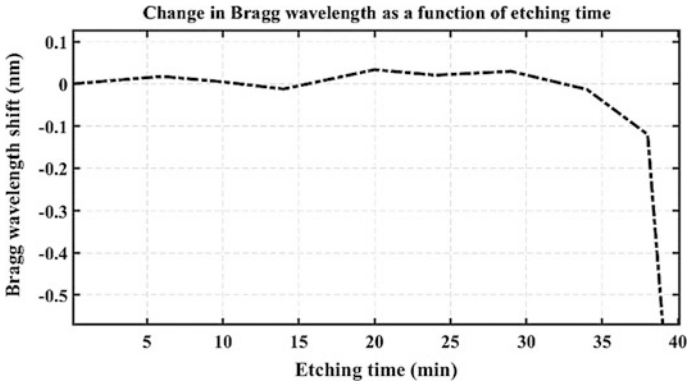

Fig. 5 Function of etching time for Bragg wavelength shifted

Table 2 Shifting of Bragg wavelength (nm) with respect to time for horizontal etching

Time in mins	Bragg wavelength shift (nm)
0	0
5	0.003
20	0.024
30	−0.004
45	−0.034
51	−0.197

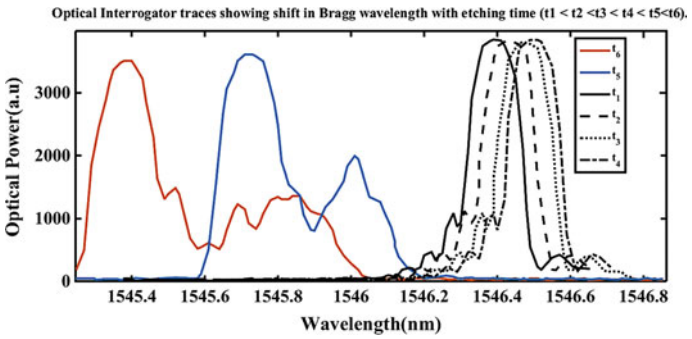

Fig. 6 Traces that showing their shifting of Bragg wavelength in accordance with the etching time (t_1 = 0 min, t_2 = 6 min, t3 = 12 min, t_4 = 25 min, t_5 = 47 min, t_6 = 51 min)

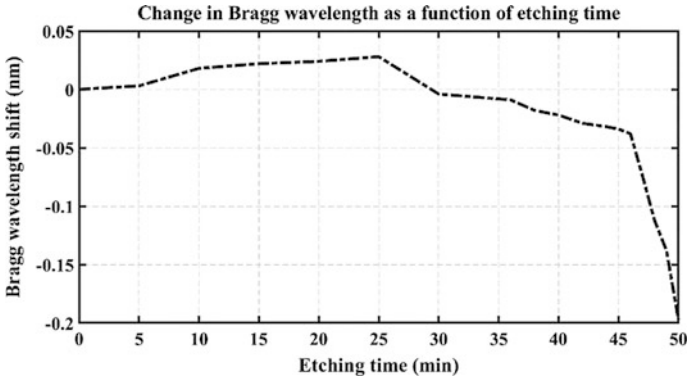

Fig. 7 Function of etching time for Bragg wavelength shifted

5 Conclusions

We have designed a different structured based on real time monitoring system of etching process of FBG for vertical and horizontal manner. The Hydrofluoric Acid (40% concentrated) based clad etching process has been done in our laboratory. The optical fiber is immersed in the solution of Hydrofluoric Acid without having any protective coating and the cladding part start reducing its diameter due to etched occurs gradually. The variation curves shows the shifting of wavelength of FBG with respect to their time of etching at constant temperature and successfully removed the cladding part of grating section of FBG. From the above experimental results, it is clear that horizontal etching process is slow as well as not so smooth as compared to the vertical etching process but there is also some positive aspects of horizontal etching is that it can use in both transmission as well as in reflection mode but vertical etching has ended with one side so it can only be use in reflection mode.

Acknowledgements This work is financially supported by (DAE) Department of Atomic Energy, (BRNS) Board of research in nuclear science- India for the project titled "Development of Field Deployable Fiber Bragg Grating based Sensor for monitoring of Hazardous Toxic Chemicals". This project is funded by DAE-BRNS, India with sanction No. 34/14/15/2018-BRNS/10105 [DAE (6)/2018-19/575/ECE]. The authors would like to thank the team of Raja Raman Centre for Advanced Technology (RRCAT) - Indore who helped a lot for the successfully fabrication of FBG, especially thanks to Shri S.V.Nakhe, Director of Laser Group (RRCAT-Indore), Dr. Om Prakash, Dr. S.K.Dixit head of (FSOSS) Fiber Sensors and Optical Spectroscopy Section.

References

1. Yu FTS, Yin S (2002) Fiber optic sensors. Marcel Decker, New York
2. Mihailov SJ (2012) Fiber Bragg grating sensors for harsh environments. Sensors 12(2):1898–1918
3. Kumar J, Mahakud R, Prakash O, Dixit SK (2014) HF-based clad etching of fibre Bragg grating and its utilization in concentration sensing of laser dye in dye–ethanol solution. Pramana 82(2):265–269
4. Prakash O, Mahakud R, Dixit SK, Nandy U (2006) Opt Commun 263:65
5. Mahakud R, Prakash O, Kumar J, Nakhe SV, Dixit SK (2012) Opt Commun 285:5351
6. Kashyap R (1999) Fibre Bragg grating. Academic Press, New York
7. Lim A, Ji WB, Tjin SC (2012) Improved refractive index sensitivity utilizing long-period gratings with periodic corrugations on cladding. J Sens 2012:5
8. Iadicicco A, Cusano A, Campopiano S, Cutolo A, Giordano M (2005) Thinned fiber Bragg gratings as refractive index sensors. IEEE Sens J 5(6):1288–1295
9. Penning DF, Weimer D, Rumpel WF (1973) Indices of refraction of HF and F2. II. J Chem Phys 59(5):2496–2497
10. Drummond DL (1982) Refractive index of HF from 2.5 μm to 2.9 μm. Appl Opt 21 (23):4331–4334
11. Harpreet KB, Sidiroglou F, Ladouceur F, Dragomir NM (2011) Fabrication of a fibre Bragg grating liquid composition sensor based on wet etching technique. IEEE Xplore 2011. https://doi.org/10.1109/acoft.2010.5929886
12. Kimura M, Tanaka A, Sukegawa T (1990) J Cryst Growth 99:1295

Formalizing Open Source Software Quality Assurance Model by Identifying Common Features from Open Source Software Projects

Ekbal Rashid, Mohan Prakash, Mohd Dilshad Ansari, and Vinit Kumar Gunjan

Abstract Not long ago many scholars used to believe and write that open source software or projects do not follow any decisive software quality assurance methods as traditional projects do. They would argue that the style adopted by open source communities is more or less ad hoc. However successful open source collaborative projects have over the years developed a typical software development quality assurance methods of their own which may be coined as continuous develop and release state quality assurance model. As a result many have started acknowledging this change and important writings are being published. In this tune the present paper discusses the quality assurance model adopted by few famous open source projects and attempts to strike a formalization of the common steps involved from practices employed by these open source software projects.

Keywords Open source software · Software quality · Software projects · Collaborative projects

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_125

1 Introduction

Quality parameters are regularly being considered and revised by software developers and analysts all over the world. Many consider quality to be a subjective matter, but yet others believe that quality can be measured objectively. As a result, the main thrust in the direction of quality parameters is to search for metrics that are more objective, measurable and realistic. By objective parameters we mean that the related quality metrics can be directly measured on some objective basis. Just as we can actually count lines of code, function points, errors detected and resolved, such parameters can be considered to be objective. On the other hand, metrics like fluency, efficiency, maintainability are by and large considered to be subjective. It is well known that the chief motivation behind attempts to measure software quality is directly related to risk and cost factors of the software itself. Software to be used in space research, medicine, robotics and many other fields involve risk of destruction of large investments and many years of hard work. There is also the possibility of loss of life in such cases. Recent failure of Chandrayan 2 lander may be due to some malfunction or even due to some underlying software failure, which only the ISRO can clarify. There have been many other examples like plane crashes to blackouts, from non working of airbags in cars to over radiation of cancer patients, security lapses in apps, cyber attacks on nuclear power plants, email security issues, problems in stock exchange trading, airport chaos, the list can go on and on. Moreover, this is only the tip of the iceberg. These incidents are related to big enterprises and hence have been discussed time and again. There are many other software QA related problems that probably have been brushed under the carpet. Several others are too seemingly trivial to be discussed and considered with importance. The bugs in MIS systems of offices, store inventory systems, institutional information management software are often rattled by bugs leading to low and inaccurate efficiency and high cost of correcting mistakes. Problems in enterprise resource management software, transaction processing systems and customer relationship management systems are not new. Here we are talking about the cost factors which are responsible for the urge to seriously deal with software quality with due importance. The Consortium for Information and Software Quality in its website expresses the importance of the need to automate the process of software quality assessment [1]. Three categories have been identified namely - software sizing, code quality and technical debt. Software sizing underlists two metrics for measurement - automated function points and automated enhancement points. Code quality has under it four metrics - security, reliability, maintainability and performance efficiency. Technical debt is a quality metric by itself. In this paper the authors have tried to study how quality models work in software projects that are open source and community based. The working of the quality assurance team has been judged by a simple parameter which has been explained and highlighted in this paper. The reason behind this is that the authors believe that if anything is measurable then it is inexorably quantifiable. How can one measure anything that is not quantified? So here, the authors have laid special focus upon open source

community collaboration software projects. There is an attempt to identify some quality assurance techniques that are in some way related to quantitative measures.

2 Literature Review

More than a decade ago there was a notion about open source community software development that these do not follow any general methods or models of software development. There was also the belief that quality is not so important so far as such software development is concerned. Hedberg et al. in their work [2] have said that there is no strict process to follow and designing and planning are rare. They believe that ad hoc style is largely prevalent in the development process and techniques for quality assurance are mostly ignored except when beta testing methods are employed. It seems the authors of the above mentioned work have not given due importance to the rawhide method of development in projects Like Fedora and Linux Foundation where software is always in the state of being tested by users and developers for years together and there have been many releases and with each subsequent release the quality of software significantly improves. And so the authors go ahead and make what seems to be contradictory remarks that OSS projects have proven that tasks related to quality assurance such as reviewing, testing and defect locating works can be parallelized. Thus greater the number of reviewers testing a project, the greater the chance of its quality being higher [2]. This is a clear indication since the very early days of scholars agreeing to the idea that quantity affects quality. What is required is an attempt to identify which parameters of quality are influenced by which parameters of quantity.

Another significant work worth mentioning in this respect is by Wahiyuddin, et al. in which the authors deal about two cases studies from Apache project which is another open source collaborative project [3]. This paper has tried to show that the number of bug detection frequency increases due to open source character and greater participation of community. It goes on to say that quality of defects reported can be determined from the number of defects considered valid against the number of defects reported. While discussing the proportion of verified solutions the authors have observed that there is no peer review in Apache Tomcat and hence there is less chance of quality being cross checked. However in such projects, most of the commit activities are not performed by the developers on their own. They have observed that only dedicated committers are authorized to do so. Such descriptions again point towards relation between quality and quantity. While the paper largely speaks about quantity parameters like bug detection frequency and valid bug reports, the authors actually have tried to address the question of quality of the mentioned software projects.

In Khanjani et al. [4] to discuss how forking can contribute to increasing the quality of software Khanjani, et al. have said that Quality in Open Source Software projects depends on two factors - code review and data testing. Now what else can be said about number of code reviews other than considering it a quantitative

attribute? Similarly about data testing tool, we can not but observe that intuitively speaking, the number of tests done also leads to a quantitative discussion. This work also lists the important factors contributing to the quality of open source software projects like Requirement Definition and Design, large development community, testing, maintenance, documentation and security issues. Again several of these factors have a quantitative indication. Hence from this discussion, we may argue that the authors have to an extent pointed towards the role of quantitative measurements in determining the qualitative aspects of software projects.

Interest has been drawn towards another scholarly writing by Spinellis, et al. [5] who have rightly pointed out that Open Source Software is not only open so far as the code of the project is concerned, but it is also open in process because it allows the opportunity for analysts to examine both the product and the processes that produce them. This paper explains the use of Alitheia system for quality measurement. Although not much value is added to the discussion on quantity and quality by citing this statement, there is however one important observation to make in this regard. The discussion of Spinellis, et al. have pointed towards the possibility of open source software having an edge qualitatively above proprietary software due to its open nature makes us feel that it is the quantitative aspects like community involvement in coding, reviewing, bug detection, bug resolving, documentation, and many other activities are responsible for the openness of such projects and hence comes the assertion. An important metric discussed in [6] is Mean Developer Engagement (MDE) metric which has been defined as the average ability over the lifetime of an open source and free software project to make use of its developer resources. This is about the quality of the project. Its equation is of the form: $de = \frac{1}{n}\sum_{i=1}^{n} \frac{dev(active)}{dev(total)}$. The authors in this work have calculated an average MDE and called it the effort score over the entire life of the project by taking the per week MDE value and calculating a simple average. This metric can be considered to be a quality parameter drawn from quantitative measurements. In [7] has another discussion about a metric called power laws which is a probability distribution function in which the probability that a random variable takes a value that is proportional to a negative power of that value having the relation $P(X = x) \propto c\, k^{-1}$ where $c > 0$ and $k > 0$, Another part of this paper which can be understood to speak about quantity affecting quality is on pg. 19 where a software quality model having two parts has been presented. These two parts are - software codebase and community quality. Worth mentioning is another work by Lin et al. in this context in which the authors have discussed many tools and methods for software specification and testing. They have explained about an automated framework called JUMBL which aids in the process of automated generation of test cases and their execution and evaluation [8].

3 Methodology

1. **Interview of quality assurance team members**

Most of the open source community members communicate among themselves through IRC channels. Internet Relay Chat (IRC) are text based communication systems that work on client/server models and they have discussion forums called channels. The channel that the Fedora project dedicates for quality assurance discussion is '#fedora-qa' [9]. Besides regular meetings one may just join the channel and speak to those available regarding the quality assurance procedure. Similar is the case with mozilla, only the IRC channel for this project is different. For mozilla the required channel is '#qa' [10, 11].

Besides speaking to the quality assurance community members on the IRC, there is another method of communicating and that is through mailing lists. Most of the open source projects use mailing lists to communicate. This is a place where discussions are organised through e-mails and people in the community respond as per their availability. The mailing list for quality assurance discussions in Fedora is called 'test' and in Mozilla it is called 'dev-quality'.

The authors have joined these mailing lists and IRC channels and have interviewed several of the community members who are actively participating in the process of quality assurance. Based on these discussions, some inferences have been drawn and elaborated in this paper. There are also wiki pages from where lots of information has been gathered.

2. **Getting involved in the process of quality assurance**

The best part of the open source projects is that one can easily become a member of the team and get involved. In this manner it becomes very easy to understand what is going on hands down and also compare the discussion of the team members in IRC chats and mailing lists with what is actually going on. The process is similar for both the projects that are being considered here. As for example in Fedora one has to create an account with the Fedora Account System called FAS, and applies for membership to the 'qa' group. Then join the mailing list and the IRC channels and start working. There are many types of quality assurance tasks in which one may get involved. This includes testing packages before they are released, compared with the release criteria of the project before the official release, testing the rawhide version, building test cases, building tools for testing, and much more. Then special occasions are organized called 'test days' in which one can participate and test the working of the software. The authors have worked with the quality assurance teams of the projects and have drawn inferences based upon this participation.

3. **Collecting and analyzing data**

Data has been collected from bugzilla and analyzed to understand quality parameters leading to bug fixes. The data shows the ratio between the number of bugs reported to the number of bug fixes over the past few years and the required regression analysis of the same. This is a parameter to show how the quality assurance team has been active over the past few years with the project. For Linux kernel project, the authors have accessed the interface at (https://bugzilla.kernel.org/query.cgi?format=report-graph). The query has to be set so that the necessary data is obtained. For collecting data from Fedora and Mozilla, similar interfaces were used.

4 Results

Inferences from interviews and participation in projects:

The quality assurance activity for the open source projects in general consists of the following:

1. When software is released into the 'branched pre release' or 'rawhide', many community members test the product on different machines to see if things work out properly. This is a type of black box alpha testing. But the difference is that while in traditional sense alpha testing is confined to workspaces, here the process of alpha testing is also open. Anyone can download the pre-release branches or rawhides and run on their machines. They can give suggestions and file bug reports. This very act of bringing together a large community for testing the product has increased the chances of the product being more robust and fault tolerant.
2. The projects normally consist of a large number of packages shipped together with the project. Hence one of the quality testing techniques also involves testing all critical path packages to be included in the system before they are accepted. This is not a pure black box test as it looks at some individual detailing for the packages that are included in the project.
3. The quality assurance team looks to act as a bridge between the developers and the users of the system so that the bugs reported may actually reach the developers and are checked and resolved within a limited time frame. It is actually the job of the quality assurance team to actually get involved in the process of assigning ownership to individual tickets and also changing the tickets if necessary. They also call upon the committers to include final patches to the codebase.

4. A section of the quality assurance team works to create ‘test plans’ and ‘test cases’ which community members can use to test the software project in their own environment. Creation of such ‘test plans’ and ‘test cases’ are usually done in collaboration with multiple users. These things ease out the process of testing for beginners and involve them into the vortex of quality assurance of the product.
5. An important work of the quality assurance team is to develop automated test tools which can be used to test packages or the project as a whole. New users or novice volunteers can get involved in the task of testing software by using these tools helping large numbers of tests helping the project to become more robust and effective.
6. The quality assurance team works with developers and production engineers to decide upon the ‘release criteria’ of the product. This includes the specific tests to be performed and the nature of bugs to be fixed before the project can be shipped to the end user. This definition is necessary or rather we can say that this is the threshold condition for the product to be released.
7. Although testing is a continuous process, it actually needs to fulfill the demand of timelines and hence there are occasions when some modules or packages need to be tested thoroughly within a limited time, like say before a release or before some package is introduced. For this there are events called ‘test days’ or ‘bug fix days’ where people in the community come together and collaborate for a few days and finalize the tests for specific areas.
8. The quality assurance team has to keep track of the project development life cycle. There are issues such as ‘milestone freeze’, ‘release candidate’, ‘accepted blocker bugs’ and ‘freeze exception’. These issues are addressed by members of the QA team in collaboration with the release engineers.
9. Organizing meetings, running mailing lists, setting up events for collaborators to come together are also the tasks carried out by the QA team. Recognition for contribution to the quality assurance tasks are also planned and defined to get the most out from the community members.
10. There are also automated tests just like http://autotest.github.io/ for the Linux kernel.

Tabulation and Analysis of Data

As said earlier, the ratio between the number of bug fixes and number of bugs reported can give us an estimate about how well the quality assurance team is working. If the ratio is one, it is the ideal condition. A score of 0.75 and greater can be considered to be good, between 0.6 and 0.75 can be considered average and less than 0.6 would be below par. There are places where the ratio is more than one. That is because some bugs that were closed belonged to the previous year (Table 1).

Table 1 Ratio between bug fixes and bug reports

year	Kernel	Fedora	Mozilla
2007	1.045526	0.87528	0.885628
2008	1.099588	1.077147	0.876125
2009	0.852567	0.942789	0.909977
2010	0.701581	0.909799	0.90937
2011	0.612144	0.882039	0.932598
2012	2.069395	1.025924	0.852118
2013	1.01569	1.007686	0.870889
2014	0.507542	0.969483	0.861651
2015	0.54883	1.220624	0.903042
2016	0.462768	1.113751	1.030793

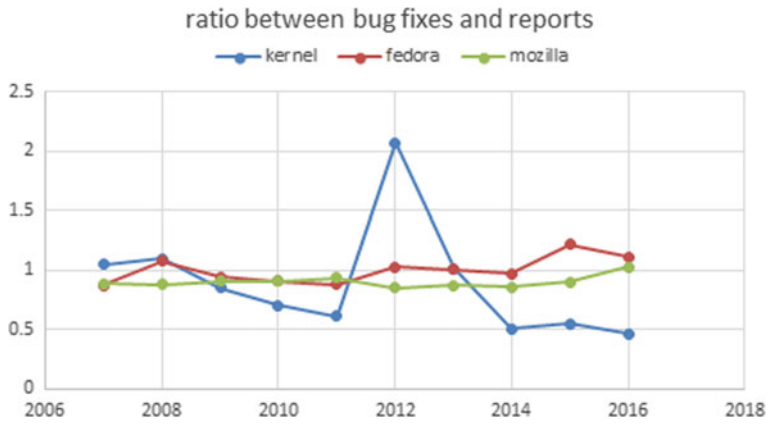

Fig. 1 Ratio between bug fixes and reports

5 Conclusion

As clearly evident from the above Fig. 1, the quality assurance teams of Fedora and Mozilla are by and large consistent. Their graphs are more or less horizontal lines. This is so far as the bug fixing tasks are concerned. Whether that can provide a true picture of the performance of the quality assurance team is a matter of serious debate. Yet the role of the quality assurance team can not be neglected when it comes to the question of bug fixes. So it can be considered to be some sort of an indicator in this respect.

Future Scope

Data that can show the efficiency of the quality assurance team may be collected. The data collected may be analyzed and a better understanding of the quality assurance work of the project may be determined. There is a scope of new parameters emerging from this study. In this way there is a scope of concretely relating quality metrics to quantitative and measurable factors.

Future scope of this work involves understanding various parameters that tries to understand the quality of the software projects. There is a community that works to analyses the health of open source software projects. Its foundations are based upon software called the Community Health Analytics Open Source Software (CHAOSS). This comprises several tools that can be used to gather and analyses data about different software projects and understand their health. What needs to be explored is whether this method provides any insight into the quality of those projects. The software identifies many quality metrics and most of these quality metrics are quantity based, that is they can be measured. Some are arbitrary though and still need well defined methods for actual measurement. The authors look forward to diving into the quality metrics that this software has to offer and also explore the tools that they have. Although work of this nature cannot be confined to merely a single paper or a couple, yet the authors look forward to publishing at least one article in the near future.

References

1. (2020). https://www.it-cisq.org/
2. Hedberg H, Iivari N, Rajanen M, Harjumaa L (2007) Assuring quality and usability in open source software development, conference on emerging trends in FLOSS research and development, pp 1–2, 16 July 2007. IEEE Xplore. ISBN: 0-7695-2961-5
3. Wahyudin D, Schatten A, Winkler D, BiffleSchatten A, Winkler D, Biffl S (2007) Software engineering and advanced applications conference. ISBN: 0-7695-2977-1
4. Khanjani A, Sulaiman R (2011) The process of quality assurance under open source software development. In: 2011 IEEE symposium on computers & informatics (ISCI)
5. Spinellis D, Gousios G, Karakoidas V, Louridas P, Adams PJ, Samoladas I, Stamelos I (2009) Evaluating the quality of open source software. In: Electronic notes in theoretical computer science, vol 233, pp 5–28. Elsevier
6. Ibid p 14

7. The 2015 international conference on soft computing and software engineering (SCSE 2015)
8. Lin L, He J, Zhanga Y, Song F (2015) Quality assurance through rigorous software specification and testing: a case study. In: The 2015 international conference on soft computing and software engineering (SCSE 2015), Procedia Computer Science. Elsevier
9. (2020). https://fedoraproject.org/wiki/QA
10. (2020). https://wiki.mozilla.org/QA
11. Rashid E, Ansari MD (2020) Fixing the bugs in software projects from software repositories for improvisation of quality. Recent Adv Electr Electron Eng 13:184 (2020). https://doi.org/10.2174/1872212113666190215150458

An Approach for Morphological Analyzer Rules for Dravidian Telugu Language

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Abstract Machine translation is a computational method for automating user queries or information posed over search engine or social media in local Dravidian language such as Telugu. Computer based translation has become global due to majority of the domains are likely to use local languages for universal resources accessing. Machine translation is an application of the major area for transforming one language to another target universal language. In this era analyzing Telugu language at syntax granularity level is essential to tackle through grammar. This article emphasizes on classification of approaches for machine translation syntactical grammar for Telugu Dravidian language. The authors also significantly presented investigations noticeable research issues in this article towards Telugu language for machine translations.

Keywords Dravidian language · Telugu language · Context free grammar · Machine translation approaches for telugu language

1 Introduction

Machine translation is computational approach for transforming one natural language to another machine understandable language in order to provide local language preference as per the user convenient level [1]. Recommendation systems are using local languages in order to pose their sentiment or opinions towards any

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_126

entity [2]. As India is having multilingual in nature, various states have their own local languages based on region [3]. Representation of natural language for machine translation is becoming essential for linguistic focussing researchers [4]. Indian Dravidian language Telugu uses most of the cases in public and government in various domains for communication [3]. Usually English language follows sentence order as SVO and where as in Telugu language follows SOV word order in a sentence formation.

Considering the broad work that is being done in the region of Indian Language Technologies, towards building Language Applications for Major Indian Languages it is the need of great importance to create and produce language assets for countless Indian dialects, which are of high calibre and with unmistakable benchmark. In order to investigate data analysis lot of machine learning techniques also employed for various purposes [5, 6]

Basically there are two mechanisms used to form the morphological analysers such as LDC-II and rule based affix stripping method. Syntactic investigation is the way toward breaking down and deciding the syntactic structure of a sentence as for a given proper sentence structure. Syntactic Parsing of a characteristic language sentence is considered to be a significant middle of the road arrange for semantic investigation that can impact numerous pipelined utilization of Natural Language Processing, for example, data extraction, word sense disambiguation and so forth. The investigation of structure of sentence is called language structure. It endeavours to portray the syntactic request in a specific language in term of rules which in detail clarify the fundamental structure and a transformational process. Linguistic structure gives rules to set up together words to shape segments of sentences and to assemble these segments to structure important sentences. On account of the considerable equivocalness present in the human language, whose utilization is to pass on various semantics, it is a lot of hard to structure the highlights for normal language handling assignments. The principle challenge is the inborn intricacy of etymological wonders that makes it hard to speak to the viable highlights for NLP tasks [7–9]. The present paper presenting an approach for Telugu language for checking morphological analysis for noun to adjective suffix stripping method.

The rest of the article is arranged in the below manner. In Sect. 2, concise information regarding classification of machine translation approaches for various natural languages. Sect. 3 demonstrated rule based suffix method for Telugu Language. Sect. 4 presents about Conclusion and future scope of the current proposed work.

2 Classification of Machine Translation Approaches

Basically there are broadly machine translation techniques for parsing information in the two ways.

i. Knowledge based Method
   a. Rule based Translation
ii. Data Driven based Method
   a. Analogy based method
      i. Example based Machine Translation
   b. Alignment based Method
      i. Statistical based Machine Translation

i. **Knowledge based Translation**
This methodology relies upon worked underway guidelines and word references that are made for every language pair. First stage in rule based machine interpretation framework is parsing. It parses the content that must be interpreted and a transitional portrayal is made from which the objective language content can be created. It experiences different stages like syntactic, semantic and morphological examination that utilizations enormous arrangement of rules. Rule based frameworks frequently create great syntactic results just on the off chance that it finds a parse or else it comes up short. These interpretation frameworks are less hearty. Their blunder rates, which are presently 3–4%, can likewise be improved and there is parcel of adapt for development. The immediate language interpretation thoroughly relies upon how well the source-target language word references are manufactured and morphological investigation.

ii. **Data Driven Based Translation**
In EBMT, likelihood is prominent by its nonappearance, however the system is information driven. Likelihood gets rule and framework in the interpretation procedure, especially in surveying the value of competitors, which are phrases from the investigation stage and sentences from the age organize. In EBMT, a similitude score is given to phrasal pieces of the info sentence that match the content units in the database of models. This is the most basic advance in EBMT. In the arrangement or move step interpretation competitors are found for phrasal parts. The variety of competitors is because of vagueness. EBMT endeavors to pick the best among interpretation competitors through syntactic and semantic match. SMT resorts to likelihood. The most plausible interpretation is anything but difficult to situate in the expression table. What are these likelihood esteems? At last, these are frequencies, the collocation tallies. EBMT's strategy for investigating the info source sentence is a lot harder, including NLP layers of morphology examination upward, until potentially profound semantic investigation. In that regard EBMT is nearer to RBMT. RBMT likewise does substantially more handling on the source language sentence than does SMT. EBMT gets coordinating phrasal pieces, while RBMT gets a profound semantic chart or a halfway portrayal like the reliance tree. After move, RBMT takes care of sentence structure arranging according to the

syntactic standards of the objective language, while EBMT, as SMT, does sewing together of deciphered parts. At this stage, SMT tackles language demonstrating, and both EBMT and SMT take care of the limit erosion marvels (changes required in the yield sentence, for instance, because of case outlines), while RBMT is occupied with punctuation arranging.

3 Rule Based Suffix Method

The WPM (Word and paradigm model) is inappropriate and insufficient to provide all features accommodate in Bengali, Assumes, Bodo, Oriya languages. Due to these languages are related to work based on classifier languages. In this context manual effort would increase for appending all combinations of nouns in those languages. Therefore, suffix stripping method is very adequate for Telugu Language. As per the method name, every individual word would have suffixes attached and stemming is performed with the help of morpheme analysis rules.

3.1 Telugu Grammar Scrutiny

As English language structure is gigantic in volume, we considered just hardly any fundamental parts, action words, relational words, vibhakti (expressions), and phrases. Action words are significant practical words in English and one can distinguish the strained of a sentence utilizing them. In this interpretation, assistant action words are disregarded in light of the fact that there is no immediate interpretation to this action word in Telugu. An action word state is developed thinking about the consequent action word. For model think about the English sentence, "Theja is going to play chess" has two action words, 'is' is the helper action word and 'playing' is considered as the ensuing action word. This will be considered as one action word like 'is playing'. There is no immediate interpretation for relational word 'is' in Telugu, hence the lexicon is created similarly and 'is going' is considered as one action word state. So also action words 'to' and 'school' are additionally consolidated to one action word state as 'to play'. 'Play' and 'to play' are deciphered differenty. Play is converted into Telugu as 'ఆడటం' (aadatam) what's more, to play is deciphered as 'ఆడటానికి" (aadataaniki). This 'ki' is called 'vibhakti' in Telugu. Vibhakti is it is possible that one single letter or more than one letter which is added to a word in the sentence to draw out the connection with different words in the sentence. English language doesn't utilize Vibhakti, so extraordinary expressions and relational words are interpreted as vibhakti in Telugu. For instance "Mary is concentrating in her room" will be deciphered as "మేరీ తన రూమ్ లో చదువుతుంది" (Mary thana room lo chaduvukuntundhi). Here 'in' is interpreted as లో (lo) furthermore, included after the thing 'room' as

'roomlo' (roomlo). While making an interpretation of from one language to other, relational words are the primary issue. In dialects like Telugu, Bangla, where Relational words are not utilized they will be considered as prepositional expressions and afterward deciphered utilizing vibhakti or it's comparable in their separate dialects. The word reference that is utilized by interpretation framework ought to be sufficiently rich to deal with them.

3.2 Analysis of Telugu Nouns

Basically Nouns in Telugu language would be classified into three groups.

1. Proper and common nouns
2. Pronouns
3. Special nouns such as verbal, pronominalized adjectives and numerals and adverbial nouns

Usually except few rest of all the nouns have gender and number.

Following are the sentences that demonstrate types of nouns in Telugu Language.

In Table 1 sentences a, b, c, d, e, f encompasses two nouns such as first one is pronoun and second one is noun like predicate that reveals about the subject.

In Telugu language sentences can be grouped in pairs and to make plural sentence, singular sentence have pair consist of one pronoun and one noun combined. In this language there are no definite and indefinite articles such as 'the' and 'a' as in English language.

Table 1 Example sentences about singular and plural

a)	[idi goDa]	ఇది గోడ	This is a wall
b)	[ivi goDalu]	ఇవి గోడలు	These are walls
c)	[Adi kitiki]	అది కిటికీ	That is window
d)	[Avi kitikilu]	అవి కిటికీలు	They are windows
e)	[Adi Puli]	అది పులి	That is the Tiger
f)	[Avi Pululu]	అవి పులులు	They are tigers

Table 2 Classification about common nouns in Telugu

Singular mass nouns		
Food	ఉప్పు (uppu)	Salt
	కారం (kaaram)	Chilli
	ధనియాలు (daniyalu)	Coriander
Metals	ఉక్కు (ukku)	Steel
	బంగారం (bangaram)	Gold
Plural mass nouns		
Grain	వడ్లు (vadlu)	Paddy
Inseparable objects		
	భూమి (bhumi)	Land
Intangible nouns		
	తెలివి (telivi)	wisdom

In Telugu language common nouns are classified as count and non-count. The names that are countable said to be count nouns and they are notable from singular and plural. Mass nouns, individual objects and abstract ideas are call them as non-count nouns (Table 2).

In Table 1 has common nouns create the plural in various context due to influence of syllable such as 'లు' (lu) or ళ్లు (Lu), these two are known as plural suffix. In Telugu language each noun has a stem which is nominative from the singular noun.

i. ఫ్యాన్లు (fanlu) → after stem → ఫ్యాన్ (fan)
ii. అక్కలు (akkalu) → after stem → అక్క (sister)
iii. అమ్మాయిలు (ammailu) → after stem → అమ్మాయి (girl)
iv. మనుషులు (manushulu) → after stem → మనిషి (man)

In the above sentences if sandhi changes accordingly suffix 'lu' becomes 'Lu' in specific cases. Following are the rules through which these suffixes would changes dynamically.

Rule. 1 the stemmer would make preceded with ి (i)/ు (u) if words are ends with ట్ (t)/ ంట,ండ (T, NT and ND) and lost plural suffix (lu).

For instances:

కోటి (kotI) (crore) ← కోట్లు (kotLu) (crores)
బంటు (bantU) (soldier) ← బంట్లు (baNTLu)
బండి (banDi) (cart) ← బండ్లు (baNDLu)

Rule. 2. After stemming words are become డి, డు, లు and ఱు then another context when stemming for more than two syllables ends with లి (li), రి (ri) then target syllable becomes ల్ (l) before లు (Lu).

బడి	[baDi] 'school'	బళ్ళు	[baLLu]
గుడి	[guDi] 'temple'	గుళ్ళు	[guLLu]
నాడు	[naaDu] 'day'	నాళ్ళు	[naaLLu]
పెరడు	[peraDu] 'backyard'	పెరళ్ళు	[peraLLu]
మనమడు	[manamaDu] 'grandson'	మనమళ్ళు/మనమలు	[manamaLLu/ manamalu]
తమ్ముడు	[tammuDu] 'younger brother'	తమ్ముళ్ళు	[tammuLLu][4]
కాలు	[kaalu] 'leg'	కాళ్ళు	[kaaLLu]
కుందేలు	[kundeelu] 'hare'	కుందేళ్ళు	[kundeeLLu]
మైలు	[mail(u)] 'mile'	మైళ్ళు	[maiLLu][5]
పెన్సిలు	[pensil(u)] 'pencil'	పెన్సిళ్ళు	[pensiLLu]
పంతులు	[pantulu] 'schoolmaster'	పంతుళ్ళు	[pantuLLu]
ఊరు	[uuru] 'village'	ఊళ్ళు	[uuLLu]
పేరు	[peeru] 'name'	పేళ్ళు/పేర్లు	[peeLLu or peerlu]
వాకిలి	[waakili] 'doorway'	వాకిళ్ళు	[waakiLLu]
మంగలి	[mangali] 'barber'	మంగళ్ళు	[mangaLLu]
పందిరి	[pandiri] 'canopy'	పందిళ్ళు	[pandiLLu]

Rule. 3. Stemming word result terminate with ట్టి (TTi), ట్టు (TTu), డ్డి (DDi), DDu before Lu (లు).

For Instance:

పుట్లు (puTlu) → puTTi (పుట్టి)

రెడ్లు (reDLu) → రెడ్డి (reDDi)

గుడ్లు (guDLu) → గుడ్డు (guDDu)

చెట్లు (cheTLu) → చెట్టు (cheTTu)

Rule. 4. After stemming LLu (ళ్లు), ను (NNu) before ND or L

For Instance:

ఇండ్లు (iNDLu) Houses → ఇల్లు (iLLu) House

ముండ్లు (muNDLu) → ముళ్ళు (muLLu) thorn

కండ్లు (kandlu) → కళ్ళు (kaNNu) eye

Rule. 5. Stemmer would target అం (am/aam), is substituted by ఆ (aa) and target stem ఎం (em) is substituted by (EE) before the plural suffix లు (lu).

For Instance:

పుస్తకం	[pustakam]	'book'	పుస్తకాలు	[pustakaalu]
గుర్రం	[gurram]	'horse'	గుర్రాలు	[gurraalu]
కష్టం	[kaSTam]	'difficulty'	కష్టాలు	[kaSTaalu]
పెండ్యాం, పెళ్ళాం	[peNDLaam, peLLaam]	'wife'	పెండ్యాలు, పెళ్ళాలు	[peNDLaalu peLLaalu]
పందెం	[pandem]	'bet', 'race'	పందేలు	[pandEElu]
పళ్ళెం	[paLLem]	'plate'	పళ్ళేలు	[paLLEElu]

4 Result and Discussion

This article presented few rules to recognize various nouns for morphological analysis during Telugu text for various situations such as question answering and recommended systems and information retrieval and sentiment or opinion analysis. Many Telugu language has issues for exceptional cases to analyze syntactically. Few words does not have any equivalent English words for further analysis as part of Telugu language. The author also presented various kinds of methods for machine translation techniques for text translation for natural language processing.

5 Conclusion

The current paper emphasized on an approach for morphological analysis in Telugu Dravidian language for syntactical and token recognition. The authors focused on noun stemming process for text analysis with various rules with distinguish situations. Apart from this, presented about information towards different types machine translation techniques for Telugu language. The proposed approach presented rule based suffix method for all types of noun and pronoun combination sentences for Telugu language.

References

1. Battacharya P (2015) Machine Translation, vol 29, no 3–4. CRC Press
2. Naik MV, Vasumathi D, Siva Kumar AP (2018) An enhanced unsupervised learning approach for sentiment analysis using extraction of tri-co-occurrence words phrases. In: Second international conference on computational intelligence and informatics, vol 712, pp 17–26. Springer
3. Dwivedi SK, Sukhadeve PP (2010) Machine translation system I Indian perceptive. J Comput Sci 6(10):1082–1087
4. Reddy MV, Hanumanthappa M (2013) NLP challenges for machine translation from english to indian languages. Int J Comput Sci Inform 3(1):2231–5292
5. Naik MV, Mohanty R (2014) An expert system approach for legal reasoning in acquiring immovable property. In: IEEE conference ICNSC, pp 370–374
6. Bharti A, Chatanya V, Sangal R (1995) Natural language processing: a paninian perspective. Prentice Hall, New Delhi
7. Antony P, Soman KP (2012) Computational morphology and natural language parsing for indian languages: a literature survey. Int J Sci Eng Technol 3(4):136–146
8. Francisca J, Mia MM (2011) Adapting rule based machine translation from English to Bangla. IJCSE 2(3):334–342
9. Naik MV, Anasari MD, Gunjan VK, Kumar S (2020) A comprehensive study of sentiment analysis in big data applications. Advances in cybernetics, cognition, and machine learning for communication technologies. Springer, Singapore, pp 333–351

A Traditional Analysis for Efficient Data Mining with Integrated Association Mining into Regression Techniques

G. SuryaNarayana, Kamakshaiah Kolli, Mohd Dilshad Ansari, and Vinit Kumar Gunjan

Abstract A Wal-Mart salesman was trying to surge the sales data of the store by combining the commodities together and putting discounts on those products. The goods are clearly distinct thus he found that nurturing kids is exhausting. And to release pain, guardian decided to buy beer. Data Mining, also known as KDD, to find irregularities, associations, arrangements, and tendencies to forecast consequences. Apriori algorithm is a standard process in data mining. It is utilised for mining recurrent sets of items and related association rubrics. It is formulated to work on a database comprising of a lot of transactions. It is very vital for operative Market Basket Investigation and this assistance the patrons in buying their substances with more effortlessness which escalates the sales of the markets. While finding goods to be associated together, it is imperative to have some association on which the commodities can be listed together. In this research work a hybrid method has been proposed to attenuate association rules using optimization algorithm Differential Evolution with Apriori Algorithm. Firstly, Apriori algorithm is applied to get frequent itemsets and association rules. Then, AMO is employed to scale back the amount of association rules with a brand new fitness function that comes with frequent rules. it's observed from the experiments that, as compared

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_127

with the opposite relevant techniques, ARMAMO greatly reduce the computational time for frequent item set generation, memory for association rule generation, and also the number of rules generated. Data mining could be a process that uses a spread of information analysis tools to find patterns and relationships in data which will be accustomed make valid predictions. Association rule is one in every of the favored techniques used for mining data for pattern discovery is that the KDD. Rule mining is a very important component of information mining. to seek out regularities/patterns in data, the foremost effective class is association rule mining. Mining has been utilized in many application domains. during this paper, an efficient mining based algorithm for rule generation is presented.

Keywords Apriori algorithm · Genetic Algorithm · Differential Evolution (DE) · Optimization algorithm · Data mining · Association rules

1 Introduction

Mining of frequent set of items [3] is a data-mining technique which is widely used for determining sets of commonly happening items in huge databases. A distinctive instance where this algorithm is utilized perceives the associations of diverse things in the store. For illustration, to detect which stuffs are accepted frequently collected. This data would allow them to have improved prearrangement plans of their belongings and would also benefit a prodigious deal with effective marketing of goods. The common item set mining (FIM) is also very convenient in numerous request domains such as social networks and supermarket applications to spot tendencies in sales. These applications in significant arenas make common item set mining a zone of active investigation these days [1–3].

In later a long time, one of the appealing and critical subject of investigate is information mining. There's a sharp eye on inquire about in this region from the specialists of computer science, IT industry, logical investigation, business application, restorative, instruction and in our society, because of expansive verifiable information. Information mining is as a rule known as KDD. KDD is one of the critical forms of extracting raw information to urge productive information which can be valuable in DSS.

From previous couple of days visible expanding intrigued in ap- managing affiliation guidelines [4] to a assortment of statistics mining errands such as classification [17], clustering [12], and peculiarity location [14]. For occasion, techniques including CBA [17, 18] and CMAR [16] had been created to consolidate affiliation policies into the development of rule-based totally classifiers. Such strategies were observationally seemed to outflank tree-primarily based calculations along with C4.5 and rule-based totally calculations inclusive of Ripper [7] making use of distinct benchmark datasets.

Regression is another information mining assignment that can possibly advantage from affiliation rules. Relapse can be seen as a more common frame of

Table 1 Descriptive techniques for predictive modeling

Technique	Classification	Regression
Tree-based	C4.5, OC1, etc.	CART, RT, etc.
Rule-based	Ripper, CN2, etc.	Cubist
Association-based	CBA, CMAR, etc.	?

prescient modeling, where the target variable has nonstop values. Right now, there's a wide range of strategies for building relapse models from straight to more complex, non-linear methods such as relapse trees, run the show- based relapse, and manufactured neural systems.

Tree-based and rule-based techniques are desirable as they create expressive models that would provide help investigators to way better grasp the essential shape and connections in information. Table 1 affords scientific class of clear techniques applied for category and relapse. Another course of procedures that will create graphic models is predicated on affiliation regulations. These techniques are precious as they'll effectively appearance the entire input area to grasp a hard and fast of candidate regulations for demonstrate building. This contrasts from the strategy taken by using many tree-primarily based or rule-primarily based strategies, which should grow a limb or run the display from scratch during a ravenous mold, without the understanding of the past of knowing whether or not it'll find yourself an excellent sub tree or run the display. Additionally, for the rationale those affiliation guidelines should fulfill positive bolster measure and are assessed over all the occurrences, fashions built from these guidelines are less vulnerable to clamor.

Table 1 moreover highlights a quintessential direction of techniques nevertheless misplaced from the scientific classification, specifically, association-primarily based techniques for relapse. Here, we display a common system, Relapse Based on Affiliation (RBA), for setting up relapse models the use of association rules. The exhibit carries of a collection of IF-THEN rules, the place the run the display ensuing con- tains the expected esteem of the target variable. The proposed systems contain unmarried-rule (1-RBA) and multi-rule (weighted k-RBA) plans. Within the unmarried run the show plot, each take a look at example is anticipated the usage of a single affiliation rule whereas interior the multi-rule plot pre- lingual authority can be a weighted whole of a few association rules.

2 Problem Definition

Most of the fundamental calculations for dominant expansive range of affiliation policies rectangular measure frequently computationally high priced and conceivably produce a lot of unimportant rules. to beat these problems, this paper proposes a contemporary affiliation run the exhibit mining algorithmic program supported Creature Relocation optimization (AMO). AMO is one in each of the major normal optimization calculations supported the behavior of creature movement. Inner the

projected strategy, rules that don't seem to be of tall bolster and superfluous rectangular measure erased from the data. Due to the fact it had been visit guidelines rectangular measure unbroken and shown. of these criteria square measure joined into the well-being work of the AMO for superior technology of rules. ARM-AMO principally progresses ARM-PSO in grappling problematic swarm optimization problems in terms of variety of rules, time and memory utilization by receiving the modern day calculation.

2.1 Knowledge Discovery Database (KDD)

KDD alludes [6] to the generally handle of finding valuable information from information. It comprises of the assessment and conceivably elucidation of the courses of action to create the choice of what qualifies as information.

Steps Included in KDD

(a). Information Cleaning - Fundamentally in this step, the commotion and conflicting information are evacuated.
(b). Information Choice - fundamentally, in this step, information pertinent to the investigation assignment are recovered from the database.
(c). Information Change - In this step, information is changed into shapes fitting for mining. Too, by performing outline or conglomeration operations.
(d). Information Mining - for the most part, in this, cleverly strategies are connected in arrange to extricate information designs.
(e). Pattern Evaluation - basically in this step, data patterns are evaluated.
(f). Knowledge Presentation - generally, in this step, knowledge is represented.

Knowledge Data in Information Mining The approach of finding and deriving go traces from statistics consists of the rehashed utility of the ensuing labels: Evolving an perception of:

- The application sphere
- Relevant past information
- The destinations of the retail

Creating a Target Dataset
Choosing a information set, or concentrating on a subset of factors, or information tests, on which revelation is to be done.

Data Cleaning and Preprocessing
Elimination of clamor or exceptions.
Gathering essential data to show or account for clamor.
Plans for taking care of lost information areas.
Accounting for time grouping data and known varieties.

Data Reduction and Projection
Finding valuable highlights to speak to the information depending on the objective of the errand. Utilizing dimensionality decrease strategies to diminish the viable number of factors. That's beneath flawless concern or to find invariant representations for the data.

Picking the Data Mining Algorithm(s)
Selecting method(s) to be utilized for looking for designs with in the information. Deciding which models and parameters may be fitting. Matching a specific information mining strategy with the criteria of the KDD prepare.

Data Mining

- Searching for traces of intrigued in a specific representational shape. Such representations as cataloguing rules or trees, relapse, bunching, and so forward.
- Interpreting mined designs.
- Combining found information.

3 Optimization Algorithms

Optimization algorithms supports to mineralize (or maximize) an target function which is basically a mathematical function reliant on internal learn able parameters of model which are utilized in computing the objective values from the set of predictors utilized in the model. Genetic Algorithm and Differential Evolution both of these are optimization which assists in minimizing association rules to make the analysis of customer transaction fast, easy and accurate.

Genetic Algorithm in addition to Differential Evolution Algorithm both of these are optimizing method for Apriori algorithm [8]. Apriori algorithm has quite a few association regulations and both of these systems backs the Apriori algorithm by minimizing the association policy of Apriori Algorithm. Knowledge Discovery in Databases (KDD) has been a very charming and fascinating investigation challenge. Its focal point is to draw captivating and determined data from a bulky miscellany of data kept in the transactional databases.

3.1 Genetic Algorithm (GA)

The center thought of Hereditary Calculation is to mimic the normal choosing and the survival of the fittest. In Hereditary Calculation, the arrangements are appeared as chromosomes. The chromosomes are assessed for wellness values and they are evaluated from best to most noticeably awful based on wellness esteem. The method to create modern arrangements in GA is to duplicate the common choice of

living beings [16], and this handle is finished through rehashed applications of three hereditary administrators: determination, hybrid, and mutation

3.2 Differential Evolution (DE)

There are 3 fundamental forms in all developmental calculations. The primary handle is the starting prepare where the essential populace is arbitrarily created [14] agreeing to a few arrangement representation. Each person speaks to a arrangement. On the off chance that an roundabout representation is utilized, everybody must first be decoded into a arrangement. Each arrangement within the populace is at that point assessed for wellness esteem within the 2nd stage. The wellness values can be utilized to characterize the normal populace wellness or to rank the individual arrangement. The 3rd handle is the creation of a amateur populace by annoyance of arrangements within the existing populace.

3.3 Reduction of Items to Find Best Associations

The Apriori theory [9] can diminish the number of thing sets that are required to examine. Put essentially, the Apriori rule states that in case an thing set is rare, at that point all its supersets must too be occasional, this implies that in case {lager} was start to be occasional, it can be expected {brew, pizza} to be consistently or indeed more rare. So in blend the list of prevalent thing sets, it is required not to consider {lager, pizza}, nor any other thing set arrangement that contains lager.

Finding thing sets with tall assistance, using the Apriori rule, the number of item sets that got to be scrutinized can be pruned, and the list of visit thing sets can be gotten in underneath steps:

Step 0: Start with item sets having just one item, such as {apple} and {pear}.
Step 1: Decide the support for item sets. Keep the item sets that gather your minimum support threshold, and remove item sets that don't.
Step 2: Utilizing the item sets you have kept in Step 1, produce all the possible item set configurations.
Step 3: Reiterate Steps 1 & Step 2 till there are no more novice item sets. {apple} was decide to have low support, hence it was removed and all other item set configurations that contain apple need not be considered. This abridged the number of item sets to consider by more than half.

Note that the bolster edge that you just choose in Step 1 can be establishment on formal examination or past involvement. On the off chance that you discover out that deals of things past a certain extent tend to have a vital affect on your benefits, you might consider utilizing that sum as your back limit.

3.4 Apriori with Genetic Algorithm (GA)

GA is based on the principle of natural selection and development. A GA is a process heuristic that imitate the procedure of natural evolution. This process is used to get purposeful solutions for optimization and search related problems. GA is a type of evolutionary algorithms (EA), which come up in each step to give solutions to optimization problems by deploying various techniques motivated by natural evolution like mutation, crossover, inheritance and selection.

Algorithm Procedure

1. Begin
2. Load dataset in the memory.
3. Deploy Apriori Algorithm on it to frequent product groups.
4. Suppose F is the frequent item-set set gained by Apriori Algorithm.
5. Set O = Φ where O is the o/p set having all discovered association rules.
6. Apply some terminating rules on Genetic Algorithm.
7. Put each item set of F in some encoding policy.
8. Then, choose members and apply GA on them to produce association rules.
9. No, find the fitness function of every rule A → B.
10. If cost of fitness function come across the criteria of choice then
11. Set O = O {A → B}.
12. If the required number of generations is not completed, then move to step 3.
13. END.

Apriori with Differential Algorithm (DE) Algorithm:

1. Begin
2. Load an item-set to the memory.
3. Deploy Apriori Algorithm on it to frequent item-sets. Let F is the frequent item-set set achieved by Apriori Algorithm.
4. Set O = Φ where O is the o/p set having all discovered association policies.
5. Apply some terminating regulations on Differential Evolution Algorithm.
6. Show each item set of F in some encoding scheme.
7. Then, chosen members and apply DE Algorithm on them to produce association rules.
8. Now, calculate the fitness function of each policy A → B.
9. If value of fitness function meet the level of selection then
10. Set O = O U {A → B}.
11. If the required number of generations is not finished, then move to step 3.
12. END.

4 Association Rule Mining (ARM)

Association rules are intended to discover strong rules from databases with the help of a variety of measures of interestingness and for uncovering regularities and sturdy relation among items in huge transactional data. ARM focuses on identifying appealing correlations, frequent occurring pattern, associations or informal structures between sets of items in the commercial databases or any other data repositories. Apart from this ARM assists in separating correlations amid products belonging to any customer conducting business in some market -basket DB can be effectively discovered using ARM.

Regulations in Association Rule Mining algorithms are usually in the form: $X \rightarrow Y$.

IF the value of the forecasting attributes is true, THEN value is predicted for goal attributes.

Both X, Y are frequent item-sets in some DB and $X \cap Y = \varnothing$. The rule $X \rightarrow Y$ can be explained as "if some item-set X happens in a transaction, then some extra item set B will also befall in the same transaction". For instance, suppose in some DBs 35% of total transactions comprise of both bread and sauce and 75% of all transactions include bread. An ARM system will create the rule bread → sauce with 35% support and 75% confidence. Rule support and rule confidence are 2 very vital virtue factors of rule interestingness.

Apriori TID
AprioriTID also aims at disclosing frequent item sets in a transaction database. It is an alternate version of Apriori which uses Apriori to find candidate item sets before beginning of pass. An interesting part of AprioriTID is that the data base is not considered for support counting after first pass. Apriori TID always scans candidate set for support counts. Not preferable when size of problem grows [9].

Apriori Hybrid
This algorithm is a combination of Apriori and AprioriTID. It uses the basic Aprioriin the initial pass but Apriori TID glitters in the next passes [10]. This gives better results in many cases. This algorithm includes extra cost when sliding from Apriori to AprioriTID.

Tertius Algorithm
It walks with order logic representation. It employs rules according to the confirmation measures. An inclusion of several options such as class index, frequency, classification, confirmation threshold, Horn clauses, missing values, noise threshold, roc analysis etc. are with Tertius. It suffers from heavy runtime which is based on the literal count in the rules. An increment in Literals indulges an exponential raise (max is 3 preferable) but still takes hours [13].

Eclat
Eclat algorithm projects transaction as bit matrix and rows projected the item sets support. It follows a depth first transversal of prefix tree [11].

Bit Matrices
Here rows present items and columns represent transactions. If a respective item is seen in a transaction, its bit is set else cleared.

Search Tree Transversal
Eclat searches the prefix tree using depth first order. A modification of node to its child is done by using a new bit matrix which is an intersection of first row with all rows followed. Similarly for other children also rows with infrequent item sets are deleted from matrix. Selectivity. For large dbs, FP tree cannot be held in main memory, so cure is simple partition into smaller database and then construct FP tree.

AIS
This algorithm is a gift by Agarwal [15], Imielinske and Swami. It improves the face of databases for better decision making. It generates only one item consequent association rule that is only rules such as $A \cap B \Rightarrow C$ Not $A \Rightarrow C \cap B$. It runs in 2 phases that is frequent item set generation and then followed by exploring confident and Frequent association rules. It needs the data set to be scanned several number of times for frequent item set and then rules. During first pass individual items support count is considered and then based on threshold value minimum supported item sets are removed/washed out.

FP Growth
The visit design tree (FP-Tree) could be a structure that's compact and stores quantitative data approximately visit design in information base. It applies partition and overcome strategy. [12] It to begin with compresses the input db making an FP tree occurrence to speak to visit thing. Another it separates the compressed db into a set of condition databases. Each one related with one visit design. At long last each such db is mined independently. This way, FP growth diminishes the look cost trying to find brief designs recursively and after that concatenating them in long visit designs, advertising best (Table 2).

Table 2 Analysis

SN	Properties	Apriori	Apriori TID	Apriori hybrid	Tertius
1	Candidate generation	Apriori produces candidate item sets from of previous pass by not taking the transaction in database	Once the first pass is completed, database is not considered for counting support of candidate itemsets	It generates Candidate item sets by using Apriori but later jumps to AprioriTID	Candidates are generated by considering attribute pairs for the rule generation
2	Methodology	Join and prune phases/ steps	Considers Join and Prune in combination with TIDS	Combination of Apriori and Apriori TID	First order logic presentation is preferred
3	Database scan	Needs many scans of databases	Needs only one scan	Addition of Apriori and AprioriTID	Scan depends on the count of literals in rules
4	Memory usage	It occupies high memory space for the process of candidate generation	In first pass, this algorithm needs memory for Lk-1 and Ci-1 candidate generation. It indulges extra cost in case if it does not fit in memory	It infers extra memory when sliding from Apriori to AprioriTID	Consumes considerable time and prints out rules when program runs short of memory and messages
5	Execution time	Mainly spends more for Candidate Generation	Executes fast in contrast to Apriori for small problems but incurs more time for large ones	Preferably better than Apriori and AprioriTID	Consumes considerable long time for larger sets i.e. even hours
6	Data support	Limited	Nearly large sets	Very Large datasets	Limited
7	Accuracy	Less	Better than Apriori	Increased Accuracy compared to AprioriTID	Considerable not high i.e. Average

(continued)

Table 2 (continued)

SN	Properties	Apriori	Apriori TID	Apriori hybrid	Tertius
8	Applications	Can be mainly preferred for closed Item sets	Preferred for small problems	Well suited for closed sets	Most generally preferred
9	Privacy preserving approach preferred	Heuristic approach	Exact approach	Heuristic approach	Cryptographic approach

5 Conclusion and Future Scope

In this paper, we have displayed history of Affiliation run the show mining and step by step inquire about advance towards affiliation run the show mining from 1993 to till date. Analysts have displayed great and imaginative thoughts towards effectiveness and exactness of affiliation run the show mining. But a few of the confinements portrays as beneath requires genuine thought and enhancement in later calculations. A few restrictions of affiliation run the show mining are recorded as one is Profundity understanding and translation of great designs, e.g., semantic explanation and relevant examination of visit designs are required. Moment Presumptions in most of the cases ought to be dodged so that it can be utilized in hone. also disclosure taken a toll, communication and computation fetched ought to be in need.

Third Association rule show calculations ought to be created utilizing single filter of database in put. Fourth Database-independent estimations ought to be set up. Fifth For XML databases, exact and efficient algorithm ought to be outlined. 6th Social arranges ought to be analyzed for better usage of social community. Seventh Computer program Mistake discovery is presently conceivable by affiliation run the show mining, but more adaptable and successful calculations are still required. Finally unused applications ought to be explored.

References

1. Han J, Kamber M (2001) Data mining concepts and techniques. Morgan Kaufmann Publishers, San Francisco. ISBN 1558604898
2. Agrawal R, Srikant R (1994) Fast algorithms for mining association rules. In: Proceedings of VLDB 1994, Santiago, Chile, pp 487–499, September 1994
3. Vaidya J, Clifton C (2002) Privacy preserving association rule mining in vertically partitioned data. In: Proceedings of conference knowledge discovery and data mining, pp 639–644, July 2002

4. Shah K, Thakkar A, Ganatra A (2012) Association rule hiding by heuristic approach to reduce side effects & hide multiple R.H.S. items. Int J Comput Appl (0975–8887) 45(1):1–7
5. Hatefi E, Mirzaei A, Safayani M (2014) Privacy preserving quantitative association rule mining using convex optimization technique. In: 2014 7th international symposium on telecommunications (IST 2014)
6. Sirole T, Choudhary J (2014) A survey of various methodologies for hiding sensitive association rules. Int J Comput Appl (0975–8887) 96(18):12–15
7. Chaudari M, Varmora J (2016) Advance privacy preserving in association rule mining. In: IEEE conference (ICEEOT) 2016
8. Singh T, Sethi M (2015) Sandwich-apriori: a combine approach of apriori and reverse-apriori. In: 2015 annual IEEE India conference (INDICON)
9. Li Z-C, He P-L, Lei M (2005) A high efficient AprioriTid algorithm for mining association rule. In: 2005 international conference on machine learning and cybernetics, vol 3, pp 1812–1815
10. Chadokar SK, Singh D, Singh A (2013) Optimizing network traffic by generating association rules using hybrid apriori-genetic algorithm In: 2013 tenth international conference on wireless and optical communications networks (WOCN), pp 1–5
11. Manjitkaur UG (2014) ECLAT algorithm for frequent itemsets generation. Int J Comput Syst 01(03):82–84 (ISSN: 2394-1065)
12. Li M, Wang C, Yan Y (2010) The research of FPGrowth method based on apriori algorithm in MDSS. In: 2010 international conference on digital manufacturing and automation (ICDMA), vol 2, pp 770–773
13. Sunita BA, Lobo LMRJ (2012) A comparative study of association rule algorithms for course recommender system in e-learning. Int J Comput Appl (0975–8887) 39(1):48–52
14. Harman R (1995) A very brief introduction to particle swarm optimization
15. Agarwal R, Imielinski T, Swami A (1993) Mining association rules between stes of items in large databases. In: SIGMOD 1993 proceedings of management of data
16. Gkoulalas-Divanis A, Verykios VS (2006) An inter programming approach for frequent itemset hiding (CIKM 2006)
17. Guo Y (2007) Reconstruction-based association rule hiding. In: IDAR-workshop on innovative database research
18. Kapil S, Chawla M, Ansari MD. (2016) On K-means data clustering algorithm with genetic algorithm. In: 2016 fourth international conference on parallel, distributed and grid computing (PDGC), December 2016, pp 202–206. IEEE

On Sudoku Problem Using Deep Learning and Image Processing Technique

Dharma Karan Reddy Gaddam, Mohd Dilshad Ansari, and Sandeep Vuppala

Abstract Sudoku has been a challenging puzzle for many people, in fact it is considered as a brainstormer. Many find it difficult to solve the puzzle. We generally apply different math techniques to solve the Puzzle. It would be great, if a computer could solve Sudoku. We have used deep-learning concepts to solve the Sudoku puzzle in a most optimized manner. Moreover, image processing and object localization algorithms are used to detect the Sudoku puzzle. Initially, an image consisting of Sudoku is provided, by using object localization & CNN algorithms we detect the Sudoku square box. A 9 × 9 square box is detected. By using ANN, we detect the numbers and empty spaces, later Backtracking algorithm is used in solving the puzzle in a more efficient manner. Puzzle is detected and digits are recognized, which can be digital or handwritten and finally the puzzle is solved. We achieved an accuracy rate up to 99% in detecting the puzzle.

Keywords Deep learning · Object localization · Backtracking · Image processing

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_128

1 Introduction

Sudoku is a math puzzle where 9 × 9 square box is given and numbers such as 1, 2, 3, 4….9 are to be filled in the boxes in such a way that

Rules of Sudoku:

1. Every row, column should have all numbers from 1 to 9
2. No number is repeated twice in every row and column
3. Each 3 × 3 boxes should satisfy the above 2 points

If the above statements are satisfied, a perfect Sudoku puzzle can be solved. Object localization was observed to be best in detecting the Sudoku. It is also noted that many CNN architectures are used for detecting the Sudoku puzzle. Object localization was therefore similar to Alexnet. Hence, we firstly need to detect the 9 × 9 square box of Sudoku. Many algorithms are used for detection, but the object localization algorithm using CNN was the most efficient in detecting 9 × 9 square boxes. We have read many research papers confined to Sudoku and worked on various algorithms and models. After all the analysis we improvised the model & we found out that an accuracy of 99.67% on test dataset was achieved in detecting puzzle. We have used tensorflow framework to solve the puzzle.

Deep learning has been evolving factor in day to day's life. One can use it's concepts for various functionalities. Object detection using image processing made life easy, as it helps detecting objects. It is difficult for a human being to detect many items. Hence we use them for detection.

The above Fig. 1 is a Sudoku puzzle, in which various digits confining from 1, 2, 3 … 9 are given, the above image has got various components apart from the Sudoku box, It is important that machine ignores the noise from the image. Hence we use object detection concept to detect the Sudoku box.

2 Related Work

Huge amount of work and research was done on solving Sudoku. The puzzle which we recognize it as the Sudoku was invented by Howard Garns, a freelance puzzle inventor from Connersville, Indiana, USA in 1979 when it was published in Dell Pencil Puzzles *and Word Games* magazine. The puzzle was called as "Number Place", since it got involved in placing the individual numbers into vacant spots on a 9 × 9 grid. Neural Networks are useful in classifying the digits in the puzzle. Algorithms such as Simulated Annealing, Genetic Algorithm are used but back-tracking was found to be the best algorithm in solving the Sudoku puzzle. As we know that a lot of research has been done on Sudoku we have used CNN architecture in detecting a Sudoku puzzle; in fact we have worked on detecting the puzzle in a more efficient manner. Some of the work and research related to puzzle

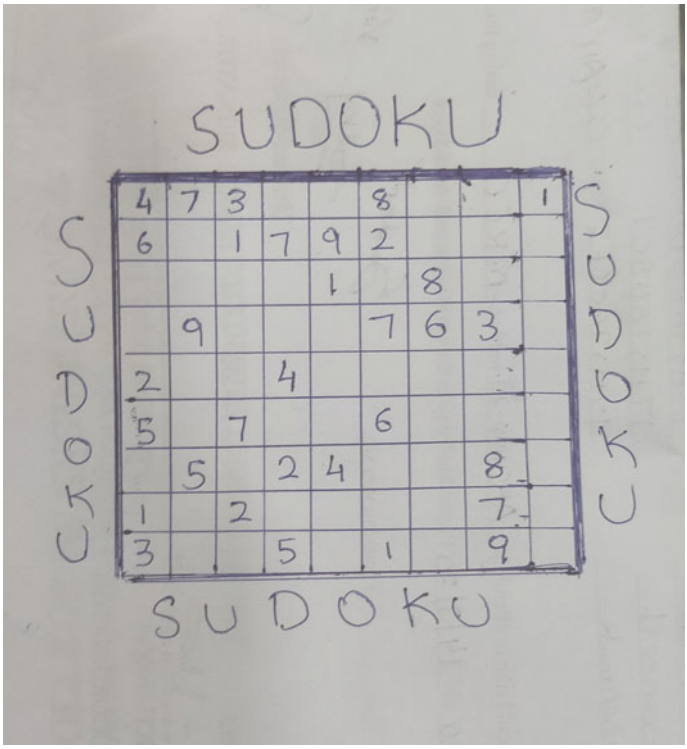


Fig. 1 Handwritten Sudoku puzzle

was done by Kamal et al. [3] they proposed, "Detection of Sudoku Puzzle using Image Processing and Solving by Backtracking, Simulated Annealing and Genetic Algorithms: A Comparative Analysis [1–6].

2.1 Introduction to Convolutional Neural Networks

CNN is generally referred to as a deep learning algorithm. CNN'S are used in the area of images. Whenever an image dataset is given, to train the model we use CNN. As image comprises of pixels,image processing is required. In general , preprocessing required in CNN is quite lower when compared to other classification algorithms. The architecture of CNN is reflection of the pattern of neural connectivity in the human brain. There are wide varieties of CNN architectures, Few of them are LeNet, GoogleNet, AlexNet, Resnet etc. CNN architectures are developed in recent years to understand the training of an image in a better way. Thus CNN is a useful in dealing an image dataset [7–11].

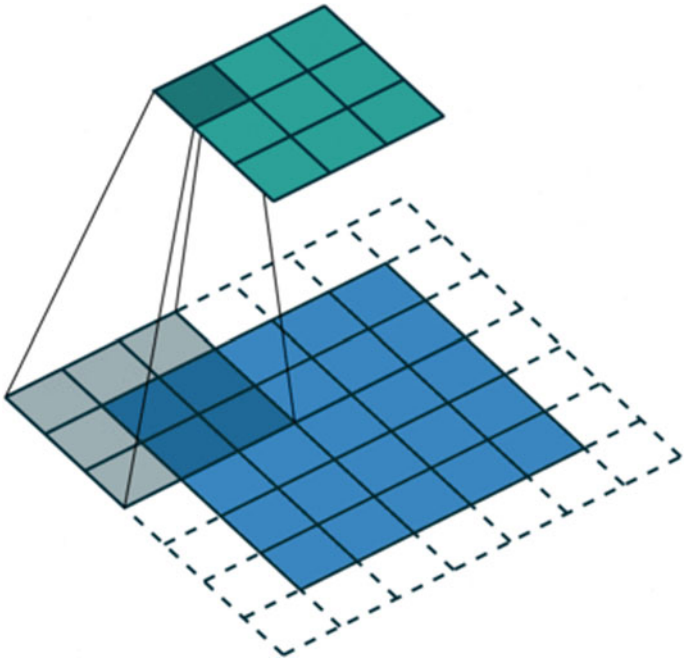


Fig. 2 Kernel of size 3 × 3 (green) and a padding = 1 and stride = 1

The main function of CNN is to convolute the image by applying kernel. The size of kernel varies upon the size of the image, it is usually in the form of (k x k). They are in a matrix representation, where as the width and height of kernel are same, we have used CNN to classify images, Padding and Stride are also used (Fig. 2).

The above representation explains about working of convolution by using kernel filters, The box(blue) represents the pixels of a input image and the box (green) represents kernel matrix, as it is clearly shown that stride = 1 has been taken, Thus the kernel matrix displaces by 1 pixel (across and below) to the image, Hence the convolution works in the above manner. Max-Pooling can also be used to reduce the spatial dimensions. During convolution large numbers of parameters are involved. Interestingly no parameters are involved during max-pooling. There is a special case known as zero padding as it helps in preserving the size of a input image. The spatial size of the output image can be calculated as ([W − F + 2 P]/S) + 1.

This is how a CNN network looks like. Finally after multiple convolutions, size is changed and is made to fit in the FCC. Fully Connected Layers are also present where each neuron is connected with other neurons and a softmax function is applied and final output is achieved (Fig. 3).

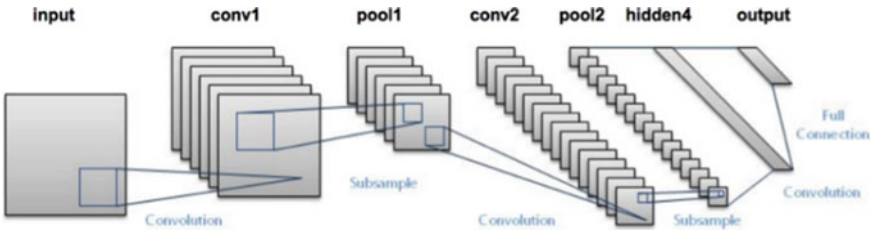


Fig. 3 Sample CNN network

Fig. 4 Sample image where objects are detected

2.2 Object Detection

Object detection is referred as computer vision technique used for finding instances of different objects in images or videos. A human from his naked eye can understand the objects present in an image by seeing. Therefore, how can a machine understand the image, here comes the concept of object detection, where by using it machine can actually detect different objects present in an image. Wide variety of deep-learning approaches using CNN such as R-CNN, YOLO and selective search etc. are used (Fig. 4).

The above image is a good example to explain how object detection is useful. By directly looking it becomes easy for a person to understand the objects present in the image. In the Sudoku puzzle, our main objective is to detect the Sudoku box, the input image given may contain other attributes and may contain noise, to eliminate all of them, we use object detection for locating the Sudoku box in a given image. This is done using CNN where a rectangular box representing Sudoku box is displayed and we crop the detected puzzle and later used ANN of skeletal recognition to identify the digits as well as empty cells. Thus, when all the things are in right place we used backtracking algorithm to get the required digits in the empty cells, finally a Sudoku puzzle is solved.

3 Methodology

The main purpose of the proposed algorithms is to detect the puzzle from the Image. Picture may also contain other attributes and statements. It has to detect the 9 × 9 square box first, and later solve the Sudoku problem by using ANN and backtracking algorithm. The architecture used by CNN is shown in below Fig. 5. Firstly, the frame is resized as 224 × 224 and convolution layers are applied to reduce the image size, we have performed deep learning following steps as given below:

1. Convolution layers.
2. Max pooling.
3. Activation functions

Firstly the image has been converted into grayscale format and the values are placed in [0, 255] and normalized to real values ranging from [0, 1]. The resized frame is given as input in the following architecture.

As shown in the above figure various convolutions and max pooling are applied. We have concerned formulae for it

$$Wo = (Wi - F + 2P)/S + 1 \tag{1}$$

Wo refers to dimension of weight as output
Wi refers to dimension of weight as input (e.g. 1)
F refers to kernel size
S refers to stride
P refers to Padding

By using the above formulae, we can generate size of Wo for each convolution. Different values for stride, padding and filter size are taken. Architecture of CNN is given as below.

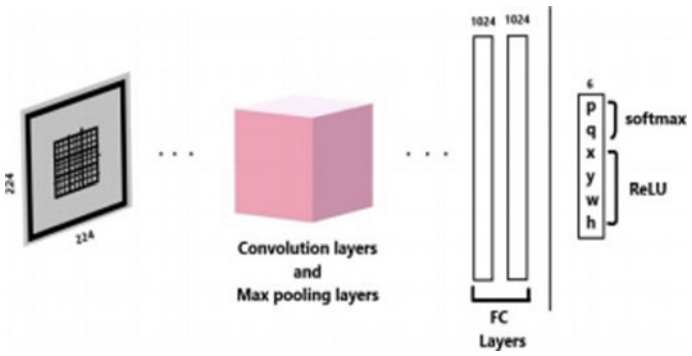


Fig. 5 CNN architecture used for object localization

Convolutional layer 1:
Input with a tensor of size-(224 × 224 × 1)
No. of filters present-96
Size of kernel-(11 × 11 × 1)
Padding-0
Stride-4
Maxpooling layer:
Input with a tensor of size-(54 × 54 × 96)
Size of Pooling-(2 × 2 × 1)
Stride size-(2 × 2 × 1)
Convolutional layer 2:
Input with a tensor of size-(27 × 27 × 96)
No.of filters present-256
size of kernel-(5 × 5 × 96)
Padding-0
Stride-1
Maxpooling layer:
Input with a tensor of size-(23 × 23 × 256)
Size of Pooling-(3 × 3 × 1)
Stride size-(2 × 2 × 1)
Convolutional layer 3:
Input with a tensor of size-(11 × 11 × 256)
No. of filters present-384
Size of kernel-(3 × 3x256)
Padding-0
Stride-1
Convolutional layer 4:
Input with a tensor of size-(9 × 9 × 384)
No.of filters present-384
Size of kernel-(3 × 3 × 384)
Padding-0
Stride-1
Convolutional layer 5:
Input with a tensor of size-(7 × 7 × 384)
No.of filters present-256
Size of kernel-(3 × 3 × 384)
Padding-0
Stride-1
Maxpooling layer:
Input with a tensor of size-(5 × 5 × 256)
Pooling Size-(2 × 2 × 1)
Stride size-(2 × 2 × 1)

Fully Connected Neural network has a input of vector, having length 1024 and output neurons of 1024

Output Layer has a input - a vector of length 1024 & softmax neurons - 2; ReLU neurons - 4; output neurons - 6.

i. ReLu function, which is referred as an activation function is used in the network.
ii. 'He' is used for initialization.
iii. Weight decay of L2 regularization with lambda value 1e − 5 is used
iv. Optimization technique used for the above architecture is Adam and a learning rate of 0.001 is used (Fig. 6).

We cropped the detected Sudoku box and resized to 300 × 300. Architecture confined to Alex-net consists of 4096 neurons in FCC, whereas, there are about 1024 neurons in the FCC (fully connected layer) & by doing it in the above manner a total drop of 18 million parameters is observed. In terms of computations it is much better and faster, which is what we were aiming of.

The architecture is used for detecting a Sudoku puzzle and all the noise confined to the original image is eliminated and exact Sudoku puzzle is displayed and by using our above CNN architecture we have successfully bounded the puzzle and eliminated the other elements i.e. out of Sudoku box.

The Above image is a simplified Sudoku (Unsolved) puzzle. The above image is resized to 252 × 252 pixels which comprise of 9 × 9 Sudoku boxes (81 boxes are present).

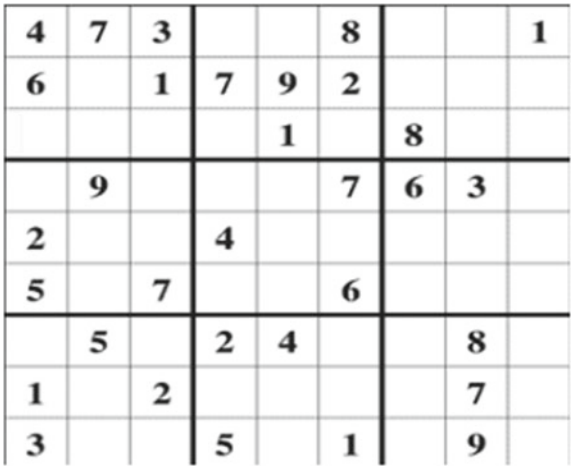


Fig. 6 Cropped image after being detected

3.1 Ann for Skeleton Recognition of Sudoku

In General ANN is inspired by bio-logical neural networks. We used ANN (Artificial Neural Network) for skeleton recognition of Sudoku. A Generic algorithm has been constructed for skeleton recognition called as feed forward back-propagation. The algorithm is used which is based on the mechanism of change in the weights of the system. Which ultimately depends upon the error. However, the output is obtained using pre-initialized weights where illustrations have been generated to the system. Thus, the error has been analyzed and calculated depending upon the output as well as the required output. To reduce the error, backward iteration is performed and ultimately gains change in weight. To get better weights, we used the concept of gradient of the criteria-field in which it ultimately results in optimizing of mean square error. The practice of weight modification depends on the former weights and is performed using the above equations.

$$\Delta w(k+1) = \mu(-\nabla(k)) + \eta \Delta w(k) \tag{2}$$

μ-Learning rate and η-Momentum that lies in the range of [0–1]. It's highly difficult to find the learning rate in a perceptron. The μ which was taken on the higher side is in high danger of giving wrong results & eventually makes slow learning once taken on the inferior side. Hence, μ should be minimized from the higher side to obtain optimized weights resulting in less error. By using the above diagram, we can say that sub-image of skeletons are segmented from a authentic Sudoku image and is targeted to the neural network in form of row binary representation which is used in the detection of numbers in a 9×9 Sudoku matrix image. The skeleton sub-image matrix is altered into a mathematical matrix of size 9×9. All the empty spaces present in puzzle are displayed with numbers 0 in the form of mathematical matrix. As a Result, all the empty blanks are filled up with number's 0 which is shown in the Fig. 10.

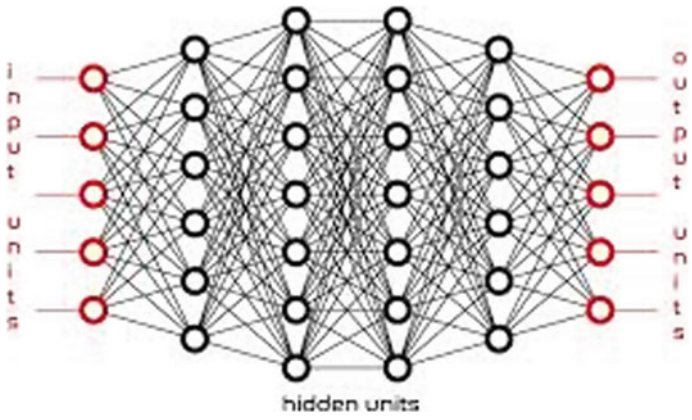


Fig. 7 Sample artificial neural network (ANN)

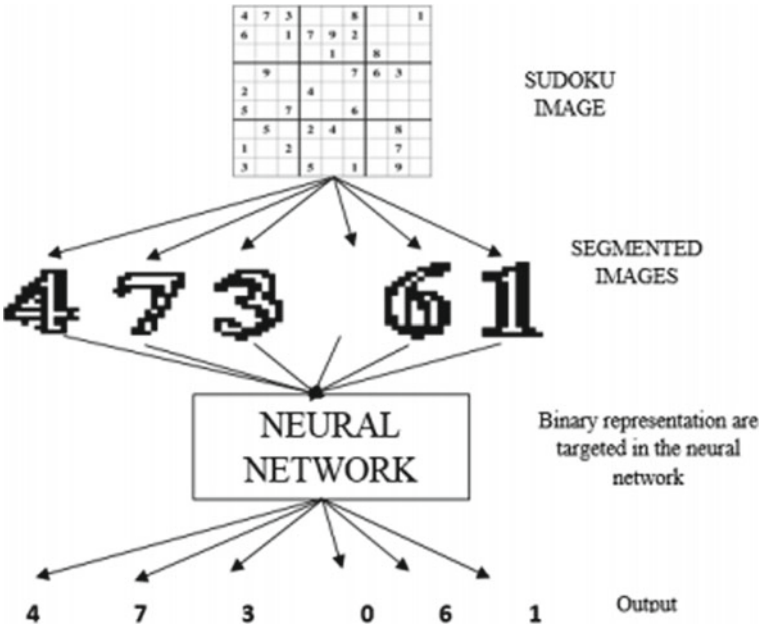
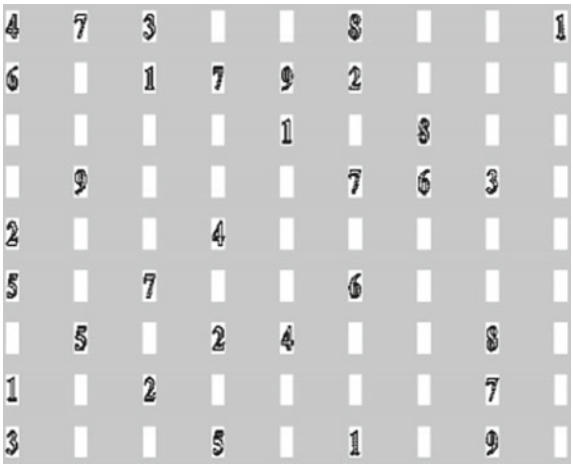


Fig. 8 Segmented image using ANN

Fig. 9 Spaces detection



As we have the Sudoku puzzle which comprises of numbers 1 to 9 and spaces filled with zeroes, we solve the puzzle by using ANN algorithm (Figs. 7 and 8).

The above Fig. 9 gives a clear representation of spaces being detected in Sudoku as the spaces are detected the empty spaces are replaced with zeroes shown in Fig. 10.

Fig. 10 Spaces filled with 0

4 Result and Analysis

Numerous algorithms have been implemented to solve Sudoku puzzle. Many mathematical algorithms have been employed and also produced the solutions for the puzzle. After many practices, it has been found out that Backtracking helps in solving the puzzle in less computation time than the other algorithms. The algorithm starts by finding the 0 present in the Sudoku. If a 0 cell is found, then every possible number is tried in the zero cells. If a number is safe to fill the cell, i.e., if it doesn't confront the row, column and block constraints, a certain number is replaced with the cell containing 0 and algorithm starts to find a another cell filled with number 0. If a number can't be filled, then, the algorithm backtracks and fills the earlier filled cell with another number or empties it. This goes on in a backward manner, until all the 0 cells are replaced with other numbers, called as Backtracking algorithm (Fig. 11).

The CNN used for detection of Sudoku has achieved an accuracy rate of 99.27% on test data set and the detection of Sudoku puzzle was implemented using image processing techniques and later artificial neural networks for skeleton recognition to detect the numbers, empty spaces and solved using Backtracking algorithms. The average time taken for detecting of Sudoku puzzle observed to be 1.738 s. We have generated numbers in empty filled boxes of Sudoku puzzle which was given originally in the above Fig. 9.

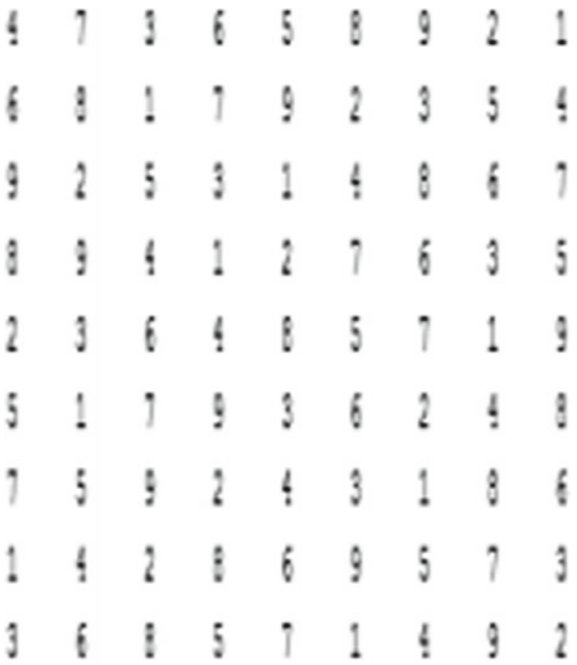


Fig. 11 Solved Sudoku puzzle using backtracking

5 Conclusion

In this work, we have proposed CNN based algorithm to detect the Sudoku box. We have found the optimal way of detecting as well as constructing the Sudoku puzzle by using Image processing with object localization. Moreover, ANN and Backtracking algorithms also used to solve the Sudoku Puzzle. We achieved the accurate rate up to 99%. In future we would like to extend this work in solving other game problems such as little words, cross words and chess etc.

Acknowledgements I would like to thank Management of CMR College of Engineering & Technology, Hyderabad for providing the facility and infrastructure to carry out the research.

References

1. Redmon J, Divvala S, Girshick R, Farhadi A (2016) You only look once: unified, real-time object detection. In Proceedings of the IEEE conference on computer vision and pattern recognition 2016, pp 779–788
2. Ren S, He K, Girshick R, Sun J (2015) Faster r-cnn: towards real-time object detection with region proposal networks. In: Advances in neural information processing systems 2015, pp 91–99

3. Kamal S, Chawla SS, Goel N (2015) Detection of sudoku puzzle using image processing and solving by backtracking, simulated annealing and genetic algorithms: a comparative analysis. In: 2015 third international conference on image information processing (ICIIP) 21 December 2015, pp 179–184. IEEE
4. Chitranshi G, Tiwari S, Singh R, Sengar PS (2016) Neural network based skeleton recognition and sudoku solving. In: 2016 3rd international conference on signal processing and integrated networks (SPIN) 11 February 2016, pp 691–693. IEEE
5. Vasudeva N, Parashar HJ, Vijendra S (2012) Offline character recognition system using artificial neural network. Int J Mach Learn Comput 2(4):449
6. Zhao H (2011) Character image recognition based on the improved BP neural network. In: Applied mechanics and materials, vol 58, pp 2655–2658. Trans Tech Publications Ltd
7. Naik MV, Vasumathi D, Kumar AS (2017) An enhanced unsupervised learning approach for sentiment analysis using extraction of tri-co-occurrence words. In: Proceedings of the second international conference on computational intelligence and informatics: ICCII 2017, 23 July 2018, vol 712, p 17. Springer
8. Rashid E, Ansari MD, Gunjan VK, Khan M (2020) Enhancement in teaching quality methodology by predicting attendance using machine learning technique. In: Modern approaches in machine learning and cognitive science: a walkthrough, pp 227–235. Springer, Cham
9. Goel AK, Chakraborty R, Agarwal M, Ansari MD, Gupta SK, Garg D. (2019, December). Profit or Loss: A Long Short Term Memory based model for the Prediction of share price of DLF group in India. In 2019 IEEE 9th International Conference on Advanced Computing (IACC) (pp. 120–124). IEEE
10. Agarwal M, Bohat VK, Ansari MD, Sinha A, Gupta SK, Garg D (2019) A convolution neural network based approach to detect the disease in corn crop. In: 2019 IEEE 9th international conference on advanced computing (IACC), pp 176–181. IEEE
11. Sethi Kapil, Jaiswal V, Ansari MD (2019) Machine learning based support system for students to select stream (subject). Recent Pat Comput Sci 12:1. https://doi.org/10.2174/2213275912666181128120527

On Security and Data Integrity Framework for Cloud Computing Using Tamper-Proofing

Mohd Dilshad Ansari, Vinit Kumar Gunjan, and Ekbal Rashid

Abstract The cloud computing has become an emerging issue in IT industry as well as in academics due to its variant advantages. Cloud computing consist of many computing possessions like memory, storage and processor which are not physically available at the user's site. These devices are stored outside and controlled by the cloud service providers, there is always a risk of losing data or the data may be altered by internal as well as external attackers. However, it may not be fully trustworthy because the user does not have copy of all stored data which refer to the fact that while users can put their files into the cloud server, nobody knows that where exactly they should be. Further, it poses various security challenges as generating secure and reliable data storage over unreliable cloud service provider. The data integrity is one of the prime concern in cloud computing. This paper presents a framework for data integrity in cloud computing using tamper-proofing algorithms (TPA) such as tamper-proof checking code (TPC) and tamper- resistance (TPR).

Keywords Security · Data integrity · Tamper-proofing · Cloud computing · Confidentiality · Authentication

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_129

1 Introduction

In IT enterprise cloud computing has been visualizes as a future generation as it has developed over time. Cloud computing is an internet-based computing system as well as an amalgamation of automation and virtualization. However, there are various definitions of cloud computing, the common definition is how to provide services to customers over the network. Moreover, it is mainly an ability to sustain user's files in the internet, so that users can save various kinds of files such as text, audio and images. The users can access database resources via internet from anywhere in cloud computing as long as they need without any management or maintenance of authentic database resources.

Although, a variety of benefits are there for using cloud computing such as 1) it diminishes the hardware cost and repairs. 2) easy accessibility of data resource from anywhere 3) the procedure action is highly automatic and flexible. Generally, cloud computing environment is containing five features, four deployment models and three services which are shown in Fig. 1. In cloud computing customers outsource their data to a server outside their locations, which is executed by a cloud service provider [1]. In addition to this processor, memory, storage and bandwidth are

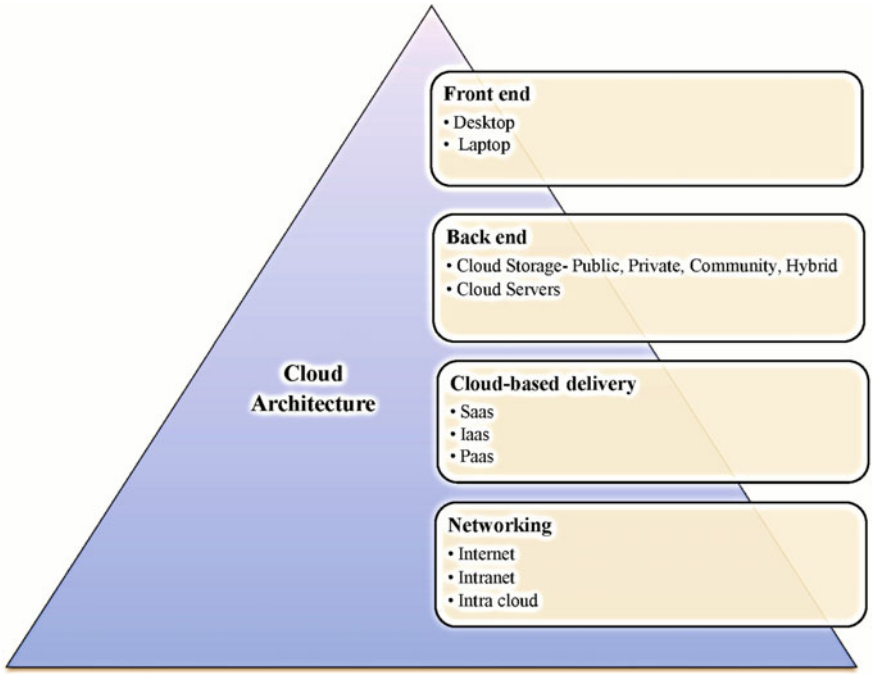

Fig. 1 System architecture of cloud computing

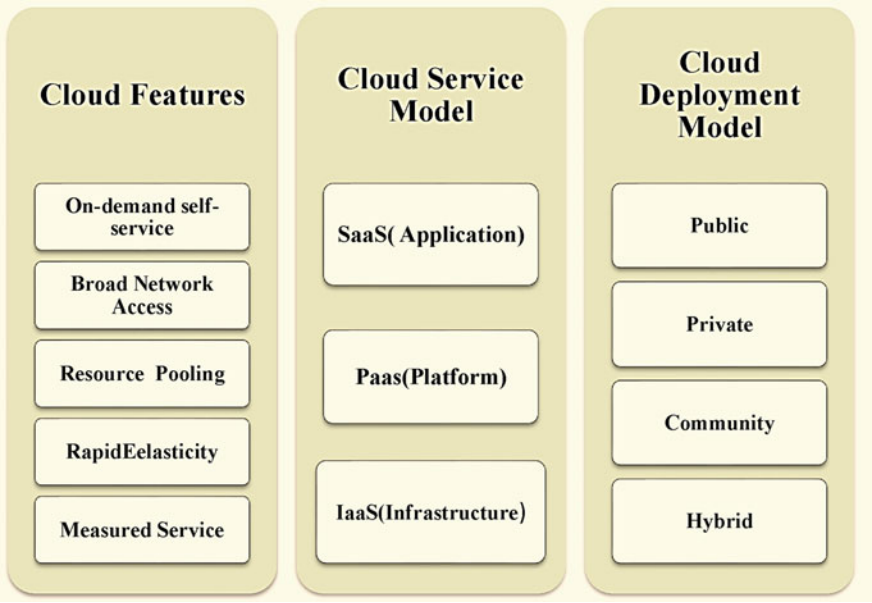

Fig. 2 Cloud computing environment architecture

visualized, also can be approached by a client using the Internet [2, 19]. The basic cloud computing architecture is depicted in Fig. 1.

Figure 1 illustrates the cloud computing system architecture. It consist of front end such as desktop, laptop and back end consists of cloud storage which provides four types of storage namely public, privates, community and hybrid. Cloud-based deliver is classified into three categories such as Software as Service (SaaS), Platform as Service (PaaS) and Infrastructure as Service (IaaS). The cloud computing network is assorted as internet, intranet and intra cloud. Cloud computing environment is composed of mainly three factors namely cloud computing features/components, service model and deployment model which is depicted in Fig. 2.

Figure 2 demonstrates cloud computing environment. It comprises service model, deployment model and cloud features [3]. Usually, there are five types of cloud computing features such as 1) on-demand service: services are provided on demand basis without human involvement and interaction of cloud providers. 2) Broad network access: resources are based on network services and can be used in distinct dimensions with the help of different platforms. 3) Resource pooling: resources are pooled for multi-tenants to share the resources. 4) Rapid elasticity: resources are increased and decreased when there is no need. 5) Measured service: it indicates the how much services is consumed by user and how much bill is paid by him or her.

Further, cloud computing services are divided into three categories such as 1) SaaS: cloud service providers offer cloud infrastructure and software to the client. 2)

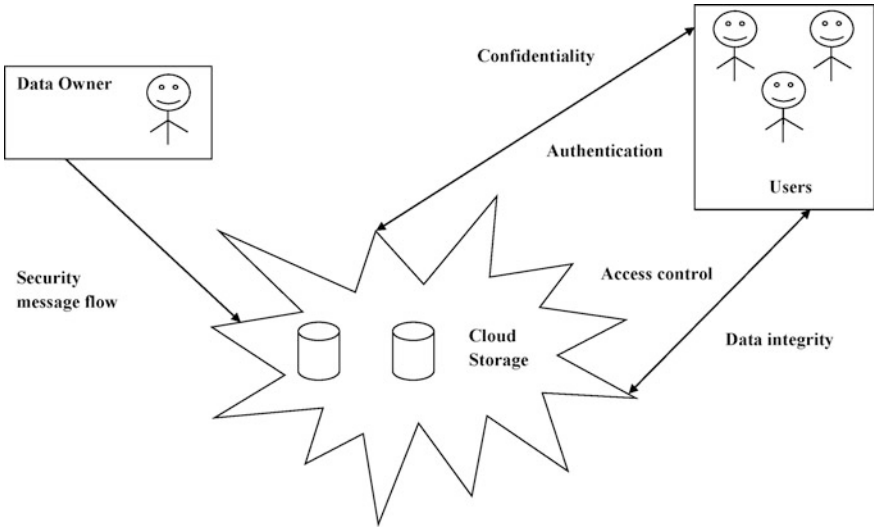

Fig. 3 Security and privacy issues in cloud computing

PaaS: infrastructure is provided by cloud service providers for the deployment of users applications. 3) Iaas: computing resources are provisioned in this service. Cloud computing deployment models have been classified into four types namely 1) Public: it provides services openly. 2) Private: services are provided by cloud service provides to a single organization which have many clients. 3) Community: services are provided to a community which comprises various organizations. 4) Hybrid: it consists of two or three models as public, private and private, community. In cloud computing environment, cloud service providers facilitate services to customers on demand over the internet [4–6]. Further, the main security issues in cloud computing as data integrity, confidentiality, authentication, access control, resource management and resource security which is shown in Fig. 3.

Figure 3 shows the security as well as privacy problems in cloud computing such as 1) Confidentiality: it means data should be private or confidential, authentication as well as access control used to assure data confidentiality. 2) Authentication: That ensue data is coming from authentic person. 3) Access control: it determined data can be accessed only by authorized users. 4 Data integrity: To protect data from unauthorized amendment, deletion.

In cloud computing information security can be divided into various functions as secure communication namely access control, confidentiality, data integrity, authentication, and secure private as well as public data. Data integrity ensure the data is same as it was stored originally in computer security while in cloud computing data integrity means to protect data from unauthorized modifications [7].

Furthermore, data integrity is the assurance by which the information is preserved from incidental alteration. However, there are various data integrity issues in cloud computing which are described below.

- Data leakage/manipulation
- Dishonest computation in remote services
- Attackers modified information during data transmission
- Data can be lost due to power failure, any disaster.

Though, all the aforementioned security issues are important in cloud computing, but data integrity is one of the major issues. Data integrity in cloud computing means to preserve data integrity as it was stored. Hence, we have proposed a data integrity as well as security model for data protection which is illustrated in Fig. 4.

Therefore, this paper presents a developed technique on a secure data integrity approach which is based on tamper-proofing algorithm (TPA). However, proposed approach used tamper-proofing based method for securing data integrity. We has used tamper-proofing approach first time for securing data integrity while most of

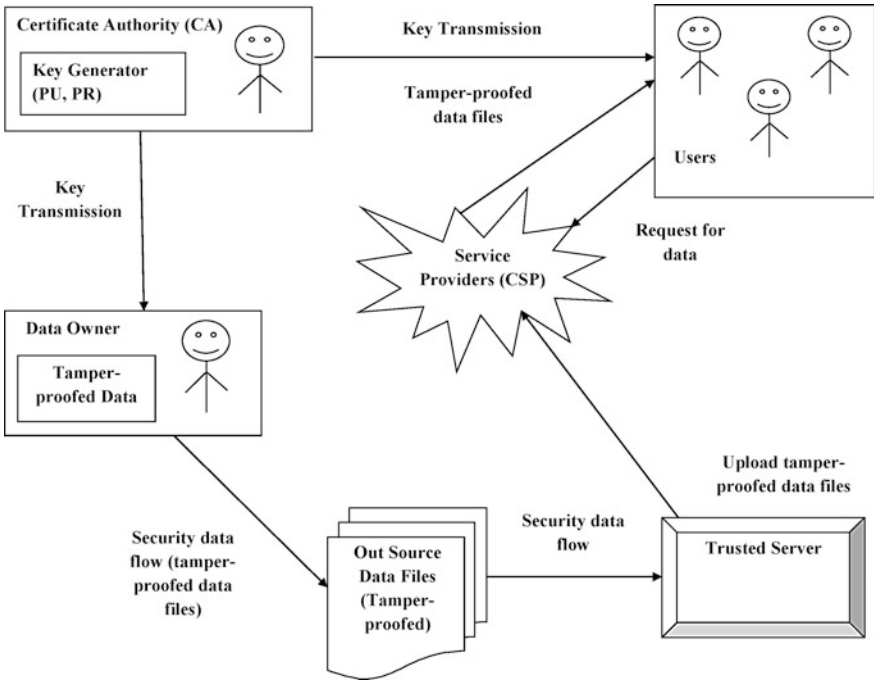

Fig. 4 Proposed data integrity model for cloud computing

the existing techniques used cryptographic algorithms for securing data integrity. The major contributions of the authors as follows:

- This paper focused on data integrity issue in cloud computing environment.
- Analysis the existing data integrity approaches.
- We used tamper-proofing approach for securing data integrity.
- The proposed technique is able to secure data which is stored on cloud service providers.
- We have used two tamper-proof algorithms as TPC (tamper-proof checking code) and TPR (tamper-resistance).

The paper is structured as follows. Section 1 Introduction are related to the basic introduction of cloud computing. Section 2 Related work presents the literature work of cloud computing. The proposed data integrity model and algorithm is presented in Sects. 3 and 4. Section 5 concludes the paper.

2 Related Work

Cloud computing has become a very promising field as well as considered an infrastructure in IT enterprises. One of the primary concerns in cloud computing with cloud storage is the verification of data integrity at untrusted server. Further, another issue which is also related to data integrity is to secure the data from unauthorized modifications. Deswarte et al. [8] proposed first time a solution to check the integrity of files which are stored on remote data servers.

They have used RSA-based function to hash entire data files for each verification but the limitation of this approach is that it is not appropriate for large files as well as it needs more times for computing hash value and transformation.

Caronni and Waldvogel [9] have used message authentication code (MAC) for sending data instead of storing the hash value for entire data. Further, Golle et al. [10] introduced two new cryptographic schemes as primitive's communication enforcing signature and a storage-enforcing commitment. Kumar and Subramanian [11] designed a proficient and secure scheme for ensuring data integrity and confidentiality of outsourced data on untrusted cloud servers. Moreover, proposed protocol is based on Elliptic Curve Cryptography as well as Sobol Sequence (random sampling).

Liu [12] proposed an data integrity approach for preserving data integrity which is based on hashing techniques, digital signatures and message authentication codes while Chauhan and Saxena [13] presents multi-tenancy characteristic of cloud are the main cause of integrity problems in big scale. A theoretical framework "Proofs of Retrievability" is developed by Bowers et al. [14] which comprehend the remote data integrity investigating by adding error correction code as well as spot-checking. The HAIL structure adopted POR method designed by Bowers et al. [15]. It is used to verify the storage of data in distinct clouds, this also ensure the redundancy of different copies and recognize the availability as well as integrity checking.

A trusted platform module (TPM) remote inspection developed by Schiffman et al. [16], which is used to check the data integrity remotely. Recently, Jouini et al. [17] has designed a security structure for secure cloud environment. Moreover, the author developed a generic structure that analyze and estimate cloud security issues. It is also proposed a feasible countermeasure to solve these problems. Though, the author designed a generic security model that deals with security problems in virtualization, business security continuity, management interfaces risks, compliance and governance etc. instead they did not focused on integrity problem in cloud computing environment. However, we can say that various integrity approaches have been found in literature with their strength and weakness. Thus, in this manuscript we proposed a secure data integrity model which is based on tamper-proofing approach.

3 Proposed Data Integrity Model

Cloud computing has been visualized as the next generation prototype in the computation. In cloud computing both software and resources are distributed on demand over the internet at minimal cost. Cloud computing is a path between hardware and software. However, cloud computing provides services to user but there are some security issue in cloud computing. Data security is one of the major concerns in cloud computing in today's scenario because the data are spread in distinct systems as well as storage devices along with servers, PCs, several mobile appliances (smart phones, wireless networks). Moreover, before discussing security issues first we discuss what kind of function cloud computing performs. There are two main functions of cloud computing namely data storage and computing.

Tamper-proofing approach is basically used to protect data from unauthorized tampering or modification. It is a protection method against tampering attack in copyright protection. Moreover, tamper-proofing approaches carry out two types of duties. First, it is going to discover the program which has been altered, a general approach is to calculate a check sum above the code and compare it to an anticipated value. Further, another unconventional tactic is to discover program in an executable position by investigating the values of variables. Lastly, the tampering has been identified the second job of a tamper-proofing approach is to carry out tamper-response framework.

Figure 4 shows the proposed security model of cloud computing using tamper-proofing algorithms. The developed model used two tamper-proof algorithms such as TPC (tamper-proof checking code) and TPR (tamper- resistance).

In the proposed model certificate authority (CA) generate two secret key for encryption and send that key to the data owner for encrypting data. Data owner first encrypt outsourced data files and then apply tamper-proof checking algorithm as well as tamper resistance algorithm after that data is shared by data owner to trusted server (TS). Trusted server uploads encrypted and tamper-proofed data to service providers (CSP).

Further, user sends data request to service providers and then service provider send tamper-proofed encrypted data files to user if any kind of changes has been made on tamper-proofed data then data owner can easily detect by comparing code checking and result checking, if a tampering has been identified then user can apply tamper-resistance and terminate the services.

4 Proposed Tamper-Proofing Algorithm

TPC (Tamper-proof checking code) has been proposed by scientist of Purdue University, Hoi Chang & Mikhail Atallah [18]. The algorithm generates a network of code regions, where an area can be a block of user code, a checker, or a responder. Checkers calculate a hash above one or more regions and match it with the expected value. In this approach, responders are typically repairers, and if the checker has revealed that an area has been tampered with, a responder will reinstate the tampered area with a copy stored somewhere else.

TAMPERPROOF (P, G):

P is the program which is secured in the form that produces control flow graph explicit or a call graph. The graph G is the directed guard graph that describes the association between code regions and checkers.

1. Let P's nodes be n0, n1, …, presenting code regions.
2. Let G's nodes be n0, n1, … (representing code regions), c0, c1, … (checkers), and r0, r1, … (responders). G has a edge ci (c)→ nj if ci checks region nj and an edge ri (r)→ nj if ri repairs region nj.
3. Add the responders in P so that they dominate the region they check.
4. Add the checkers in P so that at least one checker dominates every corresponding responder.
5. Connect checkers to responders by adding variables, as necessary.

5 Conclusion and Future Scope

We have developed an efficient data integrity method using tamper-proofing algorithm. The developed technique is based on tamper–proofing algorithms such as tamper-proof checking code and tamper-resistance. The main advantage of this algorithm is that, if any kind of tampering has been occur on the data then TPC check the entire code or checking the result. Further, if any type of tampering has been detected then TPR prevent or terminate services. Hence, data integrity will be preserved on cloud storage. Thus, this work presents a secure and efficient data integrity model which is based on tamper-proofing while existing work not based on tamper-proof technique. In future, we empirically evaluate proposed approach and compared with the existing ones.

References

1. Zhou Z, Huang D (2012) Efficient and secure data storage operations for mobile cloud computing. In: 2012 8th International Conference and 2012 Workshop on Systems Virtualiztion Management (svm) and Network and Service Management (cnsm), pp 37–45. IEEE
2. Kumar K, Lu YH (2010) Cloud computing for mobile users: can offloading computation save energy? Computer 43(4):51–56
3. Aldossary S, Allen W (2016) Data security, privacy, availability and integrity in cloud computing: issues and current solutions. (IJACSA) Int J Adv Comput Sci Appl 7(4):485–498
4. Aguiar E, Zhang Y, Blanton M (2014) An overview of issues and recent developments in cloud computing and storage security. In: High Performance Cloud Auditing and Applications, pp 3–33. Springer, New York
5. Gul I, ur Rehman A, Islam MH (2011) Cloud computing security auditing. In: 2011 The 2nd International Conference on Next Generation Information Technology (ICNIT), pp 143–148. IEEE
6. Mohamed EM, Abdelkader HS, El-Etriby S (2012) Enhanced data security model for cloud computing. In: 2012 8th International Conference on Informatics and Systems (INFOS), pp. CC–12. IEEE
7. Sun Y, Zhang J, Xiong Y, Zhu G (2014) Data security and privacy in cloud computing. Int J Distrib Sens Netw 10(7):190903
8. Deswarte Y, Quisquater JJ, Saïdane A (2004) Remote integrity checking. Integr Internal Control Inf Syst VI:1–11
9. Caronni G, Waldvogel M (2003) Establishing trust in distributed storage providers. In: Third International Conference on Peer-to-Peer Computing, 2003, (P2P 2003), Proceedings, pp. 128–133. IEEE
10. Golle P, Jarecki S, Mironov I (2002) Cryptographic primitives enforcing communication and storage complexity. In: International Conference on Financial Cryptography, pp. 120–135. Springer, Heidelberg
11. Kumar PS, Subramanian R (2011) An efficient and secure protocol for ensuring data storage security in Cloud Computing. IJCSI Int J Comput Sci Issues 8(6):261
12. Liu W (2012) Research on cloud computing security problem and strategy. In: 2012 2nd International Conference on Consumer Electronics, Communications and Networks (CECNet), pp 1216–1219. IEEE
13. Chauhan NS, Saxena A (2011) Energy analysis of security for cloud application. In: 2011 Annual IEEE India Conference (INDICON), pp 1–6. IEEE
14. Bowers KD, Juels A, Oprea A (2009) Proofs of retrievability: theory and implementation. In: Proceedings of the 2009 ACM workshop on Cloud Computing Security, pp 43–54. ACM
15. Bowers KD, Juels A, Oprea A (2009) HAIL: a high-availability and integrity layer for cloud storage. In: Proceedings of the 16th ACM Conference on Computer and communications security, pp 187–198. ACM
16. Schiffman J, Moyer T, Vijayakumar H, Jaeger T, McDaniel P (2010) Seeding clouds with trust anchors. In: Proceedings of the 2010 ACM Workshop on Cloud Computing Security Workshop, pp 43–46. ACM
17. Jouini M, Rabai LBA (2016) A security framework for secure cloud computing environments. Int J Cloud Appl Comput (IJCAC) 6(3):32–44
18. Nagra J, Collberg C (2009) Surreptitious software: obfuscation, watermarking, and tamperproofing for software protection. Pearson Education
19. Gautam P, Ansari MD, Sharma SK (2019) Enhanced security for electronic health care information using obfuscation and RSA algorithm in cloud computing. Int J Inf Secur Priv (IJISP) 13(1):59–69

A Framework for Private Hospitals Service Cost Recommendation Based on Page Ranking Technique

Ahmed Yasin Syed and P. V. R. D. Prasada Rao

Abstract The Search engine is a software program designed to identify and respond to specific questions called keywords and display relevant informational data available on the web. Thousands of websites are available but we want only specific information. The Solution is a search engine, it will find the relevant information related to that keyword and display that information in an aggregated format. With the rapid growth of data and information sources on the internet, finding the relevant and required information is becoming more tedious as well as important for internet users, for this reason, web mining is becoming popular day by day. We proposed a system for private hospital cost aggregation for hospital recommendation system by page ranking algorithm. Sample results are collected. This paper gives depictions of different web mining methodology. It gives an examination of three classifications of web mining. The page ranking algorithm assumes a noteworthy job in making the client look route less demanding in the after-effects of a web crawler. The correlation rundown of different page rank algorithms is recorded in this paper which helps in the best usage web assets by giving expected data to the guides. For performance evaluation, we have collected samples as well as real-time data set from UCI data repository and hospitals. For case 1 and case 2 implementation is done in python with numpy package and panda's package. For Case 3 implementation is done in python as well as C#. Deep learning methodology can be applied for greater efficiency and accuracy. The improved result can be in the range of 85 to 95%.

Keywords Web mining · Met search engine · Web crawler · Web ranking

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_130

1 Introduction

The ranking is a crucial application of net mining that is predicated on the structure, content and usage. Several algorithms exist for web content ranking and these algorithms area unit primarily based upon one or additional parameters like forward links, backward links, contents and user interaction time. Figure 1 demonstrates the working of the World Wide Web. It consists of the user who wants to search query results which will be dependent on user query search engine and page ranking algorithm. The potency of Associate in the algorithmic program is also primarily based upon the parameters that the area unit applied to work out the ranking of the page. Web mining is the subdomain of data mining techniques to find patterns from the WWW.

1.1 World Wide Web (WWW)

World Wide Web is a network, which allows users of one system to access the information present on another system though the WWW called the internet. For its implementation, the client-server technology model is used. In this model user relay on a program called a client, and it's used to connect to a remote machine, the remote machine is called as Server where data is stored. Navigating through the web is done by a client a program called the browser. It works by sending the request to a remote server for information and then interpreting and returning the documents in the form of text or GUI screen on the client-side. [1, 2] The operation of the web depends on the structure of its hypertext documents. The Internet has many distinct properties, some of which are as follows.

1. The bulk of the information is available on the web and still growing rapidly. The coverage of the information is also very wide and diverse. Hence users can find information on almost anything on the web. 2. All Formats of data are available on the internet e.g. Unstructured, Semi-structured, & structured type of data. 3. The Internet also provides us services such as current share market status, rate of products, online shopping, and online data submission. 4. Web information is in dynamic nature it may change continuously and to tackle this dynamic nature is an important aspect of the World Wide Web.

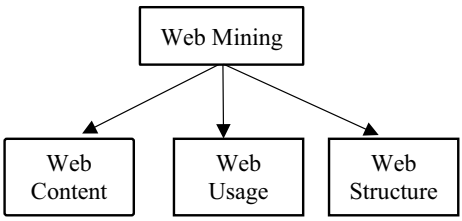

Fig. 1 Types of web mining

Above all properties can be challenges as well as opportunities for mining and discovery of information and knowledge from the web. With the rapid growth of data and information sources on the internet, finding the relevant and required information is becoming more tedious as well as important for internet users, for this reason, web mining is becoming popular day by day. Web mining has three types based on which part of the web to mine.

a) Web Content Mining: Web Mining is essentially extract vital the data i.e. information on the web. Which process is happening to get to the data on the web. It is a web content mining. Numerous pages are available to get to the data on the web. These pages are content or part of the web. Since there are different content present on the web as content, picture, video, sound and so forth. In any case, the essential assets that are mined in web content mining are singular pages.
b) Web Structure Mining: We can characterize web structure mining in terms of a graph. Web pages are demonstrated as hubs and Hyperlinks speak to as edges. Essentially it's demonstrated the connection between client and web. The thought process of web structure mining is producing organized synopses about data on pages/networks. It is demonstrated the connection one webpage to another website page. Web structure mining really on link information.
c) Web Usage Mining: Web mining utilization goes for use knowledge discovery systems to discover the pattern of use from online sources. It is a method to foresee client behavior when it is connected with the web

Figure 1: only shows the subtypes of only web mining, there are subtypes of web content mining, web usage mining, & web structure mining, and comparatively they are summarized as below [3–5] (Tables 1 and 2).

Table 1 Overview of web mining techniques

Features	Web structuring mining	Web usage mining	Web content mining
Mining focus	Between the documents, within	Navigational patterns (User)	Within the doc
Input data	Hyperlinks	Query logs, server log files	Txt, HTML documents
Representation of data	In the form of web graph Structured summary of web pages	Relational tables	Bags of words for unstructured data HTML tags for semi-structured data, ontology
View of data	Structured	Event triggers	Semi- and unstructured
Method	Proprietary algorithms	Personalization algorithms, association rules	NLP and machine learning

Table 2 Categories of web mining

Parameters	Categories		
	Web structuring mining	Web usage mining	Web content mining
Visualization of data	- Collection of interconnected web pages - Hyperlink structure	- Client/server interactions statistics	- Unstructured documents - Structured documents
Source data	- Hyperlink structure	- Log file of server - Log of browser	- Hypertext documents - Text documents
Topology	How all web pages in the website are interlinked together	- How well the behavior of users varies for the given web site	- How well content of one page is related to the content of another page
Depiction	Web graph	- Relational table - Graph	- Relational - Edge labeled graph
Working model	Page rank algorithms	- Association rules - Classification - Clustering	- Statistical - Machine learning
Usability	Web site personalization User modelling Adaptation and management	- Extracting users behavior - Detecting outliers - Categorization	- The relevance of web pages - Relationship between segments of text paragraphs

2 Meta Search Engine

It receives a request from the client and sends the demand to different web crawlers. The web crawlers check their records and concentrate a rundown of pages as connections and pass the outcome to the Meta Search Engine. The Meta Search Engine gets the connections, applies a couple of calculations, positions the outcomes lastly shows the outcome [6].

2.1 Page Rank Algorithm

The link structure of the Web page is used to find out the importance of a Web page. The importance of a page P can be obtained by evaluating the importance of

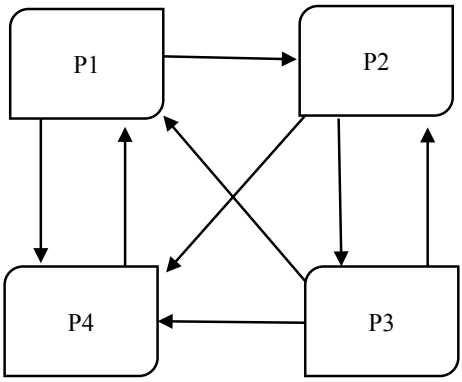

Fig. 2 Web structure

pages from which the page P can be accessed. Links from these pages are called inbound links. According to this algorithm, if the inbound links of a page are important, then its outbound links also become important. The PageRank of a page P is similarly separated among its outbound connections which further engendered to pages comparing to these outbound connections. The PageRank of page X can be determined by the equation as follow

$$\mathrm{PR(X)} = (1 - \mathrm{d}) + \mathrm{d}\frac{PR(\mathrm{P1})}{\mathrm{O}(P1)} + \frac{PR(\mathrm{P2})}{\mathrm{O}(P1)} \cdots \frac{PR(\mathrm{Pn})}{P(Pn)} \tag{1}$$

Where: $\mathrm{P1}, \mathrm{P2}\ldots\mathrm{Pn}$ represents the inbound links of page X, $\mathrm{O(P1)}, \mathrm{O(P2)}\ldots\mathrm{O(Pn)}$ is no. of outbound links of page $\mathrm{P1}, \mathrm{P2}\ldots\mathrm{Pn}$, respectively, d is the damping factor which is a measure of the probability of user following direct link. Its value is usually set to 0.85. To clarify the working of PR strategy, Let us take a little Web structure as appeared in Fig. 1a comprising of four pages, to be specific P1, P2, P3, and P4, where page P1 is inbound connection of page P2 and P4, page P2 is inbound ink of page P4 and P3, P3 is inbound connection of P1, P2, and P4, and P4 is inbound connection of P1. As indicated by Eq. (1), PageRank of page P1, P2, P3, and P4 can be registered as pursues (Fig. 2):

$$\mathrm{PR(P_i)} = [(1d) + d(PR(P_3)/3 + PR(P_4)/1] \tag{2}$$

$$\mathrm{PR(P_2)} = [(1 - d) + d(PR(P_1)/2 + PR(P_3)/3] \tag{3}$$

$$\mathrm{PR(P3)} = [(1 - d) + d(PR(P_2)/2)] \tag{4}$$

$$\mathrm{PR(P4)} = [(1 - d) + d(PR(P_1)/2PR(P_2)/2 + \mathrm{PR(P_3)}/3] \tag{5}$$

3 Objectives of This Paper

1. Vast information sources are present on the internet, extraction, and visualization of useful information is the need of the era, hence to address this problem web mining techniques can be used for this.
2. The objective of this research is to provide relevant web pages on the topmost of the web search result page.
3. Web structure mining can play a key role in web mining as a hyperlinked network structure can be a big source of web content.
4. Web content mining is an important source of information for search query hence it will play a major role in web mining. 5. The objective of this research is to study existing web mining techniques in content as well as a structure for possible improvement and for the development of a hybrid search method for efficient and smart web search.
5. The objective of this research is to study existing web mining techniques in content as well as a structure for possible improvement and for the development of a hybrid search method for efficient and smart web search.

3.1 Literature Review on Meta Search Engine and Page Ranking

Summary of Page Ranking Algorithms: From the above survey of literature it's found that different algorithm exists for web mining and shows a different level of result. All findings is summarized in below table [7–10] (Table 3).

3.2 The Conclusion from the Literature Survey

1. Web content, web usage & web structure mining are the major web mining techniques for searching relevant queries.
2. Content, Usage as well as structure mining techniques can be improved and hybrid search method can be developed for efficient web search [11–16].

Table 3 Summary of Page Ranking Algorithms

S. N	Algorithms	Input parameters	Main technique	Limitations
1	Page rank	Back links	Web structure mining	Results come at the time of indexing and not at the query time
2	Weighted page rank	Backlinks and forward links	Web structure mining	Relevancy is ignored
3	Weighted page content rank	Content, Back Links, Forward Links	Web structure mining, web content mining	Numerical value based on which the ranking is done
4	HITS	Content, back links and forward links	Web structure mining, web content mining	Topic drift and efficiency problem
5	Distance rank	Forward links	Web structure mining	The calculation for the distance vector is required If new page inserted between two pages
6	Eigen rumor	Agent/object	Web structure mining	It is most specifically used for blog ranking not for web page ranking as other a ranking like a page rank, HITS
7	Time rank	Original page rank and sever log	Web usages mining	Important pages are ignored because of it increases the rank of those web pages are opened for a long time
8	Tag rank	Popular tags and related bookmarks	Web content mining	It is a comparison-based approach so it requires more site as input
9	Relational based page rank	Keywords	Web structure mining	In this ranking the algorithm every page is to be annotated with respect to some ontology, which is a very tough task
10	Query dependent ranking	Training query	Web content mining	Limited number of characteristics are used

4 Proposed System Architecture for Meta Search Engine

The figure represents key elements of the proposed system, it consists of health data, price data, and actors of the system. For data analytics and knowledge discovery, we have collected two types of data one is price data of individual services provided and health data which is required for data analysis [17, 18] (Fig. 3).

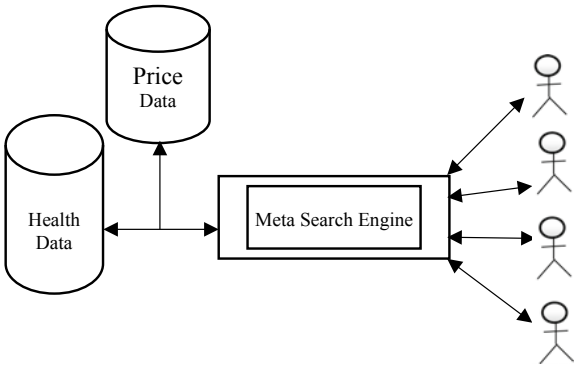

Fig. 3 Proposed system architecture for meta search engine

Health Data: This data refers to full-fledged data related to health services provided and charges of particular services. Data size may vary from megabytes to gigabytes.

Price Data: This data is the cost of each service provided by the healthcare organization. This patient data in real-time and collected from hospitals. Stakeholders: Patient: Patient is a key stakeholder who can get all the required information from the system such as availability of service, quality of service, and cost of the service.

Hospital: Hospital those who want exposure and want their facility to be utilized by the patient can be benefited from this system. Welfare organization: Welfare organization can get benefit from this system in the form of availability of the system and concession available for the system.

4.1 Proposed System for Hybrid Page Ranking

Figure 4 shows our proposed system architecture where we will display user queries with the help of the hybrid algorithm. The proposed hybrid algorithm will be a combination of web content as well as web usage mining by rage re-ranking stage where both techniques will be combined for effective and relative results. Here deep learning techniques will show greater efficiency than traditional machine learning techniques. Experimental results can be performed by using deep learning techniques like deep learning to give good results on a larger dataset. Machine learning techniques suitable for the problem where the data set is small [19–21] (Fig. 5).

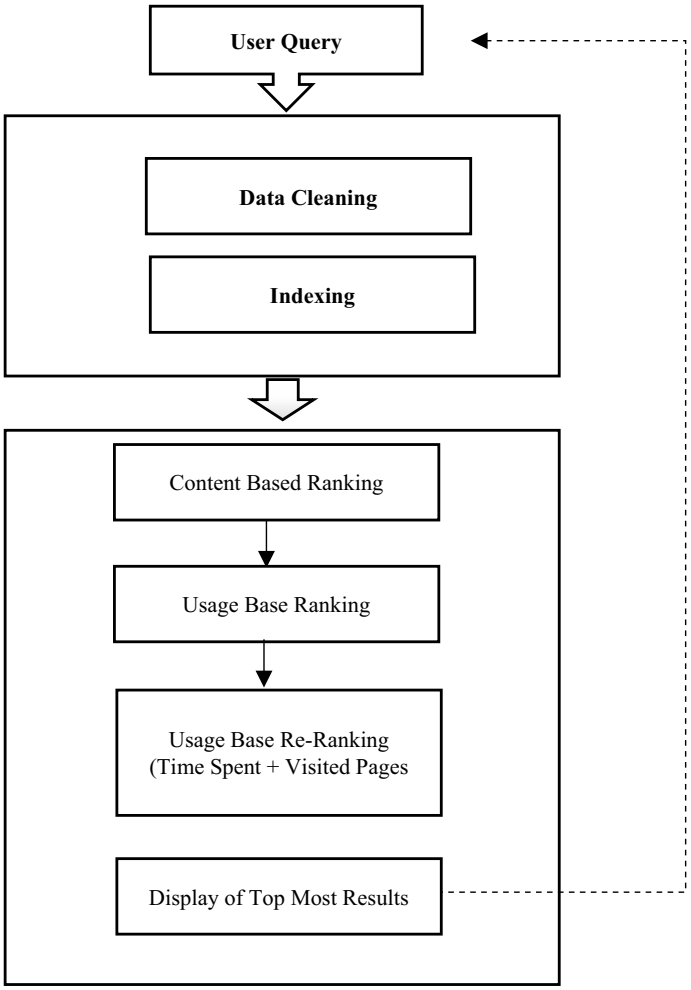

Fig. 4 Proposed system for hybrid page ranking

Above two screenshots of a User interface of the proposed system where the DOM Extractor module is designed which consists of Extractor module and Search Metadata module. Before that Welcome page will display the basic information of the proposed system, introduction to system is given on its description. Here the user has to enter his/her choice for location i.e. city. On the second page, the user has to select a procedure or service such as X-ray in the first-page user has selected city after this, in this page system will show available services present in that city. In the result page, the user will see the available services in that city, the system will show a total no of hospitals available in that location for specific service. Other than

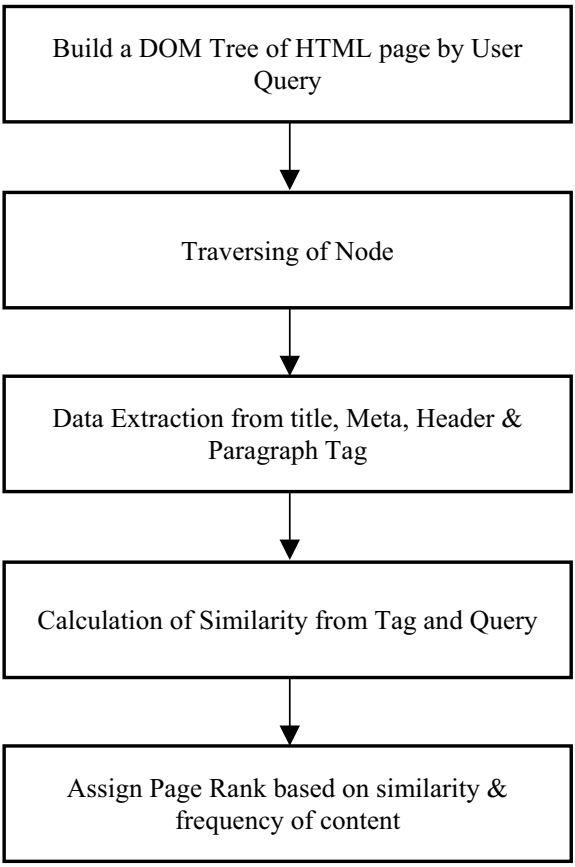

Fig. 5 Proposed system for tag analyzer algorithm

these users can compare the cost of service by using Filter. The following filter can be used for effective comparison.

1. User Rating
2. Distance
3. Hospital Class
4. Availability Of Service the goal of this system is to help for understanding the cost and health converge and to bring transparency to health care costs. Users can also see the nearest hospital services by map view where hospitals will be pointed for the availability of respective services.

5 Conclusion

This paper gives depictions of different web mining methodology. It gives an examination of three classifications of web mining. The page positioning algorithm assumes a noteworthy job in making the client look route less demanding in the aftereffects of a web crawler. The correlation rundown of different page rank algorithms is recorded in this paper which helps in the best usage web assets by giving expected data to the guides. The related site pages' data can be effortlessly associated with the clients' practices. In the future, the new strategy can be incorporated with any of the Page rank Algorithms to deliver better and important related results by deep learning methodology.

References

1. Minnie D, Srinivasan S (2011) Multi-domain meta search engine with an intelligent interface for efficient information retrieval on the web. In: CCIS 204, pp 121–129
2. Bharamagoudar GR, Totad SG et al (2012) Literature survey on web mining. IOSR J Comput Eng (IOSRJCE) 5(4):31–36
3. Jain A, Sharma R, Dixit G et al (2013) Page ranking algorithms in web mining, limitations of existing methods and a new method for indexing web pages, ISBN 978-0-7695-4958-3
4. Preethi N, Devi T (2013) New integrated case and relation based (CARE) page rank algorithm, ISBN 978-1-4673-2907-1
5. Kumar K, Abhaya, Mukoko FD (2013) PageRank algorithm and its variations: a survey report. IOSR J Comput Eng (IOSR-JCE) 14(1):38–45, ISSN 2278-8727
6. Sharma R, Kaur K (2014) Review of web structure mining techniques using clustering and ranking algorithms. Int J Res Comput Commun Technol 3(6), ISSN 2278-5841
7. Sangeetha M, Suresh Joseph K (2014) Page ranking algorithms used in web mining, ISBN 978-1-4799-3834-6
8. Prabha S, Duraiswamy K, Indhumathi J (2014) Comparative analysis of different page ranking algorithms. Int Sch Sci Res Innov 8(8) http://scholar.waset.org/1307-6892/10000128
9. Devi P, Gupta A, Dixit A (2014) Comparative study of HITS and PageRank link-based ranking algorithms. Int J Adv Res Comput Commun Eng 3(2):5749–5754 ISSN 2278-1021
10. Kumari T, Gupta A, Dixit A (2014) Comparative study of page rank and weighted page rank algorithm. Int J Innov Res Comput Commun Eng 2(2):2929–2937 ISSN 2320-9801
11. Chauhan JS, Gadwal A (2015) Improving web search user query relevance using content-based page rank. In: IC4-2015
12. Nagappan VK, Elango P (2015) Agent-based weighted page ranking algorithm for web content information retrieval, ISBN 978-1-4799-7623-2
13. Shamsul Amin M, Kabir S et al (2015) A score based web page ranking algorithm. Int J Comput Appl 110(12), ISSN 0975-8887
14. Singh V, Chaudhary A, Punia P (2015) Optimized searching algorithm based on-page ranking: proposed algorithm
15. Chauhan V, Jaiswal A, Khan JK (2015) Web page ranking using machine learning approach, ISSN 2327-0659
16. Yasin AS, Prasada Rao, PVRD (2018) A framework for decision making and quality improvement by data aggregation techniques on private hospitals data. ARPN, ISSN 4337-4345

17. Yasin AS, Prasada Rao, PVRD (2018) Analysis of single and hybrid data mining techniques for prediction of heart disease using real-time dataset. IJET 7:97–99
18. Prasada Rao PVRD, Phani Madhuri N, Meghana A, Prem Kumar P (2019) Ailment prognosis and propose antidote for skin using deep learning. Int J Innov Technol Explor Eng (IJITEE) 8 (4), ISSN 2278-3075
19. Prasada Rao PVRD, Vineetha B, Priyanka Ch., Satish V (2018) A comparative study on recommendation system using hybrid approach. Int J Mechan Eng Technol (IJMET) 9(1):75–82
20. Prasada Rao PVRD, Varakumari S, Vineetha B, Satish V (2018) Application of data mining to e-commerce recommendation systems. Int J Eng Technol 7(2.32), Special Issue 32
21. Prasada Rao PVRD, Reshma Sai Sri A, Rama Raju D, Venkata Rama Reddy S (2018) Capturing the knowledge of user preferences by recommender system. J Adv Res Dyn Control Syst

Sequence Alignment By Modified Teaching Learning Based Optimization Algorithm (M-TLBO)

Lakshmi Naga Jayaprada Gavarraju and Kanadam Karteeka Pavan

Abstract Sequence alignment is a most important first step to a wide variety of analyses that can be performed on the biological sequences like DNA, RNA or protein. Sequence alignment is a daily practice of many biologists to determine the similarity among biological sequences. It is considered as an optimization problem. Researchers developed many meta-heuristic optimization algorithms inspired by nature to produce optimal alignment. In all these heuristic algorithms mutation and crossover are the most prominent steps. Every algorithm is having different criterion for mutation and crossover operations. Recently in 2011, R.V. Rao and et al. proposed a new algorithm called Teaching Learning Based Optimization algorithm (TLBO) to deal with constrained and unconstrained optimization problems. This paper uses TLBO to solve the sequence alignment problem and also proposes a new optimization algorithm called Modified-TLBO (M-TLBO). Both the algorithms, TLBO & M-TLBO are analysed by conducting experiments with bench mark data sets from "prefab4ref" & "oxbench" and observed that the newly proposed algorithm M-TLBO outperformed TLBO in solving the sequence alignment problem by producing the best fitness scores in reduced computational time.

Keywords PSA · MSA · TLBO · DE

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_131

1 Introduction

The most stimulating problem in bioinformatics is to excerpt the evolutionary relationships among various organisms. By taking a group of biological sequences protein, DNA or RNA sequences, establishing the relationship among multiple biological sequences can be stated as a multiple sequence alignment problem (MSA) and establishing the relationship between only two biological sequences is known as Pairwise sequence alignment (PSA). MSA and PSA are the fundamental tools for several concepts like molecular function prediction and phylogenetic analysis [1]. Sequence alignments are categorized into two types namely Local sequence alignment and global sequence alignment. When the sequences are having more number of similar residues with nearly equal length and when the entire length of sequences are to be compared then Global sequence alignment is preferable. Local sequence alignment is done on variable length sequences having more dissimilar residues.

Dynamic programming is best suited to perform PSA. Two well-known dynamic programming algorithms known as Smith-Waterman algorithm [2] for local sequence alignment and Needleman–Wunsch algorithm [3] for global sequence alignment are widely used to solve the problem of PSA efficiently. Dynamic programming algorithms are best suitable when the quality of alignment is utmost important. For MSA Dynamic programming is a time consuming process. From the past few decades so many tools were developed by researchers to perform MSA like CLUSTALW [4], CLUSTAL-OMEGA [5], MAFFT [6], KALIGN [7], MUSCLE [8], PROBCONS [9], RETALIGN [10], T-Coffee [11], M-Coffee [12], HMMER [13] etc., based on progressive and iterative approaches.

Though there are so many tools to perform MSA, researchers are also making use evolutionary algorithms which were developed with nature inspiration. One such algorithm is genetic algorithm (GA). Cedric Notredame and Desmond G. Higgins used GA to perform sequence alignment in 1996 and is called as Sequence Alignment by Genetic Algorithm (SAGA) [14]. Later so many variations in genetic algorithm for sequence alignment came into existence. A novel genetic approach for optimized biological sequence alignment was developed by Gautam Garai and Biswanath Chowdhury [15]. Cyclic Genetic Algorithm for Multiple Sequence Alignment was developed by Nizam et al. [16]. Later many evolutionary algorithms like Differential Evolutionary Algorithm (DE) [17], Ant Colony Optimization Algorithm (ACO) [18], Particle Swarm Optimization (PSO) [19], Artificial Bee Colony (ABC) [20] were evolved and they were used to perform MSA. But among all these algorithms DE has emerged as a most competitive evolutionary algorithm to solve all kinds of optimization problems [21].

Recently, in 2011 R.V. Rao et al., developed an evolutionary algorithm to solve the constrained and unconstrained optimization problems namely Teaching Learning Based Optimization algorithm (TLBO) [22]. It doesn't require any algorithmic specific parameters. TLBO is consisting of two phases called Teacher phase and Learner Phase. In Teacher phase all the students learn from teacher and in

learner phase the learner learns from their peers. Compared to the previous optimization algorithms TLBO is having two advantages. Because it works in two phases: teacher and learner, definitely the performance is improved compared to other optimization algorithms which had only single phase. Tuning to the algorithmic specific parameters depending upon the application is very completed. But, TLBO needs no algorithmic specific parameters. These advantages motivated to make use of TLBO to perform sequence alignment and to propose new optimization algorithm.

This work advises a novel evolutionary algorithm designated as Modified-TLBO (M-TLBO). M-TLBO is compared with TLBO and noticed that its performance is far better than TLBO. The performance assessment is accomplished for both PSA and MSA and found that M-TLBO outperformed TLBO. To undertake analysis on both the algorithms bench mark datasets from "prefab4ref" and "oxbench" are utilized. The work is available in 5 sections. Section 1 is introduction. Section 2 highlights proposed algorithm. Section 3 represents the experimental outcomes and discussions. Section 4 displays limitations and to conclude Sect. 5 encompasses conclusions and future accomplishments.

2 Proposed Algorithm and Fitness Function

With the zeal of determining new methods and techniques to achieve sequence alignment with enriched performance, a new algorithm is proposed and named as M-TLBO. In the next subsections proposed algorithm and fitness function are explained.

2.1 Modified Teaching Learning Based Optimization Algorithm (M-TLBO)

1. Depending on the population size (pop-size) initial population is developed. Every portion of the population (pop) is known as chromosome.
2. Alignment is performed by making use of specific gap locations existing in the pop.
3. Determine the fitness of the pop with a fitness function "Sum of Products" (SoP).
4. Repeat the steps 5 to 9 for all the specified number of generations (no_of_ generations).
5. Start of Teacher Phase: Chromosome with best fitness score is taken as "teacher" and it is labelled as "Xt" (Teacher).
6. Chromosome with worst fitness score is taken as "slow learner" and it is labelled as Xw.

7. For j = 1 to pop-size Xn (New) must be evaluated with the specified expression. **Xn = Xt + r(Xj − Xw)**. Now calculate the fitness of Xn. If Xn fitness is greater than fitness of Xj then Xj ← Xn. End of the Teacher Phase.
8. Start of Learner Phase
9. For j = 1 to pop-size, k has to calculated as k = random (pop-size) and k ≠ j
10. If Xj better than Xk then Xj, new = Xj + r (Xk − Xj) else Xj, new = Xj + r (Xj − Xk).
11. If Xj, new better than Xj then Xj ← Xj, new. End of Student Phase.
12. If no_of_generations completed, the best fitness one is declared as result.

2.2 Fitness Function

Fitness functions are for evaluating the alignment quality. Many fitness functions are available in the literature to calculate the fitness score of the aligned biological sequences. Sum of Products score (SoP) is used in this work as the fitness function. It is explained in detail as follows. If there are G biological sequences in alignment and if each sequence is containing H columns and if elements in each column are labelled as X11, X21, X31,…, XG1. Then

$$SoP = \sum_{a=1}^{H} \sum_{b=1}^{G-1} \sum_{c=b+1}^{G} Score(Xvu, Xwu) \tag{1}$$

where

$$Score(Xba, Xca) = \begin{cases} match\ if\ Xba = Xca\ and\ Xba \neq' -'\ and\ Xca \neq' -' \\ gap\ if\ Xba =' -' or\ Xca =' -' \\ mismatch\ if\ Xba \neq Pca \end{cases} \tag{2}$$

where '−' denotes a gap which is allocated a value of −2, mismatch is allocated a value of '−1' and Match is assigned a value of '+20'. Match is given such a high value '+20' to achieve positive value in the fitness calculation. Experimental outcomes and discussions are present in the next section.

3 Experimental Outcomes and Discussions

The performance of the proposed algorithm M-TLBO is compared with TLBO. In this work, both the algorithms are developed in MATLAB and executed on the PC with Intel® core(TM) i5-8250U CPU @ 1.60 GHZ with 8 GB RAM under Windows 10 Platform. Experiments are conducted on both PSA and MSA. To evaluate the performance of proposed algorithm, bench mark datasets from "prefab4ref" and "oxbench" are used.

3.1 Pair-Wise Sequence Alignment (TLBO and M-TLBO)

The fitness score of the TLBO and M-TLBO algorithms are observed using "prefab4ref" bench mark dataset. Experiments are conducted on 50 test data sets taken from "prefab4ref" and the results (average fitness values and execution time in milliseconds) are tabulated in Tables 1 and 2 as shown below.

Table 1 TLBO algorithm & M-TLBO algorithm performance comparison for PSA (Average Fitness Scores)

S. No	Name of the sequences	TLBO fitness	M-TLBO fitness
1	1bak-1btn	55.5	**94.7**
2	1bak-1dynA	100.9	**135.4**
3	1bak-1faoA	84.5	**120.5**
4	1bak-1mai	**1571.6**	1418
5	1bb9-2semA	**111.6**	108.1
6	1bbhA-1jafB	399	**408.9**
7	1bbhA-2ccyA	320.2	325.8
8	1bbzA-1ckaA	160.9	191.1
9	1bbzA-1gcpA	170.3	167.2
10	1bcfA-1dpsA	138.3	166
11	1bcfA-1eumA	171.4	181.4
12	1bcfA-1qghA	123.5	130.7
13	1bcfA-2fha	246.8	293.2
14	1bcpD-1prtF	145.6	175.6
15	1bcpD-1tiiD	82.9	106.4
16	1bcpD-3chbD	53	**62.5**
17	1bdyA-1r1w	**225.4**	201.9
18	1bebA-1bj7	120	**121**
19	1bebA-1epaA	174.5	**180.8**
20	1bh9B-1tafA	**72.6**	50
21	1bj7-1epaA	148.6	**208.7**
22	1bj7-1obpA	83.7	**97.4**
23	1bjx-1qgvA	119	**194.1**
24	1bk7A-1bo1A	300.9	**308**
25	1bm9A-1cf7B	49.7	**60.1**
26	1bmfG-1mabG	**1343**	1107.4
27	1bndA-1aocA	**18**	7.7
28	1bndA-1nt3A	**851**	715.4
29	1bo4A-1cjwA	**83.4**	82.3
30	1bo4A-1i21A	35.2	**59.5**
31	1bp7A-1af5	323.2	**578.5**

(continued)

Table 1 (continued)

S. No	Name of the sequences	TLBO fitness	M-TLBO fitness
32	1bpi-1brcl	326.5	**331**
33	1bpv-2fnbA	85.3	**116.5**
34	1bqk-2mtaA	87	**87.2**
35	1btkA-1btn	**−2.7**	−13.9
36	1btkA-1dynA	**7.8**	5.3
37	1btkA-1faoA	**−21.2**	−22.5
38	1btkA-1pls	**0.8**	−7.2
39	1btkA-1rrpB	59.6	**85.4**
40	1btn-1dynA	**90.5**	89.4
41	1btn-1mai	109.2	**134.5**
42	1btn-1p1s	106	**158.5**
43	1btn-1rrpB	69.2	**91.3**
44	1byfA-1esl	218.2	**244.1**
45	1byfA-1fmsA	130.8	**163.6**
46	1byfA-1htn	122.8	**139.6**
47	1byfA-1rtml	**223.8**	211.8
48	1bywA-1drmA	56.3	**69.2**
49	1bywA-1g28D	268.2	**333.3**
50	1bywA-3pyp	**79.3**	76.1

Table 2 TLBO algorithm & M-TLBO algorithm performance comparison for PSA (Time in ms)

S. No	Name of the sequences	TLBO time (ms)	M-TLBO time (ms)
1	1bak-1btn	228.481	**224.99**
2	1bak-1dynA	199.98	**180.697**
3	1bak-1faoA	216.645	**183.37**
4	1bak-1mai	106.83	**88.06**
5	1bb9-2semA	268.745	**200.106**
6	1bbhA-1jafB	**167.304**	174.58
7	1bbhA-2ccyA	213.409	**174.765**
8	1bbzA-1ckaA	104.185	**54.904**
9	1bbzA-1gcpA	100.247	**68.677**
10	1bcfA-1dpsA	**312.32**	339.79
11	1bcfA-1eumA	202.87	**154.706**
12	1bcfA-1qghA	301.709	**279.94**
13	1bcfA-2fha	143.237	**130.76**
14	1bcpD-1prtF	140.628	**132.585**
15	1bcpD-1tiiD	150.432	**144.89**
16	1bcpD-3chbD	131.165	**117.5**
17	1bdyA-1r1w	124.44	**120.96**

(continued)

Table 2 (continued)

S. No	Name of the sequences	TLBO time (ms)	M-TLBO time (ms)
18	1bebA-1bj7	**217.856**	278.16
19	1bebA-1epaA	441.349	**417.058**
20	1bh9B-1tafA	279.94	**277.41**
21	1bj7-1epaA	**309.663**	335.384
22	1bj7-1obpA	**576.51**	624.67
23	1bjx-1qgvA	**167.54**	173.82
24	1bk7A-1bo1A	291.238	**264.22**
25	1bm9A-1cf7B	282.11	**278.44**
26	1bmfG-1mabG	81.74	**80.492**
27	1bndA-1aocA	724.69	**693.117**
28	1bndA-1nt3A	98.791	**83.2**
29	1bo4A-1cjwA	295.55	**277.197**
30	1bo4A-1i21A	**197.71**	217.38
31	1bp7A-1af5	230.2	**224.916**
32	1bpi-1brcl	**45.44**	45.87
33	1bpv-2fnbA	104.37	**90.54**
34	1bqk-2mtaA	**144.29**	155.92
35	1btkA-1btn	506.87	**479.972**
36	1btkA-1dynA	548.76	**487.64**
37	1btkA-1faoA	648.2	**543.63**
38	1btkA-1pls	505.15	**414.711**
39	1btkA-1rrpB	240.76	**238.02**
40	1btn-1dynA	122.684	**84.19**
41	1btn-1mai	**33.39**	112.259
42	1btn-1p1s	190.177	**127.77**
43	1btn-1rrpB	214.259	**204.197**
44	1byfA-1esl	138.436	**103.414**
45	1byfA-1fmsA	106.871	**91.051**
46	1byfA-1htn	147.997	**84.797**
47	1byfA-1rtml	**97.78**	101.6
48	1bywA-1drmA	**86.87**	92.761
49	1bywA-1g28D	87.325	**79.235**
50	1bywA-3pyp	**131.428**	137.727

3.2 Multiple Sequence Alignment (TLBO and M-TLBO)

The fitness of the TLBO and M-TLBO algorithms is observed using "oxbench" bench mark dataset. Experiments are conducted on 50 test data sets taken from "oxbench" and the results (average fitness values and execution time in milliseconds) are tabulated in Tables 3 and 4 as shown below.

Table 3 TLBO algorithm & M-TLBO algorithm performance comparison for MSA (Average Fitness Scores)

S. No	Name of the sequences	TLBO fitness	M-TLBO fitness
1	−112	1041.1	**1114**
2	−127	**409.5**	328.2
3	−145	**3618.2**	2984
4	−235	1160.8	**1265.1**
5	−236	**1446.9**	1428.6
6	−303	1612.2	**1628.8**
7	−332	755.2	**850.3**
8	−370	**1741.6**	1398.8
9	−388	**2136.6**	2115.9
10	−394	1541.8	**1859.9**
11	−397	**428.3**	377.9
12	−410	**4309**	3574.7
13	−433	705.4	**797.9**
14	−46	**258.9**	252
15	−469	1210.1	**1391.9**
16	−502	1942.5	**1959.6**
17	−54	**357.1**	355.6
18	−591	2203	**2852.1**
19	−60	318.2	**475.8**
20	−71	433.6	**529.8**
21	−84	3321.7	**3286.5**
22	−94	**1978.4**	1936.9
23	−118	1362.3	**1849.9**
24	−120	1087.4	**1109**
25	−96	992.9	**1029.9**
26	−14	379.8	**382.2**
27	−19	686.1	**747.5**
28	−89	**519.3**	507.3
29	−415	1780.7	**1787.7**
30	−442	3098.3	**4005.9**
31	−471	4225	**4451.4**
32	−573	**1840.6**	1747.8
33	−587	1320.9	**1889.6**
34	−62	**1020.5**	769.4
35	−655	1340.7	**1741.8**
36	−669	**1609.3**	1279
37	−76	**3794.9**	3642.7
38	−12s19	2880.9	**3042.9**
39	−4t2	2294.1	**2833.8**

(continued)

Table 3 (continued)

S. No	Name of the sequences	TLBO fitness	M-TLBO fitness
40	−104s6	**3182.4**	2712.7
41	−104s8	2207.7	**2038.4**
42	−118s1	1403	**1413.6**
43	−120s1	796	**821.4**
44	−130t2	1040.9	**1184.9**
45	−130t3	731.2	**937.7**
46	−34s1	**2160.6**	2137.8
47	−22s46	753.9	**797.5**
48	−22t54	**466.1**	443.9
49	−22s24	1698.3	**2421.7**
50	−22s44	1064.6	**1188.8**

Table 4 TLBO algorithm & M-TLBO algorithm performance comparison for MSA (Time in ms)

S. No	Name of the sequences	TLBO Time (ms)	M-TLBO Time (ms)
1	−112	**201.67**	201.786
2	−127	**393.618**	434.167
3	−145	**148.45**	178.63
4	−235	978.56	**741.838**
5	−236	149.52	**133.667**
6	−303	958.982	**929.39**
7	−332	1196.274	**1163.232**
8	−370	154.34	**103.79**
9	−388	519.425	**416.26**
10	−394	505.602	**467.24**
11	−397	399.48	**379.08**
12	−410	936.43	**877.52**
13	−433	84.377	**72.26**
14	−46	**160.047**	170.497
15	−469	801.625	**395.712**
16	−502	595.733	**562.95**
17	−54	**939.248**	956.577
18	−591	565.829	**517.86**
19	−60	308.6	**299.184**
20	−71	84.78	**83.489**
21	−84	572.731	**549.45**
22	−94	1027.04	**940.114**
23	−118	292.66	**258.39**
24	−120	792.885	**776.97**

(continued)

Table 4 (continued)

S. No	Name of the sequences	TLBO Time (ms)	M-TLBO Time (ms)
25	−96	944.177	**871.4**
26	−14	**235.302**	255.5
27	−19	925.548	**866.68**
28	−89	**831.588**	865.311
29	−415	63.082	**55.143**
30	−442	677.47	**653.762**
31	−471	641.921	**605.48**
32	−573	61.942	**58.74**
33	−587	471.65	**443.386**
34	−62	309.094	**298.35**
35	−655	405.855	**393.068**
36	−669	90.615	**85.679**
37	−76	414.08	**382.44**
38	−12s19	637.588	**306.109**
39	−4t2	355.527	**333.084**
40	−104s6	174.023	**168.197**
41	−104s8	**66.49**	85.054
42	−118s1	564.88	**461.908**
43	−120s1	303.95	**289.445**
44	−130t2	281.754	**244.498**
45	−130t3	**56.76**	67.569
46	−34s1	182.936	**172.568**
47	−22s46	215	**210.084**
48	−22t54	274.94	**263.937**
49	−22s24	445.848	**432.469**
50	−22s44	149.523	**78.07**

3.3 Discussions

The performance of the TLBO and M-TLBO are found for both PSA and MSA and the results are analyzed as follows.

TLBO and M-TLBO are run on 50 bench mark data sets taken from prefab4ref and recorded the average fitness scores of the respected data sets in Table 1 and depicted with Fig. 1. It is observed that 16 times TLBO performed best and 34 times M-TLBO performed best and it is depicted in Table 5.

TLBO and M-TLBO are run on 50 bench mark data sets taken from prefab4ref and recorded the execution times of respected data sets in Table 2 and depicted with Fig. 2. M-TLBO's execution time are less when compared with TLBO. It is observed that 13 times TLBO performed best and 37 times M-TLBO performed best and it is depicted in Table 6.

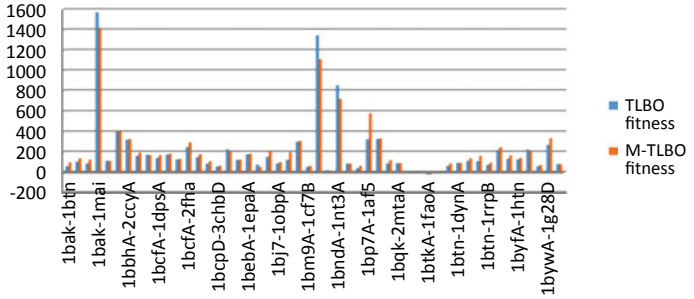

Fig. 1 TLBO algorithm & M-TLBO algorithm performance comparison for PSA (Average Fitness Scores)

Table 5 Frequency of best performance in terms of average fitness scores (PSA)

TLBO	M-TLBO
16	34

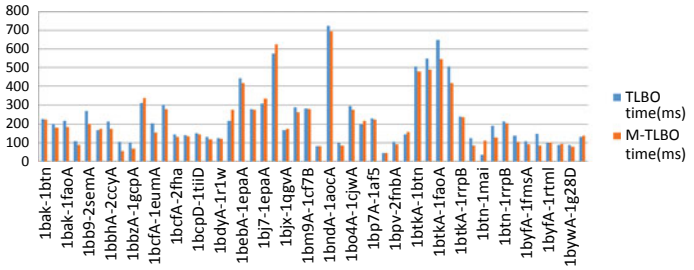

Fig. 2 TLBO algorithm & M-TLBO algorithm performance comparison for PSA (Time in ms)

Table 6 Frequency of best performance in terms of time in ms (PSA)

TLBO	M-TLBO
13	37

TLBO and M-TLBO are run on 50 bench mark data sets taken from OX (OXBENCH) and recorded the average fitness values of the respected data sets in Table 3 and depicted with Fig. 3. It is observed that 18 times TLBO performed best and 32 times M-TLBO performed best and it is depicted in Table 7.

TLBO and M-TLBO are run on 50 bench mark data sets taken from OX (OXBENCH) and recorded the execution times of respected data sets in Table 4 and depicted with Fig. 4. Most of times M-TLBO's execution time are less when compared with TLBO. It is observed that 9 times TLBO performed best and 41 times M-TLBO performed best and it is depicted in Table 8.

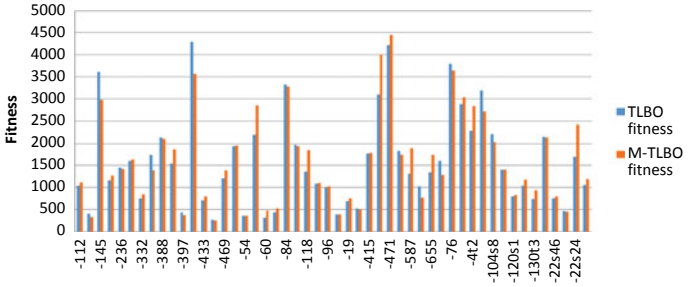

Fig. 3 TLBO algorithm & M-TLBO algorithm performance comparison for MSA (Average Fitness Scores)

Table 7 Frequency of best performance in terms of average fitness values (MSA)

TLBO	M-TLBO
18	32

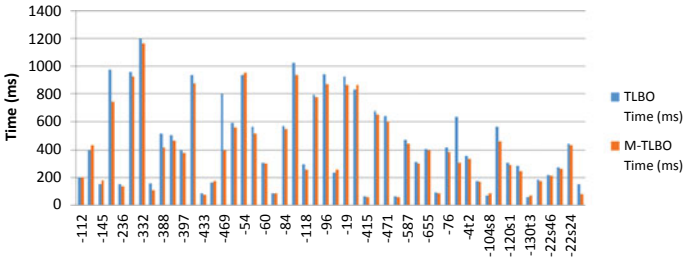

Fig. 4 TLBO algorithm and M-TLBO algorithm performance comparison for MSA (Time in ms)

Table 8 Frequency of best performance in terms of time in ms (MSA)

TLBO	M-TLBO
9	41

4 Limitations

For testing PSA using M-TLBO the length of the sequences are less than nearly 500 residues only and for testing MSA using M-TLBO number of sequences used is less than 10.

5 Conclusions and Future Accomplishments

Aligning two biological sequences is termed as PSA. Aligning three or many sequences is termed as MSA. In the literature many methods were developed to achieve both PSA and MSA. Among all the methods DE outperformed. It is a stochastic real parameter optimization method which requires few control parameters. Later to resolve optimization problems TLBO was developed. TLBO doesn't need any algorithmic specific parameters. Inspired by the concept, this paper proposes a new algorithm called M-TLBO to perform both PSA and MSA. To do performance analysis on the proposed algorithms bench mark data sets from "prefab4ref" are used for PSA and data sets from "oxbench" is used for MSA. In order to calculate the fitness of the above algorithms SoPs fitness function is used. The proposed algorithm M-TLBO outperformed TLBO in performance with less computational time. Parallelization may be applied on M-TLBO to further enhance the performance in terms of time.

References

1. Shehab S et al (2018) A survey of the state-of-the-art parallel multiple sequence alignment algorithms on multicore systems, arXiv:1805.122223v1 [cs.CE]
2. Smith TF, Waterman, MS (1981) Identification of common molecular subsequences. J Mol Biol 147(1):195–197. https://doi.org/10.1016/0022-2836(81)90087-5. PMID 7265238
3. Needleman SB, Wunsch, CD (1970) A general method applicable to the search for similarities in the amino acid sequence of two proteins. J Mol Biol 48(3):443–53. https://doi.org/10.1016/0022-2836(70)90057-4. PMID 5420325
4. Thompson JD, Higgins DG, Gibson TJ (1994) CLUSTAL W: improving the sensitivity of progressive multiple sequence alignment through sequence weighting, position-specific gap penalties, and weight matrix choice. Nucleic Acids Res. 22(22), 4673–4680
5. Sievers F, Wilm A et al (2011) Fast, scalable generation of high-quality protein multiple sequence alignments using clustal omega. Mol Syst Biol 7:539
6. Katoh K, Standley DM (2013) MAFFT multiple sequence alignment software version 7: improvements in performance and usability. Mol Biol Evol 30(4):772–780
7. Lassmann T, Sonnhammer EL (2005) Kalign—an accurate and fast multiple sequence alignment algorithm. BMC Bioinform 6:298
8. Edgar, RC (2004) MUSCLE: a multiple sequence alignment method with reduced time and space complexity. BMC Bioinform 5:113
9. Do MCB (2005) ProbCons: probabilistic consistency-based multiple sequence alignment. Genome Res 15(2):330–340
10. Szabo A et al (2010) Reticular alignment: a progressive corner-cutting method for multiple sequence alignment. BMC Bioinform 11:570
11. Di Tommaso P, Moretti S, Xenarios I, Orobitg M, Montanyola A, Chang JM, Taly JF, Notredame C (2011) T-Coffee: a web server for the multiple sequence alignment of protein and RNA sequences using structural information and homology extension. Nucleic Acids Res 39(2), w13–w17
12. Wallace IM et al (2006) Mcoffee: combining multiple sequence alignment methods with t-coffee. Nucleic Acids Res 34(6):1692–1699

13. Finn RD et al (2011) HMMER web server: interactive sequence similarity searching. Nucleic Acids Res 39(suppl_2):W29–W37
14. Notredame C, Higgins DG (1996) SAGA: sequence alignment by genetic algorithm. Nucleic Acids Res 24:81515–1524
15. Garai G, Chowdhury B (2012) A novel genetic approach for optimized biological sequence alignment. J Biophys Chem 3(2):201–205
16. Nizam A et al (2011) Cyclic genetic algorithm for multiple sequence alignment. Int J Res Rev Electr Comput Eng (IJRRECE) 1(2), ISSN 2046-5149
17. Storn R, Price KV (1995) Differential evolution: a simple and efficient adaptive scheme for global optimization over continuous spaces. ICSI, USA, Technical report TR-95-012. http://icsi.berkeley.edu/~storn/litera.html
18. Dorigo M, Stutzle T (2004) Ant colony optimization. MIT Press, Cambridge
19. Kennedy V, Eberhart R (1995) Particle swarm optimization. In: Proceedings of the IEEE international conference on neural networks, pp 1942–1948
20. Basturk B, Karaboga D (2006) An artificial bee colony (ABC) algorithm for numeric function optimization. In: IEEE swarm intelligence symposium
21. Das S, Suganthan PN (2011) Differential evolution: a survey of the state-of-the-art. IEEE Trans Evol Comput 15(1)
22. Rao RV et al (2011) Teaching–learning-based optimization: a novel method for constrained mechanical design optimization problems. Comput Aided Des 43(2011):303–315

A Comparative Study of Feed Forward Hybrid Neuro-Computing Framework with Multilayer Perceptron Model for Prediction of Breast Cancer

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Abstract Cancer originates when cells start to grow disorderly and there is a possibility that all the cells of the body have the scope to become cancer and can spread to other areas of body. A malignant tumor that initiates in the cells of breast turns out to be breast cancer. The presence of tumor anywhere in the body can be either malignant or benign i.e. cancerous and non-cancerous. Many research works have been carried out to diagnose the cancer disease. In this proposed research, A hybrid neural network model (SOM and LVQ) has been proposed. The output of SOM has been fed as an input to LVQ model. The classification of the dataset is done with SOM network using a competitive learning algorithm where as LVQ is trained with a vector quantization method. The patient's data set contains 9 attributes which have been considered as input to the model. The inputs are then given to an SOM where each data point is classified into various clusters by using competitive learning process. Gradually, the classes obtained from SOM are appended back to the training input data for the training of supervised LVQ. After training, LVQ can be used to classify any unknown input data. The output thus obtained from this supervised learning algorithm is used to diagnose the presence of tumor leading to breast cancer. The labelled data from SOM is given as input to Multilayer Perceptron (MLP) and performance of the network is compared with the hybrid network. It has been observed that, The hybrid model performed equally well with that of the MLP model in diagnosing the cancer disease.

Keywords Breast cancer · Competitive learning · Self Organizing Map · Learning Vector Quantization · Back propagation algorithm · Multi layer perceptron neural network · Competitive learning

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_132

1 Introduction

Cancer has been identified as one of the most common diseases in today's world. As the research continued, researchers identified that cancer doesn't restricts to few organs in the body. Cancer was identified in some delicate and complex organs like lung, liver, breast etc. Of all these, breast cancer has been identified as a major threat to women in modern world.

Many causes have been identified for breast cancer and some of those include change in lifestyle, increase in stress levels. Statistics indicated that percentage of women suffering from breast cancer is being increased compared with yester years.

Medical researches illustrated that technological impacts along with improper working timings had increased the stress levels in women.

Although several techniques and medicinal advances contributed to predict out this disease [1–3], there are still hidden cases which cannot be identified even with the present models. Over the years, the researchers in the medical domain witnessed a significant improvement in this area.

Basically, Hybrid neural networks comprising of two neural networks one is self-organising management (SOM) [2–4] and other is learning vector quantization (LVQ) [5, 6]. SOM framework, also called as Kohonen Network has a sustain forward structure that contains a single computational layer of neurons which are organized in rows and columns. Every neuron is fully connected to all the source units in the input layer. Encoding a large set of input vectors is one basic aim of using a Self Organizing Map (SOM) which is done by finding a smaller set of representatives, also called as prototypes or code-book vectors. A decent estimation is given to the original input space. This is the essential thought of vector quantization theory, the inspiration of which is dimensionality reduction or data compression.

One of the most ideal approach to comprehend vector quantization is to characterize it in the terms of general encoders and decoders. A vector quantizer with least encoding twisting is known as a Voronoi quantizer or nearest-neighbor quantizer. The input space is divided into a set of Voronoi or nearest neighbor cells each containing an associated Voronoi or reconstruction vector.

The SOM calculation gives a valuable strategy to figuring the Voronoi vectors (as weight vectors) in an unsupervised way. One regular application is to utilize it for discovering great focuses (contribution to concealed unit weights) in RBF networks.

In order to assess the results obtained from hybrid neural networks, we use another technique called multilayer perceptron (MLP) [1, 7, 8], one of the most efficient techniques in neural networks.

2 Methodology

Self Organizing Map
Kohonen SOM (KSOM) is a type of artificial neural network and uses unsupervised learning to train the network. The goal is to classify the input data to the desired number of class labels.

The input patterns shares the common features which have to be uncovered or identified by SOM to complete the training of the network [2, 3]. The concept, Competitive learning makes the SOM network different from other available ANN, in which the output neurons compete among themselves to be the activated for the particular input neuron, only one at a time. Activated neuron will be the winning neuron. Here we used SOM [4, 5] initially to learn our data of breast cancer.som network classified breast cancer data into two classes, i.e. malignant or benign. This SOM classified data is given further to supervised LVQ [2, 5] network to cluster the data and to eliminate any existing misclassifications.

SOM Algorithm

Step 1:
Initiate the output neurons matrix based on the input attributes and output class labels i.e. w[m][n],
where, m—number of input pattern attributes
n—number of output class labels
Step 2: Load the input data file.
Step 3:

(i) For every input pattern i, calculate the Euclidean distance with every column of output matrix.

$$d_i = (x - x_i)^2$$

for the smallest d_i value announce that output neuron as winning neuron.

(ii) Update the weights of the winner neuron in the output matrix,

$$w_{new} = w_{old} + \text{alpha} * (x_i - w_{old})$$

Step 4:
Repeat the step 3 for a fixed number of iterations and stop.

Learning Vector Quantization
Learning Vector Quantization uses supervised training to train the input dataThis learning strategy utilizes the class data to reposition the Voronoi vectors marginally, in order to enhance the nature of the classifier choice regions. LVQ can be utilized when we have named input data, which utilizes class data to migrate the winning neurons, to enhance the nature of classifiers [2, 3]. LVQ is a predecessor to SOM, k-nearest neighbour algorithm (k-nn).

Here, the labelled input data is obtained from SOM [5] and LVQ network trains the data to eliminate the existing misclassifications if any. Later, test data is given to LVQ [6] network, which can label the given unknown test sample.

The essential LVQ approach is very natural. It depends on a standard prepared SOM with input vectors and weights/Voronoi vectors. The new factor is that the input data focuses have related class data. This enables us to utilize the known classification labels of the contributions to locate the best classification label for each Voronoi cell. For instance, by essentially tallying up the aggregate number of examples of each class for the inputs inside every cell. At that point each new input without a class label can be assigned to the class of the Voronoi cell it falls inside.

The issue with this is, in general, it is far-fetched that the Voronoi cell limits will coordinate with the most ideal order limits, so the arrangement speculation execution won't be in the same class as conceivable. The obvious solution is to move the Voronoi cell limits so they better match the classification limits.

LVQ Algorithm

Step 1:
Initiate the output neurons matrix based on the input attributes and output class labels i.e. w[m][n],
where, m—number of input pattern attributes
n—number of output class labels
Step 2: Load the input data file.
Step 3:

(i) for every input pattern i, calculate the Euclidean distance with every column of output matrix.

$$d_i = (x - x_i)^2$$

(ii) for the smallest d_i value announce that output neuron as winning neuron.

Step 4:
For the i th input pattern, validate the calculated LVQ class and the target class i.e. SOM class.

if LVQ class == target class

$$w_{new} = w_{old} + \text{alpha} * (x_i - w_{old})$$

Else

$$w_{new} = w_{old} - \text{alpha} * (x_i - w_{old})$$

Step 5:
For the testing data, do step 3.
Step 6:
Stop

3 Multilayer Perceptron

The simple model of a biological neuron was first introduced in early 1940's, which consists of a swimming function, and internal threshold and some weighed inputs. The modified version of single layer perceptron is the multi layer perceptron (MLP) [1, 7] or multi layer neural networks. The primary difference between these two perceptrons is, SLP [9] can solve only linearly separable problems where as MLP can solve both linear and non linear separable problems. The limitations of the single layer perceptrons has led to the discovery of the multi layer perceptrons [8, 10].

Over the last few years the multi layer perceptrons are widely used type of neural networks. MLP is the most powerful technique of all to solve the problems which are more complex [10, 11]. MLP neural networks is supervised learning and consists of three layers which are subsequently connected to one another. The input layer accepts the data pattern from the source, the second layer i.e. the hidden layer which accepts the output of the input layer, weighs them and it is passed through a non linear activation function. The output layer accepts the output from the hidden layer, weigh them and produces the target values.

Learning in each perceptron can only be occurred if the connection weights are changed or modified after each data is processed. So based on the amount of output is compared with the expected result and accuracy is detected. The main advantage of the MLP is that they actually classify the unknown patterns with other known patterns sharing same features. To be more precise, The noisy data will be modified [9, 10].

A technique can only said as an optimised one when it possess a minimal accuracy. There are different algorithms in multilayer perceptron. Of all, one of the best algorithm that has been proven from the last decade and is widely used is back propagation neural network algorithm [12]. In order to train a network we use only supervised learning. Back propagation is one of the most simplest and generalised methods. Generally, supervised algorithms are error-based algorithms which takes an external signal and generates an error by the obtained output. It calculates the errors present in the output layer to find the errors in hidden layer. This main advantage in BPNN [8] allows it to find the problems that have no relationship between input and outputs.

The operation of the typical MLP with back propagation algorithm is as follows. The operation of the typical back propagation network occurs as follows.

Step 1:

After presenting input data to the input layer, information propagates through the network to the output layer (forward propagation). During this time input and output states for each neuron will be set.

$x_j[s] = f(I_j[s]) = f(\Sigma\ (w_{ij}[s] * x_i[s - 1]))i$ [7].

Where $x_j[s]$—Denotes the current input state of the jth neuron in the current [s] layer.

$I_j[s]$—Denotes the weighted sum of inputs to the jth neuron in the current layer[s]. f is conventionally the sigmoid function.

W_{ij} [s]—denotes the connection weight between the ith neuron in the current layer [s] and jth neuron in the previous layer [s − 1].

Step 2:

Global error is generated based on the summed difference of required and calculated output values of each neuron in the output layer. The Normalized System error E (glob) is given by the Equation E(glob) = 0.5 * $(r_k - o_k)2$ and $(r_k - o_k)$ denotes the difference of required and calculated output values [10].

Step 3:

Global error is back propagated through the network to calculate local error values and delta weights for each neuron. Delta weights are modified according to the delta rule that strictly controls the continuous decrease of synaptic strength of those neurons that are mainly responsible for the global error. In this manner the regular decrease of global error can be assured [10].

E_j [s] = x_j[s] * (1.0 − x_j[s]) * Σ (e_k[s + 1] * w_{kj}[s + 1])k [15]

Where E_j [s] is the scaled local error of the jth neuron in the current layer [s] layer

$$\Delta w_{ji}[s] = \text{lcoef} * e_j[s] * x_i[s-1]$$

where Δw_{ji} [s]—Denotes the delta weight of the connection between the current neuron and the joining neuron. Here, lcoef denotes the learning coefficient/learning constant of the training parameters.

Step 4:

Synaptic weights are updated by adding delta weights to the current weights [10].

4 Results

699 samples are trained by SOM network and classified into two classes i.e. class 2 or 4 (Tables 1 and 2).

599 samples are trained by LVQ network and clustered into two classes. LVQ network eliminates the misclassified SOM classes.

100 samples are tested by LVQ network. Testing results illustrates that 3 input samples are misclassified by SOM.

Table 1 SOM classification

Class labels	Number of samples
2	518
4	181
Total number of samples	699

Table 2 LVQ Training

Class labels	Number of samples
2	343
4	256
Total number of samples	599

Table 3 LVQ testing

Class labels	Number of samples		Accuracy percentage of LVQ network
	SOM	LVQ	
2	83	80	97%
4	17	20	
Total number of samples	100		

Table 4 MLP training

Samples	NI	NO	NOHL	NUHL	LR	MTE	MIE	NIT	NSE
10	10	1	1	7	0.7	0.01	0.001	14	0.0093
15	10	1	1	7	0.7	0.01	0.001	11	0.0096
20	10	1	1	7	0.7	0.01	0.001	12	0.0098
25	10	1	1	7	0.7	0.01	0.001	500	0.0103
30	10	1	1	7	0.7	0.01	0.001	500	0.0131
35	10	1	1	7	0.7	0.01	0.001	500	0.0134
40	10	1	1	7	0.7	0.01	0.001	500	0.0127
45	10	1	1	7	0.7	0.01	0.001	500	0.0136
50	10	1	1	7	0.7	0.01	0.001	500	0.0104
55	10	1	1	7	0.7	0.01	0.001	500	0.0111
60	10	1	1	7	0.7	0.01	0.001	500	0.0133
65	10	1	1	7	0.7	0.01	0.001	500	0.0137
70	10	1	1	7	0.7	0.01	0.001	500	0.0141

NI: Number of input units **NO:** Number of input units
NOHL: Number of hidden layers **NUHL:** Number of units for hidden layer **LR:** Learning rate alpha **NIT:** Maximum number of iterations **MTE:** Maximum total error **MIE:** Maximum individual error **NSE:** Normalized system error

Input samples are trained by MLP network gradually till a minimal error is encountered. Here, for 75 samples we got the minimal error and stopped the training (Table 5).

One sample at a time is given for testing and compared with the target class label to measure the accuracy rate (Table 6).

Table 5 MLP testing

Sample number	Target output	Actual output	Accuracy
6	0.5	0.48	96%
17	1	0.96	96%
34	0.5	0.49	98%
43	0.5	0.46	92%
60	1	0.99	99%
68	1	0.98	98%
70	0.5	0.49	98%
84	1	0.98	98%

Table 6 Performance assessment of hybrid neural network and MLP network

Total number of samples	Hybrid neural network accuracy	MLP network accuracy
100	97	96.2

5 Discussion

The hybrid network model had been trained by competitive learning algorithm to predict the breast cancer using the available dataset from university of Wisconsin. Neural Networks models have been utilized in an assortment of clinical settings, however to our knowledge, this is the first time the hybrid model is used to predict the breast cancer diagnosis. The improvement of our model is a viable apparatus to anticipate the cancer disease given the biological and biographical variables. As more information are created, the proposed framework enhances accuracy and can be widely employed in patient care and research.

6 Conclusion

In summary, we built up a hybrid model utilizing the accessible data on breast cancer exhibited that it gave best outcomes which are steady with domain experts. The proposed model could be improved to any coveted level by giving more number inputs.

References

1. Mojarad SA, Dlay, SS, Woo WL, Sherbet GV (2010) Breast cancer prediction and cross validation using multilayer perceptron neural networks, 978-1-86135-369-6/101
2. Thein, HTT, Tun KMM (2015) An approach for breast cancer diagnosis classification using neural network. Int J (ACD) 6(1), January
3. Singh S, Sushmitha H, Harini J, Surabhi BR (2014) An efficient neural network based system for diagnosis of breast cancer. Int J Comput Sci Inf Technol l5(3):4354–4360. ISSN 0975-9646
4. Angas JK, Kohonen T (1996) Developments and applications of the self organising map (SOM) and related algorithms. Accepted for Mathematics and computers in simuation. Predicted Publication: MACTOM 42(5–6) July
5. Somerbuo P, Kohonen T Self-Organizing maps and Learning vector Quantization for feature sequences. Neural Networks Research centre, P.O. Box 2200, FIN-02015-HUT, Finland
6. Bichi M, Ghosh A, Hammer B (2007) Dynamics and generalization ability of LVQ Algorithms. J Mach Learn Res 8:323–360
7. Raad A, Kalakech A, Ayache M (2012) Breast cancer classification using neural network approach: MLP and RBF. In: ACIT 2012, 10–13 December, ISSN 1812-0857
8. Yua C, Manryb MT, Lic J, Narasimhab PL (2006) An efficient hidden layer training method for the multilayer perceptron. Sci Direct Neurocomputing 70:525–535
9. Daqi G, Yan J (2005) Classification methodologies of multilayer perceptrons with sigmoid activation functions. Sci Direct Pattern Recogn 38:1469–1482
10. Devarapalli D, Apparao A, NarasingaRao MR, Kumar A, Sridhar GR A multilayer perceptron (MLP) neural network based diagnosis of diabetes using brain derived neurotrophic factor (BDNF) levels. Int J Adv Comput 35(12):422–427
11. Durairaj M, Revathi V (2015) Prediction of heart disease using back propagation MLP Agorithm. Int J Sci Technol Res 4(08). ISSN 2277–8616
12. Saduf, MAW (2013) Comparitive study of back propagation learning algorithms for neural networks. Int J Adv Res Comput Sci Softw Eng 3(12). ISSN 2277 128X

Analysis of Shape Signature in First and Second Derivatives by Using Wavelet Transformation

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Abstract The object recognition techniques are popular in computer vision and pattern recognition research field. The present paper focuses on the design of a novel shape signature based on angular information. The Wavelet coefficients are also used to formulate the shape signature. Further, the angular information is captured at two different derivatives of the input image. The angular information is used to estimate the tangential measure for each of the representative point of the input image. The represented shape signature is described with the Fourier transformation. The Fourier descriptors are used for the classification stage. The classification stage uses Euclidean distance measure for the classification. The proposed approach is evaluated on the standard database. The estimated performance measures show the efficiency of the proposed approach.

Keywords Signature · Feature vector · Distance · Classification · Representation

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_133

1 Introduction

A wide variety of object recognition methods are used in real time applications viz., road detection [1, 2], face recognition [3–5], Biometric finger recognition [6], character recognition [7], document image recognition [8] and medical imaging applications [9–11] etc. Due to the intrinsic advantages involved with the shape based object recognition method [12, 13] it has become a popular. The representation [14] of object shape follows either contour or region. However, contour based methods are found to be advantageous [15] than other group of methods. The other category i.e. region based focus on the complete information. Various methods under this category are Moment Invariants [16], Zernike Moment invariants [17], Krawtchouk moments [18], Chebyshev moments [19, 20] and medial axis transform [21, 22] etc. Contour based methods include Angular Radial transform [23], Fourier transformation [24], Curvature Scale Space and Wavelet transformation etc.

It is observed that the contour based methods are prominent than the region based methods. The objects can be efficiently discriminated by the shape of the object. The shapes can be further described with the feature vector. Owing to its tremendous applications in real time scenario, the contour methods are the considered as the emerging techniques of the computer vision field. The region content of the input object is not considered as a dominating property of the object than the boundary. Initially, the object should be represented with an efficient shape representation. The represented shape should be described in terms of various features. The associated feature vector should be invariant various properties viz., translation, rotation and scaling etc. The estimated feature vector should represent the complete information about the input object.

A Shape signature denotes a one dimensional functional boundary points that are derived. Many shape signatures are reported, which include centroid distance tangent angle, centroid profile, complex coordinates, chord-length, curvature, cumulative angle and area. These signatures are generally normalized with respect to the scale and translation invariance. The Distance Interior Ratio (DIR) is used to represent the given shape with a signature. In this, the signature is constructed for the intersection points of the line segments within the object. This method is an improvement approach for histogram based shape signature. A signature is constructed based on angular information within the input object. The angular information consists of the information related to minimized bounding circles. To overcome the loss of the pixel information during the binarization process, a signature is constructed. This signature represents pixel coverage information. It overcomes the limits of fuzzy representation.

Multi resolution analysis is an imperative method in the image processing. This combined with the Wavelet Transform yields better success rate. In Wavelet analysis, with a wavelet based vector the decomposition process is performed at multiple orientations and scales. The complex wavelet transformation is used for providing descriptions at multiple scales. The Fourier and Wavelet transformations are applied at polar and radius axes. The advantage is that, it yields better results for

the wavelet coefficients with additional localized frequency information. Further, the wavelets allow for a function into hierarchical frequency band decomposition. A harmonic wavelet based descriptor is used to analyze the erosion and wear of the particles. A Wavelet based recognition process is proposed based on wavelet and Fourier transformation based description. The wavelet networks stabilization takes less amount of time. This is achieved with the prominent feature extraction by the wavelet transformation. Some examples of them are MLP (Multi Layer Perceptron) and KSON (Kohonen Self-Organizing Network). Other than these transformations, Ridgelet transformation is also found to be efficient for providing the detailed description of the object. The Mexican-Hat Wavelet transformation is also found to be efficient for the object recognition. The Wavelet Zernike moment descriptor (WZMD) performs better than other descriptors. The radon transformation describes the shape of the object with various patterns represented into various slices. The utility of various transformations using a fuzzy similarity measure are widely employed. Similarity measurement between the extracted features is an important and crucial aspect during the stage of feature extraction in shape based object recognition procedures. Although the distance based methods are simple and straight forward for the matching representation, they found to be effective to the sealing invariance. The distance measures are found to be efficient for the object recognition.

With the reported literature survey, it is clearly exhibited that the Fourier and Wavelet transformations are efficient for representation and description. Presently, the authors use the angular shape representation for Wavelet Fourier based description. For this, the ED is used. In the present paper, introduction is given in Sect. 1, Systematic step wise multiscale FPA processing is given in Sect. 2, along with the further details of performance estimation. The results obtained, their trends and performance are given in Sect. 3.

2 Methodology

Currently, the object recognition techniques gain attention in the computer vision and pattern recognition field. The researcher's focus is on the development of shape based object recognition techniques than texture and other techniques. The shape of the object can be represented by using only the contour pixel information or the complete regional pixels information. The present paper uses contour based shape representation for object recognition. The present considered the input object into two different levels of derivatives. The first order derivative image contains the thick edges and is sensitive to noise. In general, the strong edge points are represented with the first order derivative image. The first derivative is given in (1).

$$FOD(I) = \frac{\partial I}{\partial x}.\Delta x + \frac{\partial I}{\partial y}.\Delta y \tag{1}$$

where

I is an input image,
Δx is the change in the neighbor pixels in x direction and
Δy is the change in the neighbor pixels in y direction.

The second order derivative of an image contains thin edges and is less sensitive to noise when compared to first order derivative image. The second order derivative image represents the major changes in spatial information. The localized edge information is exhibited with the second order derivative image. The second order derivative is shown in (2) (Figs. 1 and 2).

$$SOD(I) = \begin{pmatrix} \frac{\partial^2 I}{\partial x \partial x} & \frac{\partial^2}{\partial x \partial y} \\ \frac{\partial^2 I}{\partial y \partial x} & \frac{\partial^2 I}{\partial y \partial y} \end{pmatrix} \begin{pmatrix} \Delta x \\ \Delta y \end{pmatrix} \tag{2}$$

The present paper uses the angular information for constructing the signature of the shape. The invariant shape signature can easily discriminates various shapes of the objects. From the literature, it is observed that the Farthest point based signature is prominent than other signatures. Based on farthest point, the distance based signature and the angle based signatures are reported. The Farthest Point Distance (FPD) based signature is constructed based on the distance information where as Farthest Point Angle (FPA) based signature is constructed based on the angular information. When compared to the distance based representation, the angular based representation is efficient. So, the present paper uses FPA signature [26] for describing the angular information between the image pixels. The FPD and FPA signatures for two points P_1 and P_2 are described in (3) and (4).

$$FPD(P_1, P_2) = D(P_1) + D(P_2) \tag{3}$$

where, D represents the Euclidean distance between given point and the centroid.

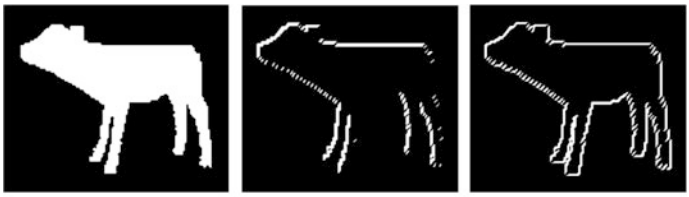

Fig. 1 **a** Input Image **b** First order derivative image **c** Second order derivative

Fig. 2 **a** Input Image **b** First order derivative image **c** Second order derivative

$$FPA(P_1, P_2) = \tan^{-1}\left(\frac{m(P_1) - m(P_2)}{1 + m(P_1)m(P_2)}\right) \tag{4}$$

where, m represents the slope of the line between given point and the centroid.

A shape descriptor regarding the shape of the object is proposed basing on the information of farthest corner from its centroid. The present method contains following stages

(i) Shape representation with FPA for each derivative image
(ii) Wavelet Transformation with multiple scales
(iii) Farthest Point Angle (FPA) signature construction at multiple scales
(iv) Fourier based description & Toning Process

In the first step, an Equivalent Arc Length (EAL) is used for sampling process. Further, the size of the representative points is limited to 128, since it is noticed that the limitation of the size of the representation to 128 would be successful, with its characteristic advantages. In the second step, the FPA is constructed for each of the derivative images. During the next step, the wavelet transformation is used. It is capable of representing the shape in four sub bands. So, with this transformation the input shape can be further represented in detail. This detailed representation with Wavelet transformation is further invariantly described with the Fourier transformation in the next step. Among these descriptors, it is found that the first ten descriptors of LL band can be used for the efficient way of description. The remaining bands can be varied with vertical, horizontal and directional patterns of the object. This variation is reflected to the feature vector in terms of the mean calculation. It turns out efficient due to the fact that they retain the most characteristic information and are sufficient to represent >99% of its information. For this the GD (Global Descriptor) is augmented to the proposed feature vector. During the next step, the ED based toning is estimated. From this result, the top ranked images will be used for the recognition result. The authors considered the estimation process of for measuring the performance. It compares with the standard benchmark descriptors CSSD, ZMD, MID and ARTD. The present paper experimented with the databases used in {MPEG and KIMIA}. The performance is further deeply estimated with the confusion matrix {FN, TP, FP and TN} for estimating ACC, FDR, PPV, SPC and TPR values.

3 Results and Discussions

Currently, design of a descriptor with Wavelet and Fourier transformation is proposed. The present method also considered the three databases {Ki99 (Kimia99), Ki216 (Kimia216) and MSB (Mpeg Set B)}. Initially, the shape contour is estimated and sampled to 128 points. Then, two level Haar wavelet transformation is applied on the contour. Figure 3 shows the three level decomposition of the input texture image. At each scale, in each sub band, the farthest Point Angle (FPA) signature is constructed.

The resulting WFPA signatures for first order images of dog and apple objects in MSB database are shown in Figs. 4 and 5. The Figs. 4(i) and (ii) contains two original images of apple group (apple-1 and apple-7). The WFPA constructed in LL sub band is presented in Figs. 4(iii) and (iv). It is noticed that the WFPA of circle shape is clearly represented at lower and higher plots. Among these, the leaf is also noticed to be clearly distinguishable. The two original images of dog group (dog10 and dog 14) shown in Figs. 5(i) and (ii). Shape of the dog object is non circular. Hence, there seems to be incremental growth in the lower and higher plots as shown in Figs. 5(iii) and (iv). From the Figs. 4 and 5, it s observed that the WFPA signature is unique for each group.

In the third step, the 1-D Fourier transformation is applied at each scale. The description process consists of the invariant features from the Wavelet-Fourier transformation. Finally, the ED based toning is used. The designed descriptor is experimented with the specified databases and the evaluated results are indicated in

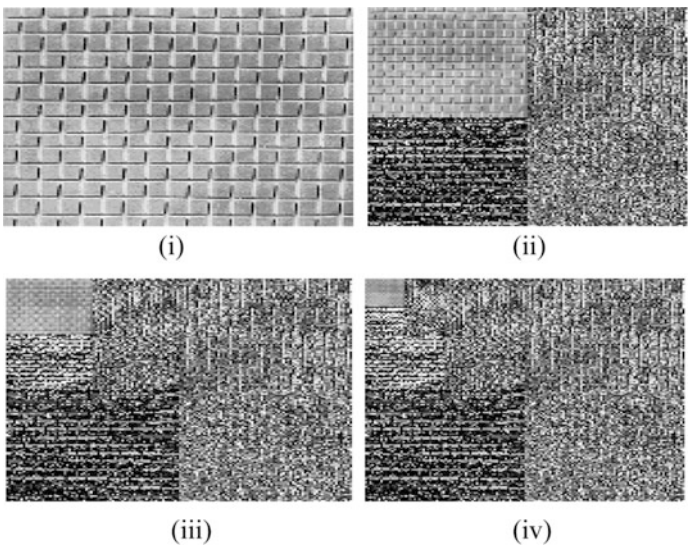

Fig. 3 **i** Original Brodatz Texture D_1 **ii** Level 1 Transformation of (i) **iii** Level 2 Transformation of (i) **iv** Level 3 Transformation

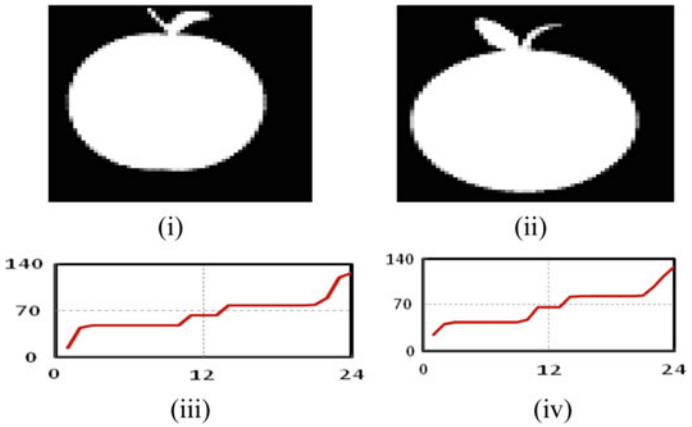

Fig. 4 **i** Original Apple-1 Image **ii** Original Apple-7 Image **iii** WFPA signature of (i) **iv** WFPA signature of (ii)

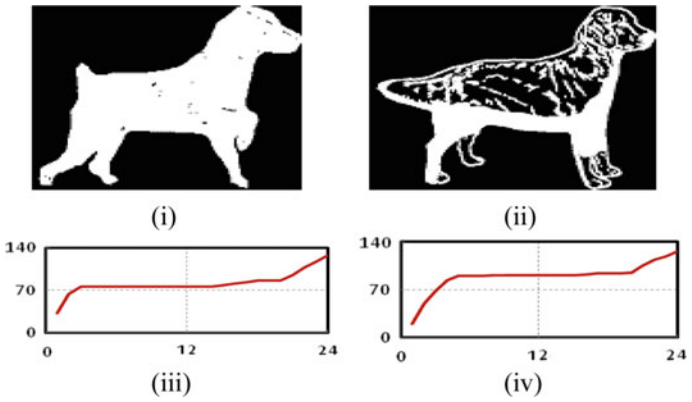

Fig. 5 **i** Original Dog-10 Image **ii** Original Dog-14 Image **iii** WFPA signature of (i) **iv** WFPA signature of (ii)

Tables 1, 2 and 3. From this, it is observed that the proposed WFPA descriptor is efficient than other benchmark descriptors. The WFPA descriptor is found to yield efficient results than FPA descriptor for first and second order derivates of the input object. When compared to the first order derivate, the WFPA is giving better results for second order derivative image. Similar to FPA, the present approach also considers the Global Descriptor (GD) feature vector for the description of the input object.

For all these databases, at both high and low recalls, the precision is significantly increased. The Precision-Recall graphs for all these database evaluation results are shown in Figs. 6, 7 and 8. The Fig. 6 shows the result with MSB database.

Table 1 Evaluation of precision at low and high recalls using MSB database

	APHR	APLR	Avg.
WFPA+SECDER+GD	84.01	52.68	68.35
FPA+SECDER+GD	82.30	51.85	67.07
WFPA+GD	83.79	52.65	68.22
FPA+GD	82.51	50.94	66.73
ARTD	82.10	45.69	63.90
MID	79.54	44.50	62.02
ZMD	82.56	45.62	64.09
CSSD	78.61	41.81	60.21

Table 2 Evaluation of precision at low and high recalls using Ki99 database

	APHR	APLR	Avg.
WFPA+SECDER+GD	89.84	63.40	76.62
FPA+SECDER+GD	89.67	61.53	75.60
WFPA+GD	89.01	62.74	75.87
FPA+GD	89.26	60.32	74.79
ARTD	84.26	45.72	64.99
MID	81.96	44.74	63.35
ZMD	89.61	61.37	75.49
CSSD	82.32	44.11	63.22

Table 3 Evaluation of precision at low and high recalls using Ki216 database

	APHR	APLR	Avg.
WFPA+SECDER+GD	89.78	66.87	78.33
FPA+SECDER+GD	89.82	65.72	77.77
WFPA+GD	89.89	65.67	77.78
FPA+GD	89.91	62.64	76.28
ARTD	81.35	44.67	63.01
MID	80.14	46.04	63.09
ZMD	88.94	61.71	75.33
CSSD	80.12	44.97	62.55

From this, it is clear that there is a major enhancement of precision at higher recalls when compared with the lower recalls. The Fig. 7 shows the result with Ki99 database. From this, it is clear that there is a major enhancement of precision at both higher and lower recalls. The Fig. 7 shows the result with Ki216 database. From this, it is clear that there is a major enhancement of precision at higher recalls.

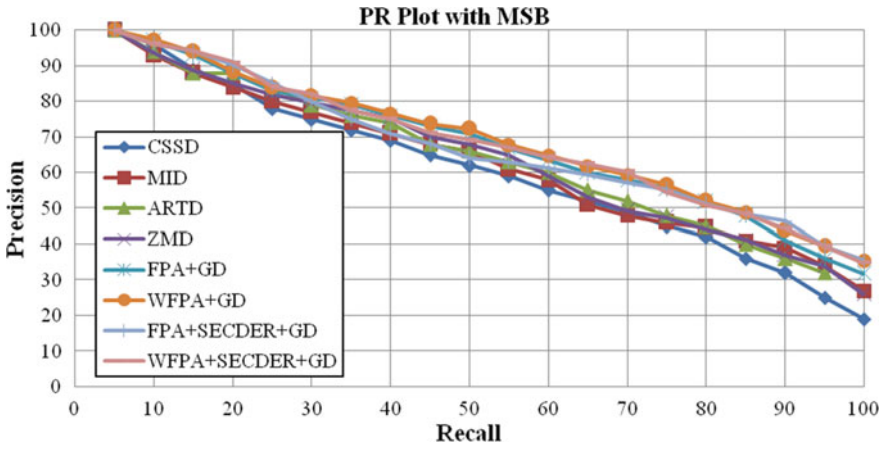

Fig. 6 PR Graph of MSB database

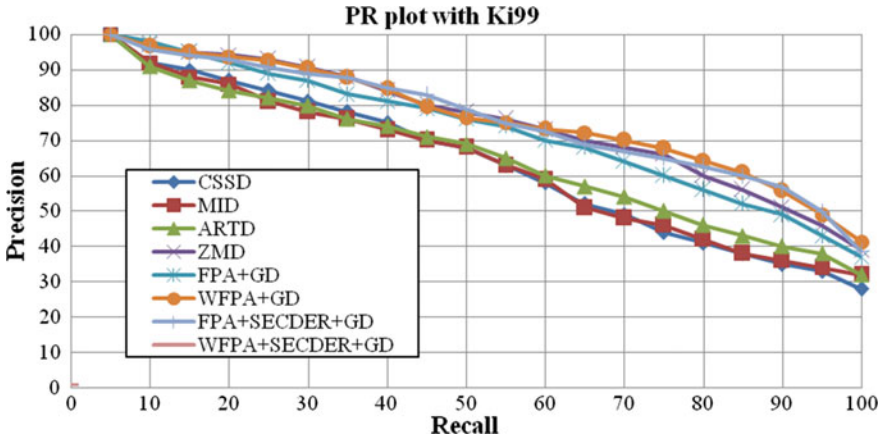

Fig. 7 PR Graph of Ki99 database

The recognition results of the proposed WFPA+GD descriptor with the three databases are shown in Figs. 9, 10 and 11. Among the various standard descriptors, the FPA+GD is having efficient performance measures. So, the present paper has compared the result of this descriptor with the proposed descriptor.

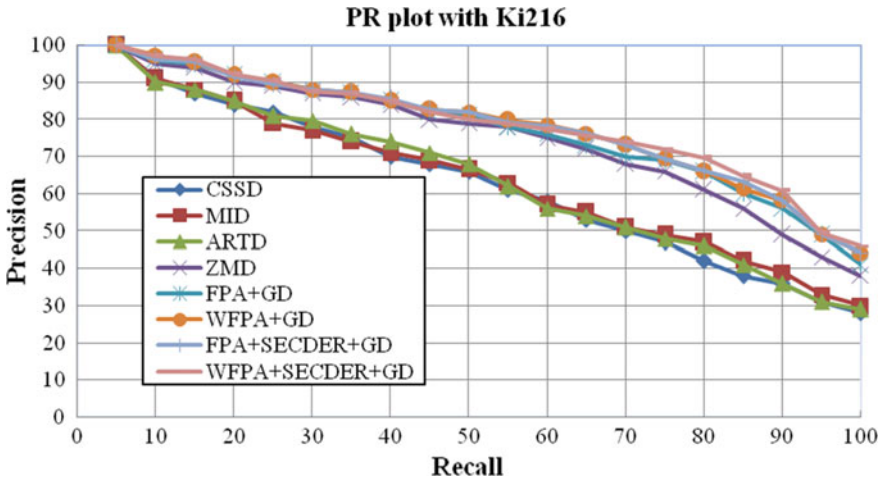

Fig. 8 PR Graph of Ki216 database

The APT measure of the proposed descriptor is similar to the FPA+GD descriptor. The measure of the bull's eye score (BES) is given in Table 4. The results of these tables are evaluated on MSB database. The BES of IDSC descriptor is found to be better than the proposed descriptor but the shape toning process of the proposed descriptor with ED is simpler than others.

The Table 5 illustrates the confusion matrix of the benchmark and proposed descriptors with MSB, Ki99 and Ki216 databases. Based on these values, the estimated performance measures of the proposed and benchmark descriptors are compared and shown in Table 6. Thus, it is clear that the proposed descriptor is having least FN and FP and greatest TP and TN values. Thus, the performance measures given in Table 6 signify the competence of the proposed descriptor. It is clear that the WFPA+GD descriptor found to yield better performance measures than the benchmark descriptor with all the three databases.

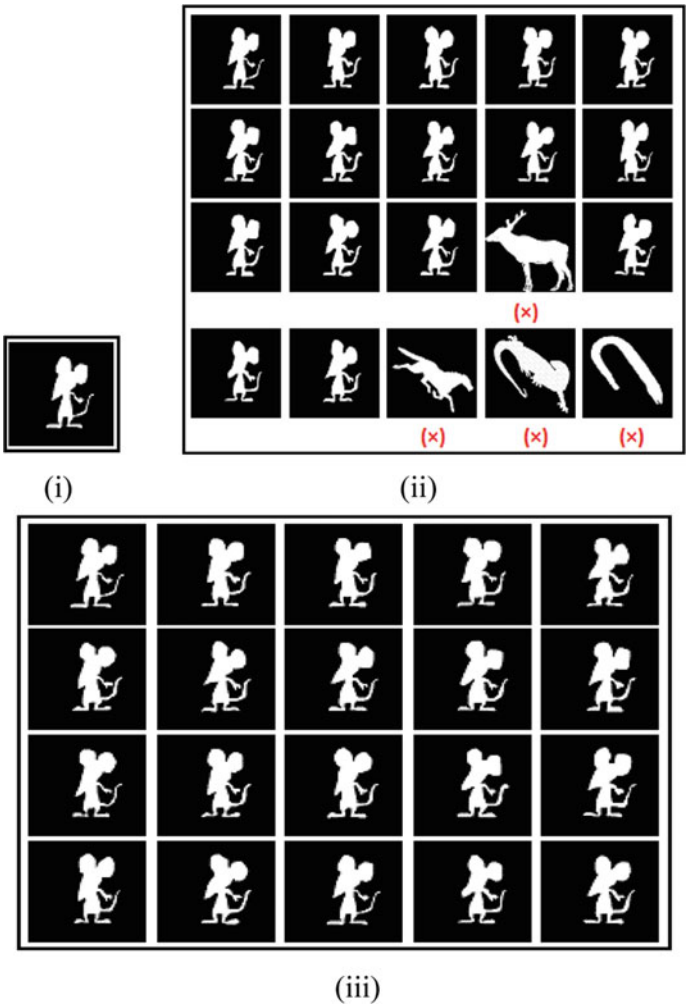

Fig. 9 **i** Rat-9 Query object from MSB **ii** Recognition Result of FPA+GD **iii** Recognition Result of WFPA+GD

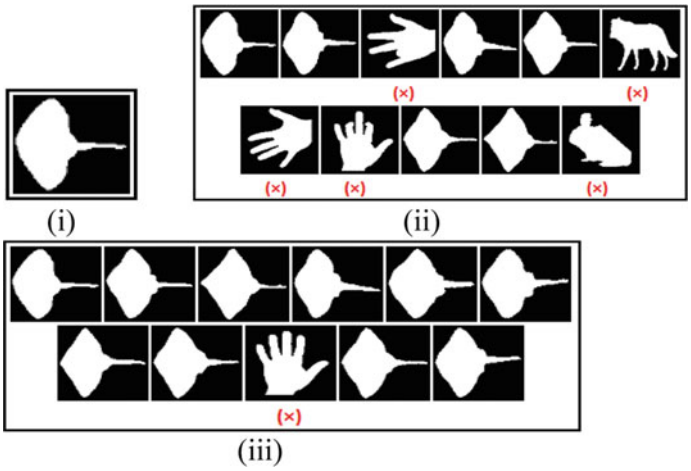

Fig. 10 **i** Key-5 Query object from Ki99 **ii** Recognition Result of FPA+GD **iii** Recognition Result of WFPA+GD

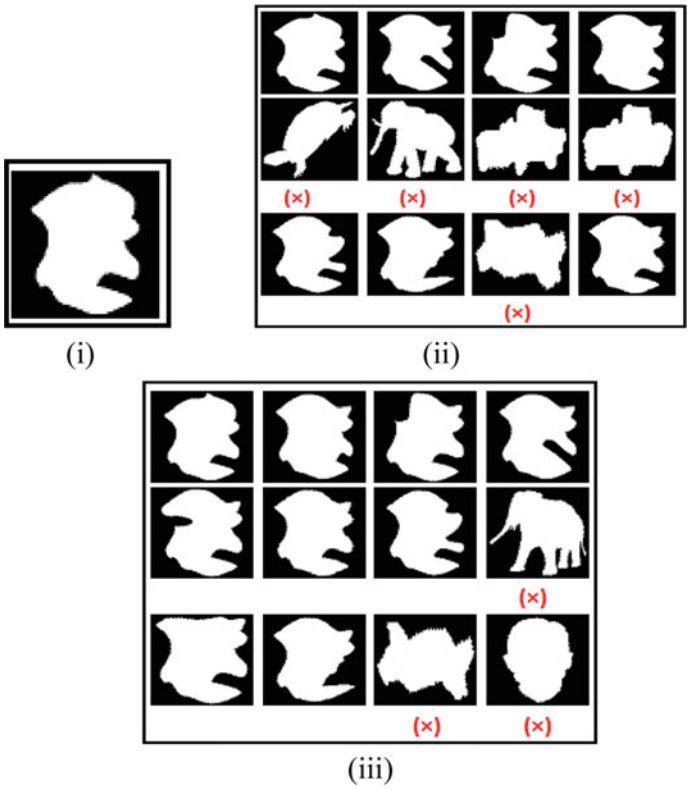

Fig. 11 **i** Misk-11 Query object from Ki216 **ii** Recognition Result of FPA+GD **iii** Recognition Result of WFPA+GD

Table 4 Evaluation of BES using MSB database

Descriptor	Score %
Descriptor in [27]	85.4
WFPA+GD	78.04
FPA+GD	76.82
Descriptor in [25]	76.56
Descriptor in [26]	76.51
Descriptor in [27]	76.45

Table 5 Evaluation of confusion matrix using MSB, Ki99 and Ki216 databases

	Descriptor	FN	FP	TP	TN
MSB	FPA+GD	0.207	0.135	0.793	0.894
	WFPA+GD	0.181	0.105	0.819	0.896
Ki99	FPA+GD	0.088	0.075	0.912	0.981
	WFPA+GD	0.069	0.055	0.981	0.998
Ki216	FPA+GD	0.079	0.075	0.921	0.995
	WFPA+GD	0.057	0.058	0.943	0.996

Table 6 Evaluation of performance measures using MSB, Ki99 and Ki216 databases

	Descriptor	PPV	TPR	SPC	NPV	FDR	ACC	F1
MSB	FPA+GD	0.855	0.793	0.869	0.812	0.145	0.831	0.823
	WFPA+GD	0.886	0.819	0.895	0.832	0.114	0.857	0.851
Ki99	FPA+GD	0.924	0.912	0.929	0.918	0.076	0.921	0.918
	WFPA+GD	0.947	0.934	0.948	0.935	0.053	0.941	0.941
Ki216	FPA+GD	0.925	0.921	0.93	0.926	0.075	0.926	0.923
	WFPA+GD	0.942	0.943	0.945	0.946	0.058	0.944	0.943

4 Conclusions

- Wavelet based description in object recognition would yield more efficiency for various performance measures.
- It describes the object with prominent lesser feature vector and further it leads to yield improved performance measures.

References

1. Li Y, Ding W, Zhang X, Ju Z (2016) Road detection algorithm for autonomous navigation systems based on dark channel prior and vanishing point in complex road scenes. Robotics and Autonomous Systems 85:1–11
2. Song W, Liu L, Zhou X, Wang C (2016) Road detection algorithm of integrating region and edge information. In: Proceedings of the international conference on artificial intelligence and robotics and the international conference on automation, control and robotics engineering, 14, Kitakyushu, Japan (2016)
3. Liu X, Lu L, Shen Z, Lu K (2016, Inpress) A novel face recognition algorithm via weighted kernel sparse representation. Future Gener Comput Syst
4. Surekha B, Nazare KJ, Raju SV, Dey N (2017) Attendance recording system using partial face recognition algorithm. In: Intelligent techniques in signal processing for multimedia security, pp 293–319
5. Wu Z, Yu Z, Yuan J, Zhang J (2016) A twice face recognition algorithm. Soft Comput 20 (3):1007–1019
6. Agarwal A, Sharma AK, Khandelwal S (2016) Fingerprint recognition system by termination points using cascade-forward backpropagation neural network. In: Proceedings of the international congress on information and communication technology. Advances in intelligent systems and computing, vol 413, pp 203–211
7. Sarkhel R, Das N, Saha AK, Nasipuri M (2016) A multi-objective approach towards cost effective isolated handwritten Bangla character and digit recognition. Pattern Recogn 58:172–189
8. Long W, Xia L, Wang XL (2016) A rapid automatic analyzer and its methodology for effective bentonite content based on image recognition technology. China Foundry 13 (5):322–326
9. Yan Z, Zhan Y, Peng Z (2016) Multi-instance deep learning: discover discriminative local anatomies for bodypart recognition. IEEE Trans Med Imaging 35(5):1332–1343
10. Carata S-V, Neagoe V-E (2016) A pulse-coupled neural network approach for image segmentation and its pattern recognition application. In: Communications (COMM) (2016)
11. Luminia A, Nannib L, Brahnam S (2016) Multilayer descriptors for medical image classification. Comput Biol Med 72(1):239–247
12. Shang J, Chen C, Liang H, Tang H (2016) Object recognition using rotation invariant local binary pattern of significant bit planes. IET Image Proc 10(9):662–670
13. Wang M, Luo C, Hong R, Tang J, Feng J (2016) Beyond object proposals: random crop pooling for multi-label image recognition. IEEE Trans Image Process 25(12):5678–5688
14. Lehky SR, Tanaka K (2016) Neural representation for object recognition in inferotemporal cortex. Curr Opin Neurobiol 37:23–35
15. Rhodin H, Robertini N, Casas D, Richardt C, Seidel H-P, Theobalt C (2016) General automatic human shape and motion capture using volumetric contour cues. In: Lecture Notes in Computer Science Computer Vision – ECCV, vol 9909, pp 509–526
16. Zhang Y, Yang J, Wang S, Dong Z, Phillips P (2016) Pathological brain detection in MRI scanning via Hu moment invariants and machine learning. J Exp Theor Artif Intell, 1–14
17. Nayaka R, Patra D (2016) Super resolution image reconstruction using weighted combined Pseudo-Zernike moment invariants. AEU - Int J Electron Commun 70(11):1496–1505
18. Dai X, Shi D, Deng H (2016) Limited-view CT reconstruction based on discrete Krawtchouk moments. In: 3rd International conference on information science and control engineering (ICISCE)
19. Zhua H, Yanga Y, Guib Z, Zhua Y, Chena Z (2016) Image analysis by generalized Chebyshev-Fourier and generalized pseudo-Jacobi–Fourier moments. Pattern Recogn 51:1–11
20. Seresht MK, Ghassemian H (2016) Remote sensing panchromatic images classification using moment features and decision fusion. In: 24th Iranian conference on electrical engineering (ICEE)

21. Sun F, Choi YK, Yu Y, Wang W (2015) Medial meshes–a compact and accurate representation of medial axis transform. IEEE Trans Vis Comput Graph 22(3):1278–1290
22. Bizzarria M, Lávičkab M, Kosinkac J (2016) Medial axis transforms yielding rational envelopes. Comput Aided Geometric Des 46:92–102
23. Senina N, Morettia M, Leachb RK (2017) Shape descriptors and statistical classification on areal topography data for tile inspection in tessellated surfaces. Measurement 95:82–92
24. Yang J, Wang H, Yuan J, Li Y, Liu J (2016) Invariant multi-scale descriptor for shape representation, matching and retrieval. Comput Vis Image Underst 145:43–58
25. Vásquez A, Kappassov, Z, Perdereau, V (2016) In-hand object shape identification using invariant proprioceptive signatures. In: IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
26. Radhika Mani M, Varma GPS, Potukuchi DM, Satyanarayana Ch (2014) Design of a novel shape signature by farthest point angle for object recognition. Int J Image Graph Sign Proces 7 (1):35–46
27. Bala E, Cetin AE (2004) Computationally efficient wavelet affine invariant functions for shape recognition. IEEE Trans Pattern Anal Mach Intell 26(8):1095–1099

An Ideal Big Data Architectural Analysis for Medical Image Data Classification or Clustering Using the Map-Reduce Frame Work

Hemanth Kumar Vasireddi and K. Suganya Devi

Abstract In the present day scenario, where huge volumes of data are being generated from various sources, as such storing and processing these data using traditional systems is a big challenge. The majority of data is of unstructured; hence necessary architectures should be designed to meet the continuous challenges. Among the possible solutions for the big data problem, one of the best solutions to address the huge volumes of unstructured data was Hadoop. In the medical field, huge volumes of clinical image data are resulting from the respective hardware tools. The necessary methods that are required to store, analyze, process and classification of these medical images can be done with map-reduce architecture using the Hadoop framework thereby reduces the computational time for the overall processing as the mapper will perform parallel processing. This paper includes a detailed review of Hadoop and its components. The main motive of this work is to deal with the medical image data using an efficient architecture such that automatic clustering or classification of images will be done within the architecture itself. The clustering of these medical images for future predictions and diagnosis for the disease is essential. In the map-reduce architecture, along with the map and reduce phases, the usage of combiners and partitioners will improve the efficiency of medical image processing for clustering the image data. The other responsibilities of this paper are to review the recent works in the image data clustering along with the state of art techniques for image classification. The clustered medical images will be used for automatic predictions and diagnosis of various patient diseases by applying Convolution Neural Network (CNN) techniques on top of the clustered or classified images.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_134

Keywords Medical image analysis · Data clustering · Classification · Hadoop · Map-Reduce · Partitioner · Convolution neural networks

1 Introduction

For the past decade, huge volumes of data are being generated from various heterogeneous sources such as social networking applications, surveillance data, E-commerce applications, Health care and so on [1]. Continuous flooding of data in various fields challenges the traditional systems in terms of processing and storage. In the traditional kind of systems (say RDBMS) the data will be organized in terms of rows and columns (Structured way) according to the business logic. The data that is generating enormously from various sources was unstructured and the problem is often referred to as "Big Data". The major pitfalls that exist in traditional systems were data scalability and complexity of the data. The four "V" often describes the characteristics of Big Data: Volume, Variety, Velocity and Veracity [2].

Including the concepts of Discrete Mathematics, we consider the basic characteristic of Big Data, the mathematical representation of Big. Discrete Mathematics includes the study on various structures such as Set theory, Logical operations, Graph Theory and so on and derives a mathematical theory for the name "Big" Data using discrete Mathematics [3]

Axiom: Let S be a non-empty set and function Big- Oh: S → S is Big operation Big-Oh if and only iff for any p € S such that Big-Oh (p) = Big p € S;

For instance, let us assume S be the set of data items from various sources and p be the actual data then Big-Oh (p) = Big-Oh (data) = Big data. Here Big-Oh transforms the data into Big data. Big-Oh represents the inclusion of all tools, technologies and systems in terms of transforming the data into Big data. The potential answers for the Huge Information issue are NO SQL databases, Hadoop, Hadoop ecosystem system components, etc. We center explicitly around Hadoop for the work that will be clarified all through this paper. Hadoop is a system appeared in Fig. 1 which is utilized to store and process tremendous volumes of utilizing ware equipment on huge clusters.

Hadoop is a blend of three primary segments: HDFS, Map-reduce, and YARN. HDFS is utilized as information store and to part the obtained in- formation into blocks or chunks state (128 bytes or 64 bytes each) relies upon the form of Hadoop we use. The pieces of information that is isolated naturally will spread over the cluster for further preparing as per the prerequisite. Map-reduce is a programming model that is utilized to perform distributed parallel handling, in this manner picks up the preferred position over the customary frameworks [4]. YARN (Yet another Resource Negotiator) is used as the resource manager for allocating and re-scheduling the necessary jobs to the respective nodes in the cluster.

The gigantic development of unstructured information (state a picture) has its effect even in the medicinal field. Different hardware tools were producing loads of clinical information as X-ray, Magnetic Resonance Imaging, and Computed-Tomography, etc.

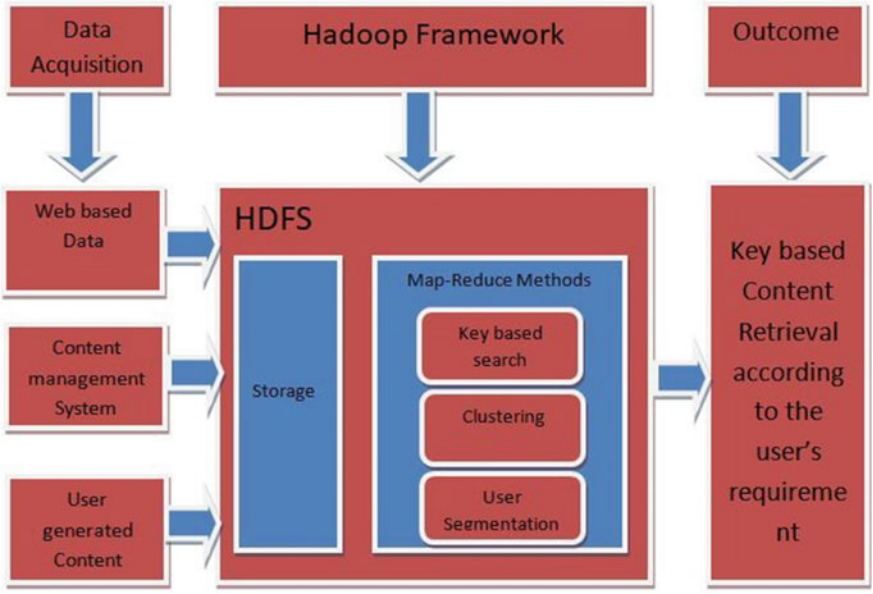

Fig. 1 HadoopFramework

The information that is produced from different equipment instruments legitimately in the clinical field as showed in the Fig. 2 might not have a superior effect for further investigation utilizing customary advances, for example, PACS (Picture Archiving and Communication Systems), etc. as they had the option to address just the organized sort of information for storage and transmission crosswise over different machines/hubs [5].

There is a requirement for some effective design that ought to have the option to store and process the clinical picture information with the goal that the prepared picture information will be additionally used to give some automated prediction of symptoms and diagnosis for those symptoms based on some Machine Learning techniques [6]. In the proposed work, we emphasis more on designing architecture for processing the medical images using Map-Reduce architecture.

The advantage in processing the images using this architecture is the medical image data set will be automatically acquired from the file system and will be spread across the cluster nodes for further processing. Once the clustered data stores in the HDFS, the necessary map () and reduce () functions will be implemented for the image processing. By the time the reduce phase generates the outcome from various reducers, the automatic clustering of images will happen thereby provides the flexibility for further prediction and diagnosis of various diseases.

The paper includes the following modules: Sects. 2 emphasis on state of the art methods for storing and processing the huge volumes of data. Section 3 focuses on various aspects of the Map-Reduce framework. A literature survey on image-based

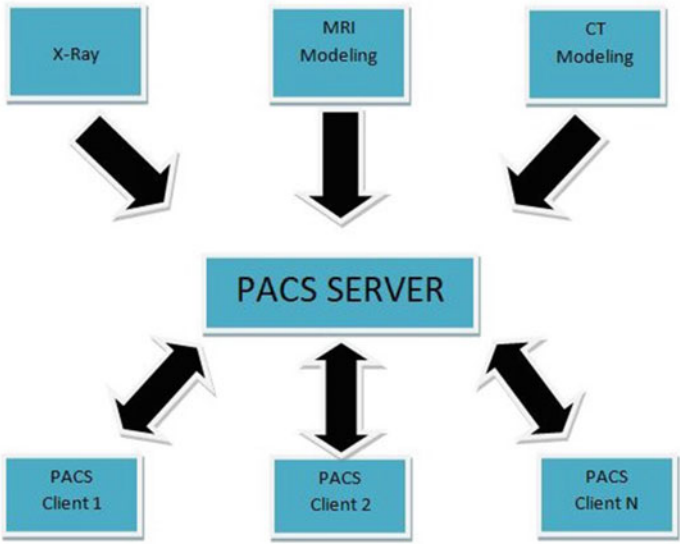

Fig. 2 Communication systems (PACS)

clustering has been carried out in Sect. 4. Sect. 5 explains the proposed architecture for automatic image classification/clustering using the map-reduce framework within the architecture itself. The necessary conclusion and future scope will be given in the last section.

2 The State of the Art Techniques for Addressing Large Volumes of Data

For instance, let us assume that 500 GB of a hard disk is accommodated in a pseudo node and there is a requirement to store 300 GB of data on the disk. This is not a serious problem to consider as the data will reside on the disk. For the same commodity hardware if there is a requirement to store 600 GB of data, then that's a problem to consider. The possible solutions to resolve the issue for the file system will be either mounting an additional secondary storage disk or compression of the data.

Suppose there is a need to store 10 TB of data for the same hardware (say 500 GB) then even the possible solutions illustrated in Fig. 3 will not be useful. Some of the major drawbacks that exist in the traditional file system were the data loss issues in terms of power failure, network failure, and hardware failure.

To address all the above-mentioned challenges that will happen in storing and processing data we go with Distributed File Systems (DFS).

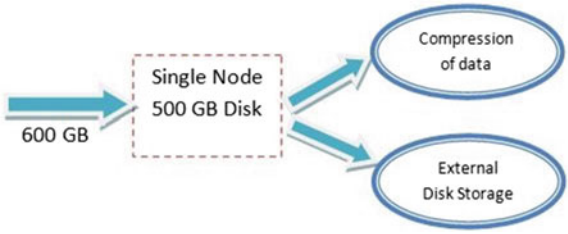

Fig. 3 Traditional file systems

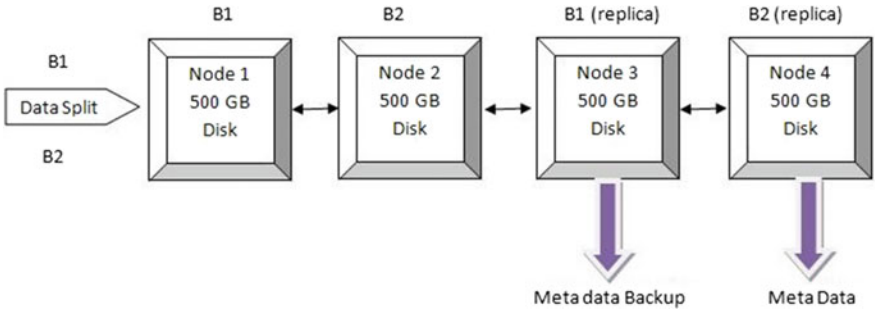

Fig. 4 DFS architecture

In the DFS, a group of systems will be connected through a network and data sharing will happen across all the nodes which are considered to be a cluster. For instance, let us assume that there is a need for data storage, data processing. Then the DFS will split the data manually into the respective blocks say B1 and B2. The cluster is being set up with 4 nodes say 500 GB of disk size each. Figure 4 explains the data organization in terms of storage using DFS. The storage issues will be resolved here even if the data that needs to be stored is more than the single-node data specifications as we spread the data across the cluster (multiple nodes).

There may be a chance of data loss in any one of the cluster nodes due to the possible reasons explained in the traditional file systems, DFS will resolve this as manual copying of data will take place in multiple nodes concerning the single block of data.

The number of block-level data copies will be maintained in other nodes as well say a replica of 2–3 depends on the node availability such that even if one node having data block has crashed due to some reason that corresponding data will be restored such that the copy will be maintained in some other node.

As we confined the cluster to only four nodes so this will be easy to identify which block(s) of data is stored in which node(s). As the size of the data increases, there will be an increase in the number of blocks that will be difficult to identify. To resolve this DFS will manually create a Meta data file which will keep track of

block-node mapping. The advantage in maintaining a Meta data file is as the data loss might happen in any one of the nodes such that it will assist the file system where the corresponding copy of data block is available in some other node. Suppose if the disk crash has happened to a node where the Meta data file exists. Then this is a serious problem to consider but still, the DFS will resolve this by manually maintaining a backup copy of Meta data file in any one of the nodes of cluster thereby improves the efficiency in terms of data availability.

The operations such as splitting of data into blocks, copying of data across many nodes and maintaining the replica of data will be processed manually in the DFS. Some of the drawbacks in DFS are the manual processing of data. If some write operation is performing on the node and at the same time some deletion operation might happen as data sharing access is available accessible across all the nodes. This situation might result in Data Corruption which is a serious problem to avoid.

The next tier of solution that came into being was the Hadoop Distributed File System (HDFS), a storage feature on the Hadoop platform that we are focused on for our proposed work. HDFS will perform all the operations of DFS in an automated way such that Data Corruption will not happen and maintains the data consistency even for large volumes of data.

The HDFS architecture generally consists of a name node, a data node and a secondary name node where the actual data component resides in the respective data nodes and the data node meta data is stored in the name node and the meta data backup is retained in the secondary name node. [7] The data that is stored in the HDFS specified in Fig. 5 will be used by the Map-Reduce programming model for processing purposes. In this paper, we focus more on how do we store the medical image data in the HDFS architecture and once the images were stored how do we process them using the Map-Reduce programming model.

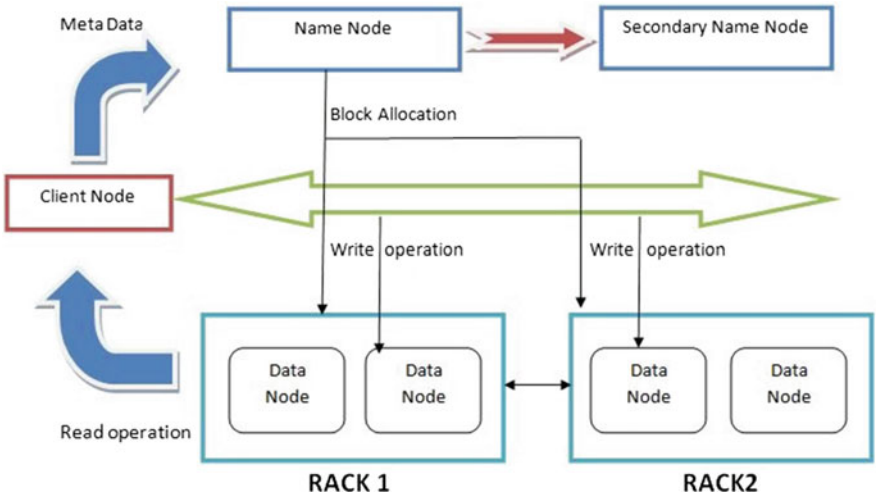

Fig. 5 HDFS architecture

3 Overview of Map-Reduce Framework

3.1 Map-Reduce Design

To gain the advantage of parallel processing we have to make use of Map-Reduce architecture as the mappers will run on a parallel basis. Map-Reduce is a functional programming system with two map and reduce features.

During the map step, the map will invoke and reduce method in the reduction phase and each phase will have the <key, value> pairs as input and output respectively [8].

Along with map and reduce phases two more components are responsible for the job execution process: Job tracker and Task tracker.

Job tracker is responsible for coordinating all the jobs running on the system by assigning tasks to run on task trackers. Task trackers will be running the tasks assigned by the Job tracker and returning the ac- knowledgement to the Job tracker after completion of the task [9]. Job tracker keeps the overall record of each job performance and whenever any task fails.

Map-Reduce follow the Master-Slave architecture principle illustrated in the Fig. 6. The input data will split into respective blocks and store the data in the data nodes and the Meta data of these data nodes will be maintained by the name node and in the processing phase Job tracker will act as Master and allocate the jobs to the various slaves (data nodes) and these will be executed by the respective Task trackers [8, 10]. The data that is stored in HDFS will maintain a default replica in 3 nodes to resolve the data loss issues in terms of Disk failure.

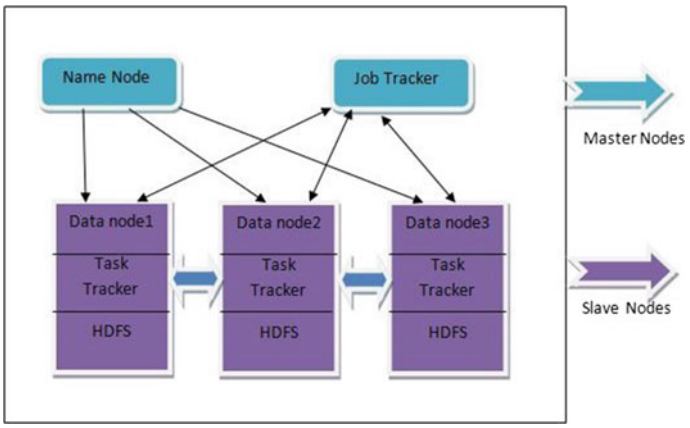

Fig. 6 Master-slave architecture

3.2 *Map-Reduce Execution Strategy*

The work flow of Map-Reduce architecture shown in the Fig. 7 is the input that is retrieved from the external source will be divided into the respective blocks (say 128 bytes/block). This divided data into respective blocks will ensure by HDFS [8]. The divided chunks of data will be sent to the input format (say record reader) so that the raw data (structured or unstructured) will be converted into the respective <key, value> pairs [11]. The obtained <key, value> pairs will send as an input to the map () function.

Then the map () function during the map phase will perform the distributed parallel processing and thereby the computation time will be drastically reduced as the mappers will run on a parallel basis [8, 12]. The map () generates the output in terms of list <key, value> pairs will be processed by the shuffle and sort functionality and the generated data is in the form of respective <key, list <values≫. The shuffle and sorting functionality generated values will be sent as an input to reduce () functionality. The reduce () function during the reduce phase will generate the respective <key, value> combinations as output. The obtained output will be sent to the output folder(s) using output for- mat (say, record writer) [8].

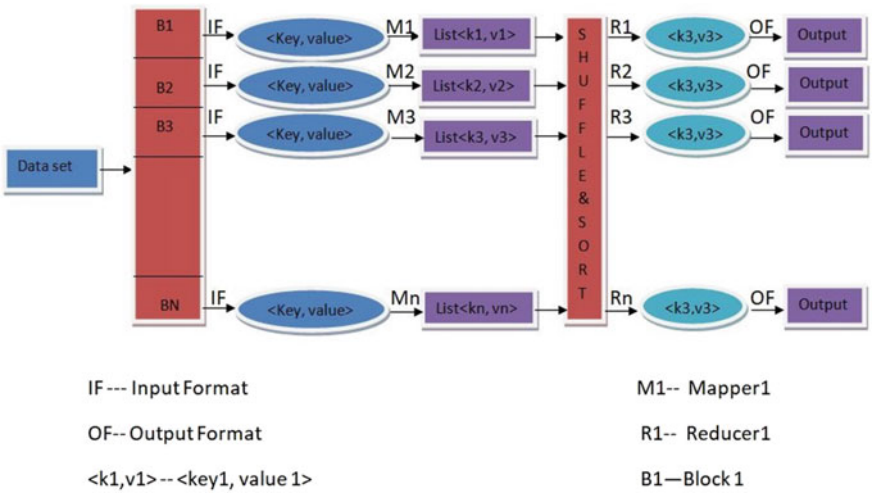

Fig. 7 Map-reduce work flow

4 Literature Survey

Saima Anwar Lashari et al. [13] has proposed a simple set system for the identification of clinical images which is an advancement of data mining technique to develop a classification algorithm based on the soft set theory principles.

Eka Miranda et al. [14] have surveyed various medical image classification techniques. The data acquisition includes an X-ray, CT scan, MRI and ultrasound Imaging.

Rajesh Sharma et al. [15] has done a comparative study on medical image classification techniques the comparison is made between the proposed RGSA algorithm with the other recent methods by conducting various experiments to prove that the proposed 3DGLCM and SGLDM with SVM classifier is more efficient.

Meyer-Baese and Theis [16] used unsupervised clustering techniques for biomedical image segmentation based on Image time series data.

Ng and Ong [17] proposed a method that implements K means clustering on medical images and on top of that they use an enhanced watershed algorithm to segment medical images that out rights the conventional watershed algorithm.

Atul Kumar et al. [18] suggested a segmentation technique to identify slow fluid flow from retinal images based on the SVM algorithm.. The overall sensitivity metric for this automatically detected efflux is 97.1% for classifier and specificity is 98.3%.

Beevi [19] suggested a new Fuzzy C-means clustering algorithm for the segmentation of clinical images. The proposed clustering algorithm focuses primarily on neighboring image pixels using the probabilistic spatial function that is integrated with FCM's objective function.

The work is further extended by Anjana [20] where she presents a clear comparison of the FCM, IFCM and T2FCM techniques.

Different types of segmentation techniques were discussed by Kumar [21] and the outcomes of some algorithms were analyzed.

Efficient big data architectures and machine learning techniques were continuously flooding for the past few years by many researchers in the medical field. A similar kind of attempt was made by Kaur et al. [22] where he focused more on the privacy and security of medical data that is processed and stored rather than disease diagnosis. Various techniques like encryption, access control, endpoint validation, activity maintaining was given high priority in the architectural framework.

Belle et al. [23] proposed a review article on the role of big data analytics in the healthcare sector. He made necessary discussions on three major areas in medical image analysis namely image, signal and genomic-based analytics. For image analysis and storage he suggested using a map-reduce architecture. In his work, he mentioned possible challenges, the necessary description and possible solutions in medical image analysis. There is a great deal of emphasis in this research on analysis medical photo, biomedical signal processing, and genomic data processing.

i. Big data technologies play a vital role in the medical field, requiring the implementation of new architectures or frameworks for better diagnosis. Such frameworks will help medical experts to test a hypothesis by questioning huge volumes of unstructured data to improve patient care. This objective has been proposed by Sarmed Istephen [24] where the query evaluation was performed in two phases: Structured data which is used for clinical data storage ii. Execution of unstructured data extraction modules distributed via Hadoop to complete the query.

Kohli et al. [25] published a white paper on machine learning medical image data and data sets. The main goal of this paper was to collect, annotate and rescue medical image data. They suggested what were the ideal data sets for medical imaging machine learning and emphasis much on common storage locations such as DICOM protocols which were used in PACS.

Markonis [26] published a paper to examine clinical images on a large scale using map-reduction architecture. Their work focused much on three use cases for processing medical images. i. Optimization of parameters for segmentation of the lung texture using SVM classifier ii. Indexing of medical images based on content iii. Three-dimensional wavelet analysis for classification of solid texture. The possible three cases reflect the various challenges of visual information processing in clinical methodologies including optimization of parameters, indexation of image collections and multidimensional processing of medical data.

5 Proposed System Architecture

We present the big data architectural analysis for medical image classification or clustering in our proposed work thereby various types of medical images, such as X-rays, CT scans, MRI, etc. which were generated from various hardware tools will be classified within the architecture itself.

The architecture implementation we propose dealing with the Hadoop framework which includes two main components HDFS and Map-reduce [27]. HDFS deals with storage issues whereas the later one addresses the processing issues.

The proposed architecture outright the conventional classification or clustering techniques discussed in the literature review as the classification of medical images will be performed within the architecture itself in an automated way. Using the map-reduce architecture the overall execution time it will take to classify the medical images will be drastically reduced as the map-reduce follows the principle of distributed parallel processing [28].

The raw image data that is present in the database will be ready by the HDFS as shown in Fig. 8 and divides the data into respective blocks (say) each block size is of either the 64 MB or 128 MB depends on the version of Hadoop.

Once the data set is taken as an input, the splitting of blocks will happen. Then the proper alignment of medical images data should happen i.e. every medical

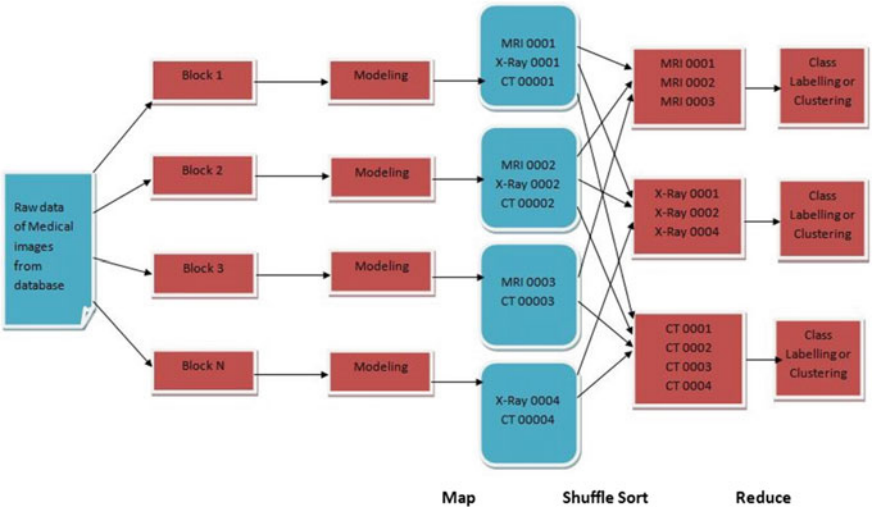

Fig. 8 Hadoop Map-reduce architecture for medical image classification/clustering

image obtained from the data set should be aligned in the form of <key, value> pair so that the result is <key, value> pair will be sent to the map function as an input. The map function will generate the list <key, value> combinations according to the number of blocks the data split have happened. The resultant list <key, value> pairs will be sent to the shuffle and sort phase, where the automatic classification of medical images will happen here which depends on the identical <key> values. All the images of the same <key> will be placed in a single cluster/class. The same process repeats until all the blocks have done the processing phase.

If the class labeling has performed then we say that as a supervised learning process where the training of data set included precisely in the classification step [29]. If the class labeling is not done then we consider that as an unsupervised learning process where the training of data set is not included instead clustering of images will happen [30] using some algorithm.

The supervised or unsupervised learning that follows depends on the system design according to the requirement.

The images that were classified, will go to the reducer phase in the form of <key, list <values ≫, and from there the resultant values will go to the respective output blocks from the reducer phase.

Modeling is a step that includes <offset, content> such that it should be converted to a specific form that will act as input [31] to the respective map function. And the particular form (modeling) the blocks of data are converted depends on the algorithm that is used in the implementation.

6 Conclusion and Future Work

The role of Big Data in medical image analysis is growing rapidly and some required infrastructure is needed to store and process some enormous volumes of clinical data created from different hardware devices. [32] We propose a map-reduce architecture for medical image processing which clusters/classifies the medical images within the architecture itself. The classification of medical images obtained from the proposed architecture is used to automate the process for the diagnosis of symptoms related to patient information [33]. Applying Deep Convolution Neural Network techniques on top of the classified medical images will give necessary suggestions for diagnosis and identification of symptoms to the disease in an automated way [34]. The proposed architecture even works for the large data set of images, therefore applying Deep learning concepts would be appropriate for automated diagnosis. Sensitivity and Specificity were the necessary metrics to perform the validation process [35] if required.

In the proposed architecture along with the map and reduce phase, usage of combiners and partitioners in between the map and reduce phase may improve the overall execution time [36]. Usage of combiners in between the map and shuffle phase may save a lot of computation time and data transfer time over the network for medical image processing [8, 37].

References

1. Sivarajah U, Kamal MM, Irani Z, Weerakkody V (2017) Critical analysis of big data challenges and analytical methods. J Bus Res 70:263–286
2. Acharjya DP, Ahmed K (2016) A survey on big data analytics: challenges, open research issues and tools. Int J Adv Comput Sci Appl 7(2):511–518
3. Sun Z, Wang PP (2017) A mathematical foundation of big data. New Math Nat Comput 13 (02):83–99
4. Slagter K, Hsu C-H, Chung Y-C, Zhang D (2013) An improved partitioning mechanism for optimizing massive data analysis using mapreduce. J Supercomput 66(1):539–555
5. Luo J, Wu M, Gopukumar D, Zhao Y (2016) Big data application in biomedical research and health care: a literature review. Biomed Inf Insights 8:BII–S31559
6. Lim J, Kim J, Cheon S (2019) A deep neural network-based method for early detection of osteoarthritis using statistical data. Int J Environ Res Pub Health 16(7):1281
7. Ramesh D, Patidar N, Kumar G, Vunnam T (2016) Evolution and analysis of distributed file systems in cloud storage: analytical survey. In: 2016 international conference on computing, communication and automation (ICCCA). IEEE, pp 753–758
8. Hemanth Kumar V, Purna Chandra Rao M, Narayanarao, CH, Haribabu P Efficient processing and recouping of data using combiners in map reduce framework
9. Gao Y, Zhou Y, Zhou B, Shi L, Zhang J (2017) Handling data skew in mapreduce cluster by using partition tuning. J Healthcare Eng
10. Kaur J, Sachdeva K, Singh G (2017) Image processing on multinode hadoop cluster. In: 2017 international conference on electrical, electronics, communication, computer, and optimization techniques (ICEEC-COT). IEEE, pp 21–26

11. Patel HM, Panchal K, Chauhan P, Potdar MB (2015) Large scale image processing using distributed and parallel architecture. Gujrat India Int J Comput Sci Inf Tech 6(6):5531–5535
12. Sravani Devi Y, Sindhura K A survey on partitioning skew diminishing techniques in hadoop mapreduce environment
13. Lashari SA, Ibrahim R (2013) A framework for medical images classification using soft set. Procedia Technol 11:548–556
14. Miranda E, Aryuni M, Irwansyah E (2016) A survey of medical image classification techniques. In: 2016 International conference on information management and technology (ICIMTech). IEEE, pp 56–61
15. Sharma R, Renisha PS, Sungheetha A (2016) Comparative study on medical im- age classification techniques. Int J Adv Eng Manag Sci 2(11)
16. Meyer-Base1 A, Gruber P, Theis FJ, Wismuller A, Ritter H (2005) Application of unsupervised bf clustering methods to medical imaging
17. Ng, HP, Ong SH, Foong KWC, Goh PS, Nowinski WL (2006) Medical image segmentation using k-means clustering and improved watershed algorithm. In: 2006 IEEE southwest symposium on image analysis and interpretation. IEEE, pp 61– 65
18. Kumar A, Kumar Gaur A, Srivastava M (2012) A segment based technique for detecting exudate from retinal fundus image. Procedia Technol 6:1–9
19. Beevi Z, Sathik M (2009) A robust segmentation approach for noisy medical images using fuzzy clustering with spatial probability. Methods 29(37):38
20. Aneja D, Rawat TK (2013) Fuzzy clustering algorithms for effective medical image segmentation. Int J Intell Syst Appl 5(11):55
21. Kumar SN, Muthukumar S, Kumar H, Varghese P et al (2018) A voyage on medical image segmentation algorithms. Biomed Res (0970-938X)
22. Kaur P, Sharma M, Mittal M (2018) Big data and machine learning based secure healthcare framework. Procedia Comput Sci 132:1049–1059
23. Belle A, Thiagarajan R, Soroushmehr SM, Navidi F, Beard DA, Najarian K (2015) Big data analytics in healthcare. BioMed Res Int
24. Istephan S, Siadat M-R (2016) Unstructured medical image query using big data–an epilepsy case study. J Biomed Inf 59:218–226
25. Kohli MD, Summers RM, Raymond Geis J (2017) Medical image data and datasets in the era of machine learning—whitepaper from the 2016 c-mimi meeting dataset session. J Digit Imaging 30(4):392–399
26. Markonis D, Schaer R, Eggel I, Muller H, Depeursinge A (2012) Using mapreduce for large-scale medical image analysis. In: 2012 IEEE second international conference on healthcare informatics, imaging and systems biology. IEEE, p 1
27. Bhosale HS, Gadekar DP (2014) A review paper on big data and hadoop. Int J Sci Res Publ 4 (10):1–7
28. Sugha P, Gunavathi R (2016) A survey paper on map reduce in big data. Int J Sci Res 5(9)
29. El Mohadab M, Bouikhalene B, Safi S (2019) Predicting rank for scientific research papers using supervised learning. Appl Comput Inf 15(2):182–190
30. Greene D, Cunningham P, Mayer R (2008) Unsupervised learning and clustering. In: Machine learning techniques for multimedia. Springer, pp 51–90
31. da Silva AR, Silva A, Ribeiro A (2015) Data modeling and data analytics: a survey from a big data perspective. J Softw Eng Appl 8(12):720–726
32. Murphy SN, Herrick C, Wang Y, Wang TD, Sack D, Andriole KP, Wei J, Reynolds N, Plesniak W, Rosen BR et al (2015) High throughput tools to access images from clinical archives for research. J Digit Imaging 28(2):194–204
33. Jain D, Singh V (2018) Feature selection and classification systems for chronic disease prediction: a review. Egyptian Inf J 19(3):179–189
34. Zhang Q, Liu Y, Liu G, Zhao G, Zhigang Q, Yang W (2019) An automatic diagnostic system based on deep learning, to diagnose hyperlipidemia. Diab Metab Syndr Obes Targets Therapy 12:637

35. Lai Z, Deng H (2018) Medical image classification based on deep features extracted by deep model and statistic feature fusion with multilayer perceptron. Comput Intell Neurosci
36. In Hadoop Mapreduce Framework. Int J Eng Sci Manag Res
37. Gao T, Guo Y, Zhang B, Cicotti P, Lu Y, Balaji P, Taufer M (2018) On the power of combiner optimizations in mapreduce over MPI workflows. In: 2018 IEEE 24th international conference on parallel and distributed systems (ICPADS). IEEE, pp 441–448

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Prediction of Guava Plant Diseases Using Deep Learning

B. Srinivas, P. Satheesh, P. Rama Santosh Naidu, and U Neelima

Abstract Plant pathology is a field which deals with the analysis, diagnosis and treatment of diseases in plants. These days agriculture is the main source of income in the Indian economy as well as important for livelihood. Identification of diseases in plants and crops are quite difficult unless someone have great knowledge and experience. Diseases in plants might cause severe damage to whole crop that leads to loss of income for farmers and results in descend of revenue for agriculture in Indian economy, if not identified and controlled forefront. Early prediction can help this situation. This documentation represents the prediction of plant diseases using images of the leaves that are given as input by the user and predicts the type of disease. In background we have used convolution neural network algorithm followed by image classification and deep learning techniques. The accuracy is obtained with the help of confusion matrix. The algorithm is implemented using Python language which uses Flask as the micro web framework for graphical user interface (GUI). User gives the input image and the predicted disease is printed.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_135

1 Introduction

In India, agriculture is the main source of income in the Indian economy. It accounts to 18% of India's Gross Domestic Product (GDP). There are many lives intertwined with this profession. This is generally practical in villages and most of their lives are dependent on farming. A large part of India's employment is contributed through agriculture. The major crops that are grown in India are rice, wheat, corn, millets.

Guava is a common tropical fruit that are generally found throughout the year (except May and June) in India. Guava is considered to have immense medicinal values and various health benefits. It is known mostly for its anti-oxidant properties. It is one of the richest sources of dietary fibre. Guavas are known to be originates in Mexico or Central America. The most frequently eaten species in India is "Apple Guava". A guava contains more citrus properties than other vitamin C fruits. It has many health benifits such as- it helps in regulating metabolism which leads to weight loss. It nourishes the skin and promotes fertility. It prevents the growth of cancer cells. It prevents the development of diabetes.

2 Literature Review

Amigud, Yevgen, et al., (2002) collectively did this Surveying the nature of web-empowered labs in undergraduate training. The utilization of web-empowered labs in under graduate education has drastically expanded in the course of past 6 years however no criteria have been set up to survey the nature of this new teaching tool they distinguished 10 imperative segments of any successful web-empowered research facilities ought to have possessed. They designed assessment criteria for evaluating One hundred arbitrarily picked web-empowered labs directly using in the US all over the world and they analyzed the results of the assessment. Patil, Jayamala K., and Raj Kumar (2011) proposed progress in image processing for discovery of plant diseases. Visually observable properties of plants are recorded for studying the traits and diseases in them. Damage due to insects has been a serious issue because the insecticides can also prove to be fatal when used on plants and some kinds of birds in the environment which disturbs natural animal food chains. Image processing is used to prevent from most of this destruction to happen. It detects the diseases at an early stage accurately and hence the throughput is also increased from the harvest. Revathi P and M Hemalatha, (2012) proposed the concept of Classifying cotton leaf spot infections utilizing image processing edge detection strategies in unfolding Trends. During the evolution of a crop a farmer needs to take a number of major decisions that affect the crop. So an advance computer aided technology has been developed to help the farmer throughout this process. This guiding will help increase produce of the crop extensively since it helps in evaluating the level of the crop quality and if any disease is affecting the crop in an earlier stage so we can take steps to curb the unwanted effects on

the crop during a later stage. There is one major fungi which bothers the cotton plants in the Indian regions called Foliar. We use an algorithm called HPCCDD to scan the images of cotton plant leaves and categorize them under different diseases with which they are suffering. The classifier uses machine learning mechanisms to learn various types to categorize the issues accordingly like disease identification or application of fungicide needs to be done. The other mechanisms used are the RGB feature for disease identification, color image segmentation for capturing the disease spots and homogenize techniques to identify and extract edge features. Finally the farmers are counselled regarding the pests to make good harvest and more yield from the crop.

S. Arivazhagan, R. Newlin Shebiah,et al., (2013) proposed a mechanism for automatic recognition and order of plant leaf diseases that can cause huge decrease in quality and also amount of agricultural items. Automatic detection of plant diseases is beneficial in observing vast areas of products and this manner naturally recognizes the indications of diseases when they show up on plant leaves. The developed process comprises of four stages, primarily a color transformation structure for the input RGB picture is made, then utilizing specific threshold value pursued by division process the green pixels are masked and eliminated, the surface insights are registered for the helpful sections, at last the separated highlights are gone through the classifier. The significance of the algorithm helped in predicting and grouping the data-set around 500 plant leaves with an exactness of 94% and this affirms the well-being of the expressed methodology. Khirade, Sachin D and A. B Patil, (2015) proposed "Plant disease detection using image processing". To find out plant diseases using image processing because recognition of plant ailments is the way to prevent loss in the yield. It is not easy to manually detect the plant condition. This includes studying the patterns on the plant using image processing. Disease detection involves image acquisition, image pre-processing, image segmentation, feature extraction and classification. It also includes some segmentation and feature extraction algorithms employed in the plant disease identification.

3 Methodology

3.1 Convolution

The convolution operation involves three elements: Input image, feature detector and feature map. The nice property of convolution is being translation invariant. The process begins in this way. Within the borders place the input image in the top left corner then count the quantity of cells where the feature detector machine equals the input. Filtering is the goal of convolution layer. An effective check for the patterns in that section of image is done. This works due to filters, stacks of weights constituting a vector, which are multiplied by the values yielded by the convolution.

3.2 Subsampling

Subsampling is generalization of Max Pooling and Average Pooling subsampling layer follows a convolution layer in CNN. Its role is to down sample the output of a convolution layer along both the spatial dimensions of height and width. To reduce the sensitivity of the filters to noise and variations, inputs from convolution layer are smoothened. This also has the additional effect of reducing over fitting and thereby increasing the overall performance and accuracy of the network.

3.3 Activation

CNN has wide and unique set of activation functions to model signal propagation. Activation function works as just like any other functions in neural networks. It controls how the signal flows from one layer to the next layer. It emulates how the neurons are fired in our brain. With the help of past references, output signals which are firmly connected would initiate more neurons, enabling signs to be propagated more productively for recognising. The activation function used in CNN algorithm is ReLU.(Rectified Linear unit). Data scientists like relus as they are really cheap and performs better than other functions. It is also favoured for its faster training speed. The output of ReLU is f(x) = max(0,x)

3.4 Fully Connected

The FC flattens the matrix into vector and feed it into a full connected layer. is changed into one-dimensional array of numbers and associated with at least one or fully connected layer known as dense layers, here all conceivable pathways from input and output are considered by a learnable weight. The neurons of preceding layers are connected to every neurons in subsequent layers The last fully connected layer regularly has a similar number of output nodes as the quantity of classes. Every fully connected layer is trailed by a nonlinear function, for example, ReLU.

CNN Algorithm and Back propagation algorithm:

Output deviation of the k^{th} neuron in output layer *O:*

$$d(\mathbf{0}_k^o) = y_{\mathbf{k}} - t_k \tag{1}$$

Input deviation of the k^{th} neuron in output layer:

$$d(I_k^{\mathbf{o}}) = (y_k - t_k)\varphi'(v_k) = \varphi'(v_k)\boldsymbol{d}(O_k^o) \tag{2}$$

weight and bias variation of k^{th}neuron in output *O*:

$$\Delta \mathbf{W}^{o}_{k,x} = d(I^{\mathbf{o}}_{k}) y_{k,x} \tag{3}$$

$$\Delta Bias^{o}_{k} = d(I^{\mathbf{o}}_{k}) \tag{4}$$

Output bias of k^{th} neuron in hide layer *H:*

$$d(0Hk) = \sum\nolimits_{i=0}^{(i<17)} d(I^{o}i) W_{i,k} \tag{5}$$

input bias of k[th] neuron in hide layer *H*:

$$d(I^{H}_{k}) = \varphi'(v_k) \boldsymbol{d}(O^{H}_{k}) \tag{6}$$

weight and bias variation in row x, column y in the m[th] feature pattern, a former layer in front of *k* neurons in hide layer *H*

$$\Delta W^{H,k}_{m,x,y} = \boldsymbol{d}(I^{\mathbf{H}}_{k}) y^{m}_{x,y} \tag{7}$$

$$\Delta Bias^{H}_{k} = \boldsymbol{d}(I^{\boldsymbol{H}}_{k}) \tag{8}$$

Output bias of row x, column y in m[th] feature pattern, sub sample layer ***S***

$$\boldsymbol{d}(0^{s,m}_{x,y}) = \sum_{k}^{170} d(I^{\mathbf{H}}_{m,x,y}) W^{H,k}_{m,x,y} \tag{9}$$

input bias of row x, column y in m[th] feature pattern, sub sample layer ***S***

$$d(I^{s,m}_{x,y}) = \varphi'(v_k) \boldsymbol{d}(O^{s,m}_{x,y}) \tag{10}$$

weight and bias variation in row x, column y in the m[th] feature pattern, sub sample layer ***S***

$$\Delta \boldsymbol{W}^{o,k} = \sum\nolimits^{fh}_{x=0} \sum\nolimits^{fw}_{y=0} d(I^{s,m}{}_{\llcorner x/2 \lrcorner, \llcorner y/2 \lrcorner}) \boldsymbol{O}^{\mathrm{c,m}}{}_{x,} \tag{11}$$

Among them, *C* represents convolution layer.

$$\Delta Bias^{s,m} = \sum_{x=0}^{fh} \sum_{y=0}^{fw} d(O^{s,m}_{x,y}) \tag{12}$$

Output bias of row x,column y in k[th] feature patter, convolution layer C

$$\boldsymbol{d}(0^{c,k}{}_{x,y}) = d(I^{s,k}{}_{\llcorner x/2 \lrcorner, \llcorner y/2 \lrcorner}) \boldsymbol{W}^{k} \tag{13}$$

input bias of row x, column y in k[th] feature patter, convolution layer C

$$d(I_{x,y}^{c,k}) = \varphi'(v_k)d(O_{x,y}^{c,k}) \tag{14}$$

weight variation of row r, column c in m[th] convolution core, corresponding to k[th] feature pattern in l[th] layer, convolution C

$$\Delta W_{r,c}^{k,m} = \sum_{x=0}^{fh}\sum_{y=0}^{fw}\mathbf{d}(I_{x,y}^{c,k})O_{x+r,y+c}^{l-1,m} \tag{15}$$

Total bias variation of the onvolution core

$$\Delta Bias^{c,k} = \sum_{x=0}^{fh}\sum_{y=0}^{fw}\mathbf{d}(I_{x,y}^{c,k}) \tag{16}$$

Forward Pass:

Output of neuron of row k, colomn y in the l^{th} convolution layer and k th feature pattern

$$_{\infty}O_{(x,y)}^{(l,k)} = \tanh(\sum\sum_{r=0}^{k_h}\sum_{c=0}^{k_w}W_{(r,c)}^{(k,t)}O_{(x+r,x+c)}^{(l-1,t)} + Bias^{l,k}) \tag{17}$$

among them, f is the convolution cores in a feature pattern Output of neuron of row x, column y in the l^{th} subsample layer and k^{th} feature pattern:

$$_{\infty}O_{x,y}^{(l,k)} = \tanh(W^{(k)}\sum_{r=0}^{s_h}\sum_{c=0}^{s_w}O_{(x\times s_h+r,y\times s_w+c)}^{(l-1,k)} + Bias^{(l,k)}) \tag{18}$$

The output of the j[th] neuron in lth hidden layer H:

$$O_{l,j} = \tanh(\sum_{k=0}^{s-1}\sum_{x=0}^{s_h}\sum_{y=0}^{s_w}W_{(x,y)}^{(j,k)}O_{(x,y)}^{(l-1,k)} + Bias^{(l,j)}) \tag{19}$$

A mid of them, s is the number of feature pattern s in sample layer. Output of the I^{th} neuron l^{th} output layer F.

4 Result

4.1 Confusion Matrix

We perform steps like data cleaning, pre-processing and wrangling to get the output for the data. After this process, the initial step is to feed it to an outstanding model

in order to obtain the probable outcome. To know the Effectiveness of the model can be measured using Confusion matrix. It can be used to evaluate a classifier's quality. In the field of machine learning, confusion matrix is otherwise called as error matrix. It is nothing but a table frequently used for describing the efficiency of model. Given a set of test data, confusion matrix specifies about the true values which are known. It makes easy identification of confusion between classes. On a classification problem, It gives the summary of prediction results.

The wide variety of correct and wrong predictions are outlined with count values and broken down by each class which will be the solution to the confusion matrix. For a class problem, it shows the true positives, true negatives. Here is the table with 4 distinct combinations of predicted and actual values

It is extremely beneficial for measuring Recall, Precision, Specificity, Accuracy and most importantly AUC-ROC Curve. Now let's apprehend the terms.

Actual values are referred to as true and false values and Predicted values are referred as positive and negative values (Table 1 and Table 2).

Confusion matrix of our test data is:

[1 0 1 0 0 3]
[0 0 1 0 0 0]
[1 0 1 1 0 1]
[0 0 0 0 0 0]
[0 0 0 0 0 0]

Classification Report:

Test accuracy: 71.85714285714286

Accuracy = (TP + TN)/ (P + N) = 71.08%

Precision = TP/ (TP + FP) = 74%

Recall = TP/ (TP + FN) = 71%

As a result of testing the model, we got accuracy in between 65%–85% of correct classification samples after 25 epochs. The sole disadvantage is that we had to wait about 20–30 min till 25 epochs come to the end (looking at the fact that we had a very less quantity of photos and one more thing is that we are taken only one tree (guava) leaves for training). We tried to adjust the epochs count and by increasing them we train the model more number of times (Figs. 1 and 2).

In this, we decided to increase the epochs count each time and check for the accuracy and it can be seen that the high accuracy (80%) is achieved after 25 epochs. In subsequent epochs on the plot the accuracy improve (and even decreases in interval 10–25 epochs).

Table 1 Confusion matrix

True Class			
Predicted class		Yes	No
	Yes	TP	FP
	No	FN	TN

Table 2 Classification report

S.No	Accuracy	Precision	Recall	F1-score	Support
1	0.83	0.33	0.20	0.25	5
2	0.94	0.00	0.00	0.00	1
3	0.85	0.90	0.86	0.88	21
4	0.00	0.00	0.00	0.00	0
5	0.00	0.00	0.00	0.00	1
6	0.00	0.00	0.00	0.00	0
Avg/total	0.71	0.73	0.68	0.70	28

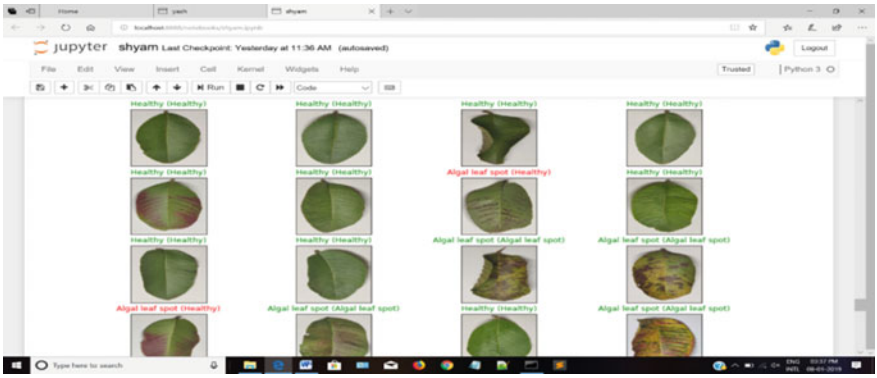

Fig. 1 Classification of healthy and diseased leafs

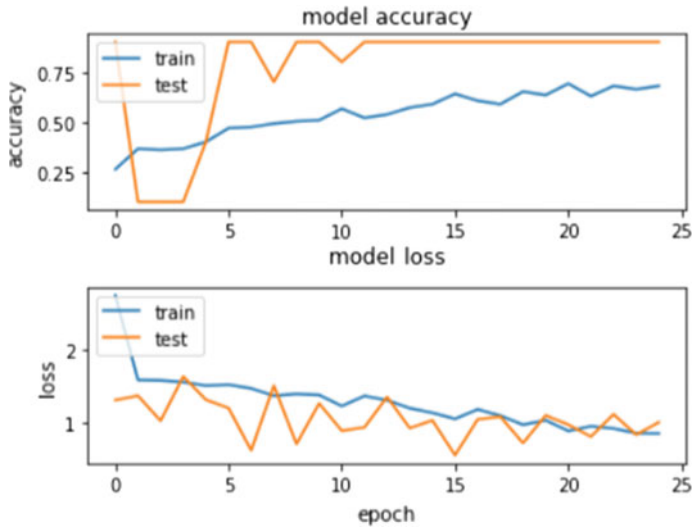

Fig. 2 Accuracy and loss

5 Conclusion

We have implemented the algorithms by developing a model in which the input images are trained that are passed through different layers of convolution neural network. We have collected our own dataset by collecting leaves from our nearest regions and taken sample images of that leaves using our android phones. Even though we have few numbers of images for training and testing as well as some of the images are damaged and not clear but we achieved more than 70% accuracy. We identified the diseases in guava plant namely Anthracnose, Algal leaf spot, Black rot, Rust, Wilt which are basically found in our neighbourhood climatic conditions.

We do not want to stop here, so in further we want to proceed by attempting to prescribe the medicine or cure for the disease identified that have to be utilised for the plant or crop to make healthy. In our dataset we have taken only the images of the leaves but we want to extend our dataset by also collecting sample images of fruits, roots and leaves attached to the branches so that a system can be developed in full extension to identify plant diseases which helps in decreasing human intervention and the diseases can be forecasted easily.

References

1. Amigud, Y., et al.: Assessing the quality of web-enabled laboratories in undergraduate education. In: 32nd Annual Frontiers in Education, FIE 2002. Vol. 2. IEEE, 2002
2. Wolf PFJ, Verreet JA (2002) An integrated pest management system in germany for the control of fungal leaf diseases in sugar beet: the ipm sugar beet model. Plant Dis. 86(4):336–344
3. Maxwell A et al (2005) PCR-identification of mycosphaerella species associated with leaf diseases of eucalyptus. Mycol. Res. 10(9):992–1004
4. Pydipati R, Burks TF, Lee WS (2006) Identification of citrus disease using color texture features and discriminant analysis. Comput. Electron. Agric. 52(1-2):49–59
5. Xu L, Liang N, Qiong G (2008) An integrated approach for agricultural ecosystem management. IEEE.Trans. Syst. Man. Cybern. 38(4):590–599
6. Huang DS, Ji-Xiang D (2008) A constructive hybrid structure optimization methodology for radial basis probabilistic neural networks. IEEE Trans. Neural Networks 19(12):2099–2115
7. Huang DS, Ji-Xiang D (2008) Electronic nose for black tea classification and correlation of measurements with tea taster marks. IEEE Trans. Instrum. Meas. 57(7):1313–1321
8. Phadikar, S., Jaya, S.: Rice disease identification using pattern recognition techniques. In: 11th International Conference on Computer and Information Technology, ICCIT 2008, IEEE, 2008
9. Camps-Valls G et al (2009) Biophysical parameter estimation with a semisupervised support vector machine. IEEE Geosci. Remote Sen. Lett. 6(2):248–282
10. Rumpf T et al (2010) Early detection and classification of plant diseases with Support Vector Machines based on hyperspectral reflectance. Comput. Electron. Agric. 74(1):91–99
11. Machado V et al (2010) A neural network multiagent architecture applied to industrial networks for dynamic allocation of control strategies using standard function blocks. IEEE Trans. Ind. Electron. 57(5):1823–1834

12. Bhattacharyya N et al (2010) Electronic nose for black tea classification and correlation of measurements with Tea Taster marks. IEEE Trans. Instrum. Meas. 57(7):1313–1321
13. Harini, D.N.D., Lalitha, B.D.: Identification of leaf diseases in tomato plant based on wavelets and PCA. In: 2011 World Congress on Information and Communication Technologies. 2011
14. Patil JK, Kumar R (2011) Advances in image processing for detection of plant diseases. J. Adv. Bioinformatics Appl. Res. 2(2):135–141
15. Laga, H., et al.: A Riemannian elastic metric for shape-based plant leaf classification. In: 2012 International Conference on Digital Image Computing Techniques and Applications (DICTA). IEEE, 2012
16. Revathi, P., Hemalatha, M.: Classification of cotton leaf spot diseases using image processing edge detection techniques. In: 2012 International Conference on Emerging Trends in Science, Engineering and Technology (INCOSET). IEEE, 2012
17. Arivazhagan S et al (2013) Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features. Agricultural Engineering International: CIGR Journal 15(1):211–217
18. Sannakki, S.S., et al.: Diagnosis and classification of grape leaf diseases using neural networks. In: 2013 Fourth International Conference on Computing, Communications and Networking Technologies (ICCCNT). IEEE, 2013
19. Verrelst J et al (2013) Gaussian process retrieval of chlorophyll content from imaging spectroscopy data. IEEE J-STARS 6(2):867–874
20. Arnal Barbedo JG (2013) Digital image processing techniques for detecting, quantifying and classifying plant diseases. SpringerPlus 2(1):1–12. https://doi.org/10.1186/2193-1801-2-660
21. Afridi, M.J., Xiaoming, L., Mitchell McGrath, J.: An automated system for plant-level disease rating in real fields. In: 2014 22nd International Conference on Pattern Recognition (ICPR), IEEE, 2014
22. Campos-Taberner M et al (2015) Mapping leaf area index with a smartphone and Gaussian processes. IEEE Geosci. Remote Sens. Lett. 12(12):2501–2505
23. Khirade, S.D., Patil, A. B.: Plant disease detection using image processing. In: 2015 International Conference on Computing Communication Control and Automation (ICCUBEA), IEEE, 2015
24. Dandawate, Y., Radha, K.: An automated approach for classification of plant diseases towards development of futuristic decision support system in indian perspective. In: 2015 International Conference on IEEE Advances in Computing, Communications and Informatics (ICACCI), 2015
25. Omer G et al (2013) Performance of support vector machines and artificial neural network for mapping endangered tree species using WorldView-2 data in Dukuduku forest. IEEE J. Sel. Top Appl. Earth Obs. Remote Sens. 8(10):4825–4840
26. Mwebaze, E., Godliver, O.: Machine learning for plant disease incidence and severity measurements from leaf images. In: 15th IEEE International Conference on Machine Learning and Applications (ICMLA), 2016 IEEE, 2016
27. Soni, P., Rekha, C.: A segmentation improved robust PNN model for disease identification in different leaf images. In: IEEE International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES), IEEE, 2016
28. Francis, J., Anoop, B.K.: Identification of leaf diseases in pepper plants using soft computing techniques. In: Conference on Emerging Devices and Smart Systems (ICEDSS), IEEE, 2016
29. Sladojevic, S., et al.: Deep neural networks based recognition of plant diseases by leaf image classification. Computational intelligence and neuroscience 2016 (2016)
30. Jayme Garcia Arnal B (2016) A review on the main challenges in automatic plant disease identification based on visible range images. Biosys Eng 144:52–60
31. Mohanty SP, Hughes DP, Salathé M (2016) Using deep learning for image-based plant disease detection. Front. Plant Sci. 7:1419
32. Singh V, Misra AK (2017) Detection of plant leaf diseases using image segmentation and soft computing techniques. Inf. Process. Agric. 4(1):41–49

33. Moghadam, P., et al.: Plant disease detection using hyperspectral imaging. In: 2017 International Conference on Digital Image Computing: Techniques and Applications (DICTA), IEEE, 2017
34. Meunkaewjinda, A., et al.: Grape leaf disease detection from color imagery using hybrid intelligent system. In: 5th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology, 2008. ECTI-CON 2008. Vol. 1. IEEE, 2008
35. Camargo A, Smith JS (2009) An image-processing based algorithm to automatically identify plant disease visual symptoms. Biosystems Eng. 102(1):9–21

Deep Learning in IVF to Predict the Embryo Infertility from Blastocyst Images

Satya kiranmai Tadepalli and P. V. Lakshmi

Abstract In Vitro Fertilization (IVF) is used to solve infertility problem caused due to damaged, blocked, weak, total absence of fallopian tubes and issues in sperm or endometriosis. Successful IVF depends on assessment of embryo quality. In visual morphology, assessment produced by embryologists are different, as an outcome low success rate of IVF is seen. To develop the success rate multiple embryos are planted which lead to several pregnancies and complications. Artificial Intelligence (AI) method can be followed to analyze embryo quality apart from human involvement. Deep learning model is proposed to analyze human blastocyst quality and to achieve 85% of test accuracy.

Keywords IVF · Blastocyst · Artificial intelligence · Machine learning · Deep learning

1 Introduction

Today IVF (In vitro fertilization) is the very important method for the treatment of infertility. It is a choice for couples who cannot conceive using conventional therapies. IVF is a technique which supports Assisted reproductive technologies (ART) from where a man's sperm and the woman's egg were integrated in a laboratory bowl, where fertilization takes place. The outcome embryo is then placed in woman's womb to grow natural way. Generally, two to four embryos are positioned in the woman's uterus at once. This trial is called as a cycle. IVF was successful for the first time in the United States in the year 1981. If the method is successful, then the growth of the embryo hardly occurs around 6–10 days of egg implantation. This morphology is the standardized technique for choosing human

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_136

Blastocysts in IVF, where few chances might fail to predict the embryo implantation as in case of live births [30].

Infertility depends on so many factors including age, Body Mass Index (BMI) and obesity [11, 25, 32]. It is difficult to calculate exactly the prevalence of infertility rates worldwide. Infertility is Reproductive issue that has affected about 186 million people globally [6]. Gonadotrophin stimulation for IVF efficiently changes the hormone milieu in follicular fluid. Efficient blastocyst culture in human IVF was implemented in patients responding to Gonadotrophin stimulation and found the pregnancy rates of a three-day old human embryo is less than the five-day old human embryo. Even though IVF is a commendable medical advancement, it has some drawbacks like multiple births, sex-ratio distortions, birth faults, Aneuploidies, etc., [13].

Multiple pregnancies which is a major problem of infertility can be ignored by transferring single blastocyst [7–9]. In the IVF process every embryo is first graded by the embryologists according to the development of the embryo. The researchers then worked on a statistical analysis to correlate the embryo grade with the possibility for gaining the successful pregnancy result (Fig. 1).

Selection of the embryo with higher chances of successful pregnancy is a subjective process. Viability of an individual embryo is analyzed at the blastocyst phase. Then, one or two blastocysts are implanted into the uterus. This decreases the chance of triplets and gains the high success rate of IVF (Fig. 2).

This survey results in a wide range of experiments conducted on machine learning algorithms. It explains the computational predictions in various stages of IVF treatment to retrieve the information directly without human intervention [10]. Various Deep learning, Machine learning methods are proposed in the ART, which prove to be fruitful even before the start of ART cycle [34]. Artificial Neural Networks are very successful in predicting IVF, considering endometriosis, tubal factors and follicles in the ovaries and some physiological factors.

These techniques are explained in the following sections.

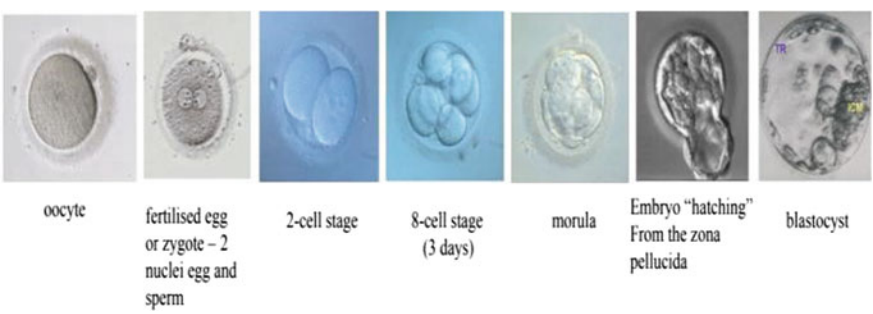

Fig. 1 Stages of blastocyst images

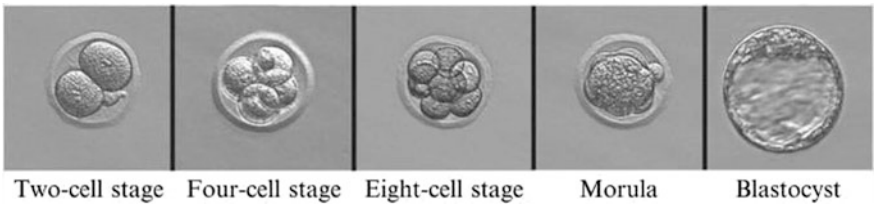

Fig. 2 Blastocyst formation

2 Role of Machine Learning Techniques

2.1 Embryo Classification

Lot of research in IVF is concentrated on examining several features of an embryo under formation and effectively grading the embryo as per the morphology, size, structure, fragmentation and improvement rate at various phases of development. There are few user interface and software techniques which can help researchers to work on different features and boundary discovery and computing various measures. Several machine-vision rely methods which could do some aspects of embryo assessment can be taken into consideration. Finding the efficient viable oocyte or embryo plays a crucial role in the process of IVF [12]. To overcome the major limitations like recognizing viability of human embryos through microscopic images is an extremely tedious process that is susceptible to error and subject to intra and inter individual unpredictability. Embryos combine smaller radii cell structures and get rapidly distinguished in the initial days after the fertilization, making it complex to find algorithmically the viability of embryo. Hence, using the automating classification of these embryo images will be beneficial [16].

2.2 Embyo Selection and Grading

Identification or the selection of embryos play a vital role in IVF which enables the embryos that need to be transferred [17]. This is mainly done based on some parameters and measures in the process of transforming into a blastocyst. This can be done by the Cleavage Stage Embryo Selection [14]. An automated grading system for embryos would enables high objective and specific analyzation to assist the decision-making ability of embryologists [15]. During the IVF, embryos are cultured right from the day of transfer and are evaluated for quality during each day of the grading cycle [3].

3 Supervised Learning Methods in IVF Prediction

Rough Set Theory is utilized in data cleaning and reduction for the effective IVF prediction and use of Artificial Neural Network (ANN), to build the network with the inputs of data and predicting the output and comparing the output with the actual output [19]. Under Supervised learning methods it is very easy for the infertility specialist to recommend a patient opts for a specific IVF or Intracytoplasmic sperm injection (ICSI) treatment [20, 31]. In support to the usage of embryos to be transferred, for the effective procedure of IVF, Bayesian network model has been used which improves the parameters that are essentially needed to select the right embryo [21]. The success estimation of choosing the embryo and the possibility of success estimation in IVF is carried out by using a success estimation ranking algorithm [22]. It can calculate the success of a treatment cycle and score values in an efficient way. The data which is collected for the efficiency in success rate of IVF should not contain any distorted or missing values.

So, preprocessing of data is an essential role for this purpose. Ant colony combined with Reduct algorithm is used for the purpose of appropriate feature selection and reduction [23]. Genetic algorithm and decision tree classification combined together are used for the prediction of IVF results [24]. True positive and False positive rates of the data for classifying the embryos is carried out using Naïve Bayes Classifier with the ROC features for an imbalanced sampling dataset [26, 31].

Machine learning techniques such as Support Vector Machine (SVM), Random Forest, classification and regression trees, Neural Networks have been used for Grading of Mammalian Cumulus Oocyte, human blastocyst images and Zebrafish embryos [1–3, 5]. Automated STORK framework is proposed to achieve the expert classification of embryo images [4].

An AI technique relies on Deep Neural Networks (DNNs) to choose the best quality embryos utilizing a huge combination of human embryo time-lapse pictures. To sort out unreliability in embryo quality, multiple embryos are frequently positioned which results in unnecessary multiple pregnancies and complications. Most of the other imaging areas, human embryology and IVF were not attached artificial intelligence (AI) for unbiased, automated embryo assessment. Using clinical data for 2182 embryos, a decision tree is developed to combine embryo quality and patient's age to find techniques related to the likelihood of getting pregnancy [5]. This experiment shows the possibility of pregnancy depends on single embryos distinguishes from the range 13.8% (age $\geq$ 41 is poor-quality) to 66.3% (age < 37 is good quality) based on automated blastocyst quality assessment and patient age [4, 27]. Average Area under the Curve (AUC) of the receiver operating feature curve is over 5-fold of stratified cross-validation, but the clinical influence of these research works is not effective [28].

4 Influence of Deeplearning and Ai

Deep Learning of Markov based model is proposed as the best treatment for the infertile women, after examining the live birth functions predicted by the AI and the multivariate logistic design functions analyzed by Conventional Embryo (CE) [29]. Most appropriate 25 attributes have been used to examine and compare the IVF pregnancy with SVM, MLP, C4.5, CART and random forest for accuracy [5]. Deep learning methods can be used to analyze the pregnancy by the age of a patient. The age of the patient plays a crucial role for the pregnancy, and as the IVF process deals with mental agony as well as the financial burdens which is difficult for the patients to endure, hence a method proposed to deal with this problem by predicting the live birth prior to IVF treatment for meeting the patient's expectation and belief [32, 33]. This process is carried out by considering the blastocyst images.

Using AI approach bovine blastocyst quality is classified resulting in an accuracy of 76.4%. Weill Cornell Medicine researchers proposed AI approach to optimize embryo selection for successful pregnancy with the help of a five-day old in age in vitro fertilized human embryo [4]. Image segmentation and segmentation of human blastocyst for embryo grading has shown good results [3]. Application of Deep learning methods to blastocyst images revealed good accuracy [18].

5 Method

There are a few user interface and software's which can help researchers to work on identification of boundary and region of the embryo and very less Machine learning techniques could predict the quality of embryo. The proposed work gives the best results on the datasets of related attributes. But still there exists some gaps over the techniques that has been proposed. It works best and gives accurate and successful predictions if embryo images can be taken as an input. A dataset STORK of time-lapse images from human embryos are used for experimentation [4]. The training dataset has the class labels of good quality and poor-quality data images. 30% of images were used for testing purpose. Convolutional Neural Networks model was generated to assess blastocyst images. For accurate evaluation, Recall, F1-score are used.

6 Results and Analysis

The model is trained with 10,644,673 no. of parameters. Two activation functions Relu and Sigmoid are used for predicting good and poor-quality blastocyst. Binary Cross-Entropy loss function and 25 epochs are also used (Figs. 3, 4, 5 and 6).

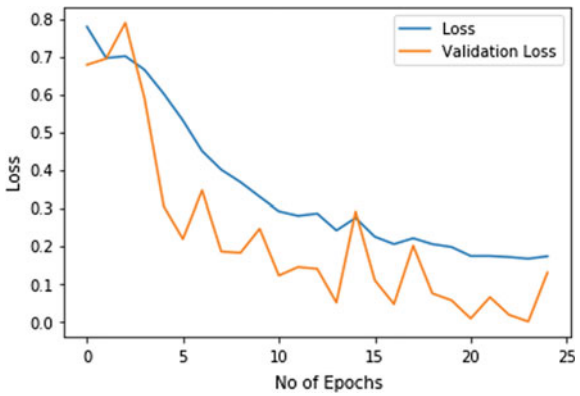

Fig. 3 Loss and validation loss of model

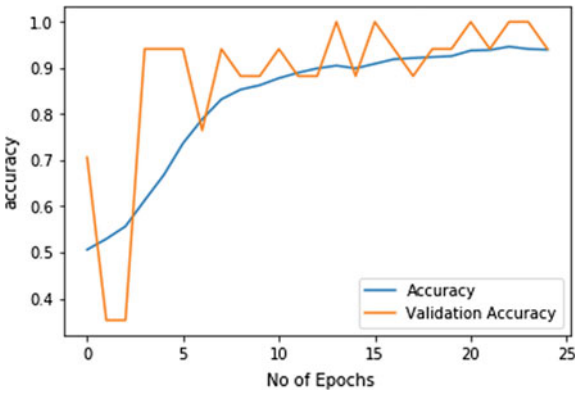

Fig. 4 Accuracy of model

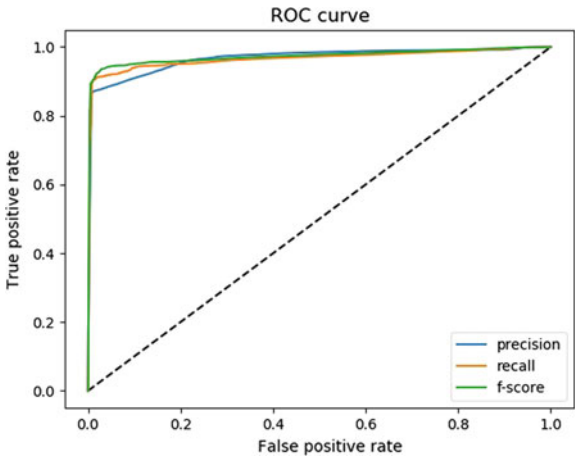

Fig. 5 Evaluation of precision, recall and f-score

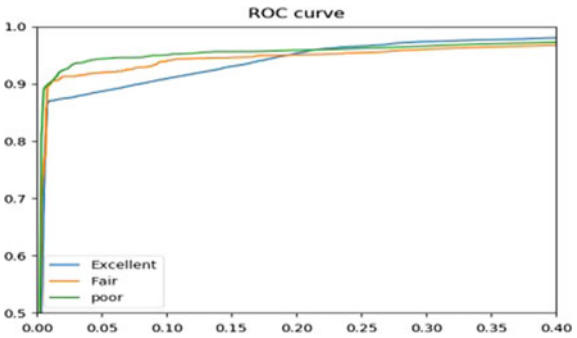

Fig. 6 ROC curves

7 Conclusion

Finally, to sort out the unreliability in embryo, fine embryos are evaluated. Machine learning systems are helpful in enhancing the success rates of IVF treatment. Though many classifiers are used but their results are not satisfactory. Training of blastocyst images with CNN, a deep learning model is obtained with better results than SVM and Random forest. The main concern is to avoid the more no. of IVF cycles, which is time consuming and expensive. AI and ML are producing the most promising results with reduced cost and efficiency. By this approach the best embryo or the blastocyst can be identified before the implementation of IVF cycle. With very large dataset, the model may give more efficient results.

References

1. Rocha JC et al (2017) A method based on artificial intelligence to fully automatize the evaluation of bovine blastocyst images. Sci Rep 7(1):7659
2. Viswanath PS, Weiser T, Chintala P, Mandal S, Dutta R (2016) Grading of mammalian cumulus oocyte complexes using machine learning for in vitro embryo culture. In: 2016 IEEE-EMBS International Conference on Biomedical and Health Informatics (BHI). IEEE, pp 172–175
3. Filho ES, Noble JA, Poli M, Griffiths T, Emerson G, Wells D (2012) A method for semi-automatic grading of human blastocyst microscope images. Hum Reprod 27(9):2641–2648
4. Khosravi P et al (2019) Deep learning enables robust assessment and selection of human blastocysts after in vitro fertilization. NPJ Digit Med 2(1):1–9
5. Hassan MR, Al-Insaif S, Hossain MI, Kamruzzaman J (2020) A machine learning approach for prediction of pregnancy outcome following IVF treatment. Neural Comput Appl 32 (7):2283–2297
6. Inhorn MC, Patrizio P (2015) Infertility around the globe: new thinking on gender, reproductive technologies and global movements in the 21st century. Hum Reprod Update 21 (4):411–426
7. von Wolff M, Kollmann Z, Flück CE, Stute P, Marti U, Weiss B, Bersinger NA (2014) Gonadotrophin stimulation for in vitro fertilization significantly alters the hormone milieu in follicular fluid: a comparative study between natural cycle IVF and conventional IVF. Hum Reprod 29(5):1049–1057

8. Gardner DK, Schoolcraft WB, Wagley L, Schlenker T, Stevens J, Hesla J (1998) A prospective randomized trial of learning-enabled blastocyst prediction system for cleavage stage embryo selection. Fertil Steril 111(4):e29
9. Adashi EY et al (2003) Human infertility therapy-associated multiple pregnancies (births): an ongoing epidemic. Reprod Biomed Online 7(5):515–542
10. Pavithra D, Jayanthi AN (2018) A study on machine learning algorithm in medical diagnosis. Int J Adv Res Comput Sci 9(4):42–46
11. Ubaldi FM et al (2019) Advanced maternal age in IVFof its treatment. Front Endocrinol 10:94
12. Manna C, Nanni L, Lumini A, Pappalardo S (2013) Artificial intelligence techniques for embryo and oocyte classification. Reprod Biomed Online 26(1):42–49
13. Miyagi Y, Habara T, Hirata R, Hayashi N (2019) Feasibility of artificial intelligence for predicting live birth without aneuploidy from a blastocyst image. Reprod Med Biol 18 (2):204–211
14. Thirumalaraju P et al (2019) Deep learning-enabled blastocyst prediction system for cleavage stage embryo selection. Fertil Steril 111(4):e29
15. Chen TJ, Zheng WL, Liu CH, Huang I, Lai HH, Liu M (2019) Using deep learning with large dataset of microscope images to develop an automated embryo grading system. Fertil Reprod 1(01):51–56
16. Patil SN, Wali U, Swamy, MK, Patil N (2018) Deep learning techniques for automatic classification and analysis of human in vitro fertilized (IVF) embryos. J Emerg Technol Innov Res 5(4):100–106
17. Patil SN, Wali UV, Swamy MK (2019) Selection of single potential embryo to improve the success rate of implantation in IVF procedure using machine learning techniques. In: 2019 International Conference on Communication and Signal Processing (ICCSP). IEEE, pp 0881–0886
18. Durairaj M, Nandhakumar R (2014) An integrated methodology of artificial neural network and rough set theory for analyzing IVF data. In: 2014 International Conference on Intelligent Computing Applications. IEEE, pp 126–129
19. Hafiz P, Nematollahi M, Boostani R, Jahromi BN (2017) Predicting implantation outcome of in vitro fertilization and intracytoplasmic sperm injection using data mining techniques. Int J Fertil Steril 11(3):184
20. Corani G, Magli C, Giusti A, Gianaroli L, Gambardella LM (2013) A Bayesian network model for predicting pregnancy after in vitro fertilization. Comput Biol Med 43(11):1783–1792
21. Güvenir HA, Misirli G, Dilbaz S, Ozdegirmenci O, Demir B, Dilbaz B (2015) Estimating the chance of success in IVF treatment using a ranking algorithm. Med Biol Eng Comput 53 (9):911–920
22. Ramasamy N, Durairaj M (2017) Feature reduction by improvised hybrid algorithm for predicting the IVF success rate. Int J Adv Res Comput Sci 8(1):37–40
23. Guh RS, Wu TCJ, Weng SP (2011) Integrating genetic algorithm and decision tree learning for assistance in predicting in vitro fertilization outcomes. Expert Syst Appl 38(4):4437–4449
24. Zhang B, Cui Y, Wang M, Li J, Jin L, Wu D (2019) In vitro fertilization (IVF) cumulative pregnancy rate prediction from basic patient characteristics. IEEE Access 7:130460130467
25. Uyar A, Bener A, Çıray N, Bahceci M (2009) Predicting implantation outcome from imbalanced IVF dataset. In: Proceedings of the World Congress on Engineering and Computer Science, vol 2, pp 20–22
26. Khosravi P et al (2018) Robust automated assessment of human blastocyst quality using deep learning. bioRxiv 394882
27. Tran D, Cooke S, Illingworth PJ, Gardner DK (2019) Deep learning as a predictive tool for fetal heart pregnancy following time-lapse incubation and blastocyst transfer. Hum Reprod 34 (6):1011–1018
28. Rao A, Diamond M (2019) Deep learning of markov model based machines for determination of better treatment option decisions for infertile women. bioRxiv 606921

29. Uyar A, Bener A, Ciray HN (2015) Predictive modeling of implantation outcome in an in vitro fertilization setting: an application of machine learning methods. Med Decis Making 35(6):714–725
30. Miyagi Y, Habara T, Hirata R, Hayashi N (2019) Feasibility of deep learning for predicting live birth from a blastocyst image in patients classified by age. Reprod Med Biol 18(2):190–203
31. Qiu J, Li P, Dong M, Xin X, Tan J (2019) Personalized prediction of live birth prior to the first in vitro fertilization treatment: a machine learning method. J Transl Med 17(1):317
32. Raef B, Ferdousi R (2019) A review of machine learning approaches in assisted reproductive technologies. Acta Informatica Medica 27(3):205
33. Babitha MA (2019) Survey on the Machine Learning Techniques used in IVF Treatment to Improve the Success Rate
34. Durairaj M, Thamilselvan P (2013) Applications of artificial neural network for IVF data analysis and prediction. J Eng Appl Sci 2(9):11–15

Towards a Framework for Breast Cancer Prognosis: Risk Assessment

Ravi Aavula and R. Bhramaramba

Abstract Breast cancer is one of the alarming and lethal type of cancer which causes most of the deaths in women across the world. The research contributions towards early detection of breast cancer, its prognosis and treatment helped to improve situation in terms of decrease in mortality rate. Nevertheless, the problem of breast cancer still attracts attention of researchers and healthcare organizations. Prognosis with comprehensive intelligence can improve the situation of breast cancer treatment further. This is the motivation behind this research work which is aimed at proposing and implementing a framework with three-fold mechanisms to have better prognosis. It includes breast cancer risk assessment models, breast cancer recurrence prediction models and breast cancer survivability prediction models. However, in this paper we present empirical results of breast cancer risk assessment while the other two parts of the prognosis research are deferred to our future research papers. We built a prototype application to demonstrate the performance of different mechanisms employed for breast cancer risk assessment. The empirical results revealed insights of performance of those mechanisms.

Keywords Breast cancer · Prognosis · Risk assessment · Recurrent prediction · Survivability prediction

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_137

1 Introduction

When cells in human body grow out of control, then we call it cancer. Cancer can start in any part of human body. When cancer is in place, the body cannot function as it is supposed to. Cancer is not a single disease. In fact it is a collection of diseases as cancer can start in the colon, breast, lungs and even blood. Different cancers grow differently. The most common cancer type in woman is breast cancer. Breast cancer, as said earlier about cancer, starts when cell in woman's breast start growing abnormally. Thus a tumor is formed and that can be detected with a simple x-ray or it can be felt as a lump. The tumor is said to be malignant when it grows into surrounding tissues and distant areas of human body. Though men can get breast cancer, it is almost entirely occurring in woman. Different parts of the breast can be subjected to cancer. The ducts that carry milk to the nipple are subjected to breast cancer most of the cases. Other kinds of breast cancers are less common. Some cancers start in other tissues of breast. They are known as sarcomas and lymphomas and. These are not really cancers. It is essential to understand the fact that most of the breast lumps are not cancer. They are known as benign. They are abnormal growths but do not spread further and they are not life threatening. Checking lump to know whether it is malignant (actual breast cancer) or benign is essential [1]. According to Shin and Nam [2], breast cancer is the second lethal cancer which needs to be addressed in the real world. It has 14.1% of all cancer cases in the world. It is really alarming that women are killed with breast cancer across the globe. The technological advances, fortunately, and innovative treatment survival rate of women who are diagnosed breast cancer is more. Nevertheless, breast cancer is still the problem to be addressed efficiently. According to National Centre for Health Statistics cancer cases are increasing across the globe every year and further research and progress is needed to combat this menace effectively (Jemal et al. [3]). American Cancer Society (ACS) made cancer prevention study and found factors that contribute to risk of cancer. The factors are pertaining to life style changes and diet. There were difficulties with breast cancer screening as the screening was proved to be inaccurate and termed as over diagnosis as explored in ACS [4].

In this research the focus is to investigate data mining techniques in order to bring about efficient prognosis method. Towards this end we proposed a methodology in this paper and focused on breast cancer risk analysis and the recurrence and survivability prediction are deferred to future work. The remainder of the paper is structured as follows. Section 2 provides review of literature. Section 3 presents the proposed system in detail. Section 5 presents experimental results while Sect. 6 concludes the paper.

2 Related Works

This section provides literature on breast cancer prognosis especially on risk assessment. Hilgart et al. [5] explored various aspects of genetic risk assessment of breast cancer. They evaluated the impact of risk of breast cancer. Shin and Nam [2] proposed a coupling approach with predictor and descriptor. Predictor component predicts outcome of cancer while the descriptor component takes care of post-processing focusing on various and their degree of significance. Variable importance is observed using a decision tree (DT) classifier. Aune et al. [6] made a survey of real breast cancer risk and blood concentrations of carotenoids. They found that the latter showed reduced breast cancer risk. Khan et al. [7] proposed a method for finding breast cancer survivability. The method is known as Weighted Fuzzy Decision Trees (wFDT). Prediction of survival of patient is an important contribution of this method. SEER breast cancer dataset is used for empirical study. Different survivability attributes are ranked and thus the survivability of breast cancer patients is predicted. They compared wFDT with other methods and found the performance benefits of their approach. Anothaisintawee et al. [8] made a review of risk prediction models related to breast cancer. They found that still there is need for developing a more reliable model for break cancer risk prediction. Delen et al. [9] compared three data mining methods for predicting breast cancer survivability. They are known as Artificial Neural Network (ANN) (Abraham [10]), DT and logistic regression. They opined that a web based decision support system (DSS) can help people in need of finding breast cancer survivability. DiSipio et al. [11] studied the lymph edema pertaining to breast cancer to find risk factors and incidence dynamics. They found that out of every five women who survived breast cancer develop aim lymph edema. Thus they opined that there was improved need for further research into breast cancer build strategies to fight menace besides reducing its effects. Cruz and Wishart [12] studied on machine learning and explored applications that are available for cancer prediction and prognosis. They found many issues in their research including growing dependence on protein biomarkers, strong bias pertaining to applications of breast cancer and prostrate, and heavy dependency on older technologies like ANN. Nevertheless, they found that machine learning algorithms contributed towards improving understanding cancer development process and progression. According to Berliner et al. [13], National Society of Genetic Counselors (NSGC) provided guidelines for genetic counseling and risk assessment of breast and ovarian cancers. Xu et al. [14] studied Ada Boost algorithms for investigating into the dynamics of breast cancer survivability. Then they compared performance of Ada Boost algorithms with other algorithms in terms of cross validation method, confusion matrix, specificity, sensitivity, and classification accuracy. Kaufmann et al. [15] provided recommendations of international consensus conference pertaining to current state and future of breast cancer treatment. They found factors that cause risk to cancer patients. Bauer et al. [16] studied the impact of menopause, plasma vitamin D levels and risk of breast cancer in women. Their research found that menopause and vitamin D levels have their

impact on the risk of breast cancer. Maglogiannis et al. [17] focused on automatic breast cancer diagnosis and prognosis. They proposed SVM based classifiers in order to achieve an intelligent system. They compared with other techniques and found that SVM showed superior performance improvement. Amadou et al. [18] made a systematic review of literature to find insights pertaining to the relationship between pre-menopausal breast cancer and obesity. Similar kind of work was done by Neuhouser et al. [19]. Kim and Shin [20] proposed a method based on Semi-Supervised Learning using labelled, unlabelled and pseudo-labelled patient data. Their method was named as SSL Co-Training. It resulted in mean accuracy of 76% and mean area under curve of 0.81. Similar kind of effort was made by He et al. [21], Belkin [22] and Chapelle et al. [23]. Shin and Cho [24] explored pattern selection based on neighborhood property as part of SVM for breast cancer analysis.

Wu et al. [25] studied the relationship between physical activity in women and the breast cancer. They conducted meta-analysis of research done priori and found that physical activity has significant impact on reduction of breast cancer. Wang and Shen [26] used benchmark datasets pertaining to breast cancer for analyzing semi-supervised learning methods. Krop et al. [27] focused on pre-treated HER2 advanced breast cancer with respect to the disease and the practices of physicians in treating patients. They found that Trastuzumab emtansine can be considered by physicians in treating patients with breast cancer with HER2-positive. Senkus et al. [28] discussed about primary breast cancer, guidelines for diagnosis besides treatment to be given ad follow-up. Itoh et al. [29] studied the cause of breast cancer in Japanese women. They found that a pollutant known as cadmium when swallowed through food caused increased risk of breast cancer. Chatpatanasiri and Kijsirikul [30] proposed a framework for dimensionality reduction approach based on SSL. Kunkler et al. [31] found that radio therapy conducted on women with breast cancer after surgery improved reduction of local control in women with 65 or above. Dyrstad et al. [32] studied Benign Breast Disease (BBD) and found that BBD can convey variable degree of possibility of developing breast cancer in women. They suggested additional screening methods to have more expert advice. Chan et al. [33] studied the breast cancer risk with respect to circulating C-reactive protein and attributed life style factors for rich of breast cancer as well. Cardoso et al. [34] studied early stage breast cancer and the usage of 70-gene signature for making well informed treatment decisions. They found that chemotherapy provided good results. Rhodes et al. [35] investigated in the relationship between awareness of breast density (BD) and the impact of risk of breast cancer detection. They found that there was relationship between BD and breast cancer detection. Thus they argued for sustainable efforts on BD awareness. Schmachtenberg et al. [36] found that breast composition assessment (BCA) helps in breast cancer research. They explored two software methods known as Volpara and Quantra for measuring Percent Density (PD), Fibrograndular Tissue Volume (FTV) and Breast Volume (BV) and as part of breast cancer analysis.

Summary of Methods Found in Literature

See Table 1.

Table 1 Summary of methods found in literature

Author (s)	Technique	Advantages	Limitations/ Research gap	Remarks
Shin and Nam [2]	Hybrid approach with a predictor and descriptor	Prediction of survivability of breast cancer patients	The technique is not tested with different kinds of cancers	Breast cancer survival dataset (SEER)
Khan et al. [7]	Weighted Fuzzy Decision Trees	Breast cancer prognosis in terms of survivability with improved accuracy	Optimization of the method with rule weights and genetic algorithms is yet to be done	SEER breast cancer dataset
Thongkam et al. [14]	AdaBoost algorithms	Accuracy in breast cancer survivability prediction and computational efficiency	Integration of AdaBoost with other algorithms needs to be done	Breast cancer survival databases in Thailand
Thongkam et al. [16]	Combination of oversampling and C-Support Vector Classification (C-SVC)	Better breast cancer survivability prediction models	Investigation into real time medical data sets for finding survivability is desired future research	Found that outliers caused issues with accurate prediction of breast cancer survivability
Maglogiannis et al. [17]	SVM based classifiers	Automatic breast cancer diagnosis and prognosis	Evaluation of their solution with SEER dataset is not done yet	WDBC and WPBC datasets
Kim and Shin [20]	Semi-Supervised Learning (SSL) using labelled, unlabelled and pseudo-labelled data	Breast cancer survivability prediction	Member models with co-training needs to be done yet	SEER breast cancer survivability dataset

3 Proposed Methodology for Breast Cancer Prognosis

Breast cancer prognosis involves breast cancer risk assessment, recurrence and survivability prediction (Shin and Nam [2]). In this section we present our framework that reflects a methodology which is used to have meaningful study of breast cancer prognosis. This study is made incrementally and the first part is breast cancer risk assessment which is the main focus of this paper. The remaining two parts of the methodology are presented in our future research papers. The research on breast cancer prognosis starts with investigation of present state-of-the-art of breast cancer in terms of prognosis. From the review of literature research hypotheses were found. The hypotheses conceived from literature are basis for our research work. The hypotheses are as follows.

- **H1:** Risk assessment methods can help in enhancing breast cancer research.
- **H2:** Breast cancer recurrence prediction can help improving situation in breast cancer diagnosis and treatment.
- **H3:** Breast cancer survivability prediction can leverage the breast cancer research further to have well informed decisions on breast cancer cases.

Research hypotheses found are best used to have systematic approach in the intended breast cancer prognosis research. As shown in Fig. 1, the research is split into three distinct parts. They are breast cancer risk assessment, breast cancer recurrence prediction model and breast cancer survivability prediction model. The framework takes breast cancer datasets and subject them to pre-processing. Pre-processing is meant for treating null values or missing values. The framework has many placeholders for risk assessment. It does meant that this framework and the underlying prototype application are built with the intention that it supports future methods in risk assessment as well. Similarly placeholders are provided for brast cancer recurrence prediction models and breast cancer survivability prediction models. Each part of prognosis results in specific intelligence that can be used for improving breast cancer research and breast cancer treatment in the real world. For instance, risk assessment methods yield risk probability, recurrent models result in recurrent probability and survivability models result in survivability probability. These three probabilities can be aggregated to have well informed decisions pertaining to breast cancer research and treatment.

4 Methodology for Breast Cancer Risk Assessment

Breast cancer risk assessment is made by using different algorithms. They are data mining algorithms such as K-Means, ID3 and J48. These algorithms are used to have risk assessment of breast cancer. The results of these algorithms are evaluated using measures like TP rate, FP rate, precision, recall and F-Measure. This work is related to hypothesis 1 (H1).

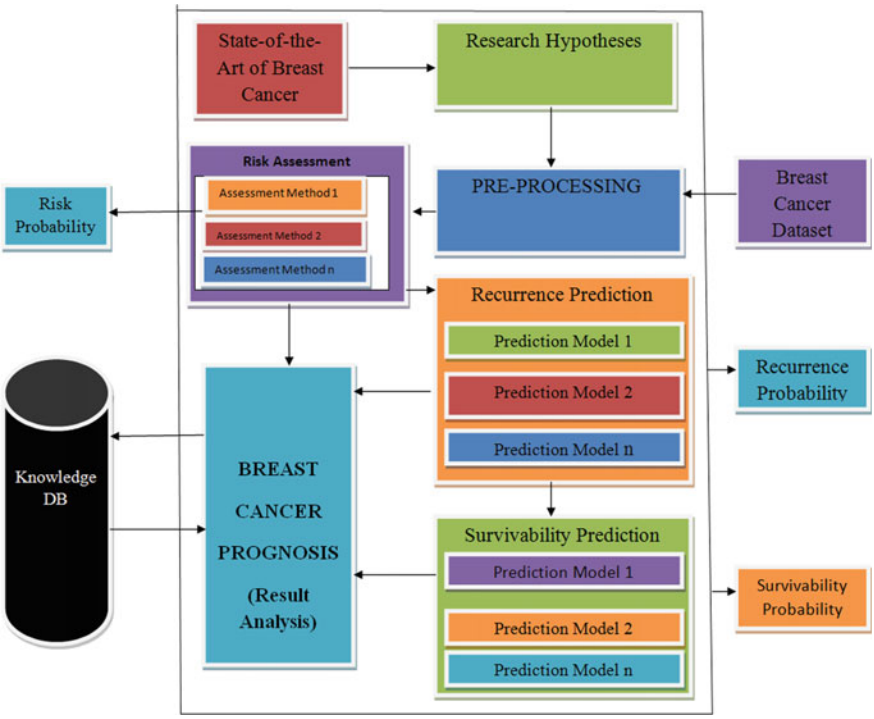

Fig. 1 Proposed framework reflecting methodology for breast prognosis research

K-means Algorithm

- k-means clustering is a data mining/machine learning algorithm used to cluster observations into groups of related observations without any prior knowledge of those relationships.
- The k-means algorithm is one of the simplest clustering techniques and it is commonly used in medical imaging, biometrics and related fields.

Working of k means Algorithm

1. Place K points into the space represented by the objects that are being clustered.
2. These points represent initial group centroids. Assign each object to the group that has the closest centroid.

3. When all objects have been assigned, recalculate the positions of the K centroids.
4. Repeat Steps 2 and 3 until the centroids no longer move. This produces a separation of the objects into groups from which the metric to be minimized can be calculated.

ID3 Algorithm

In decision tree learning, ID3 (Iterative Dichotomiser 3) is an algorithm invented by Ross Quinlan used to generate a decision tree from a dataset. ID3 is the precursor to the C4.5 algorithm, and is typically used in the machine learning and natural language processing domains. In ID3, a recursive procedure is used to construct a decision tree from data. We tentatively select an attribute to place on the root node and make one branch for each possible value of the attribute. Thus the data set at the root node split and moves into daughter nodes producing a partial tree. Make an assessment on quality of split. Repeat the process with all the other attributes.

Working of ID3

1. Calculate the entropy of every attribute using the data set.
2. Split the set into subsets using the attribute for which entropy is minimum (Or equivalently, information gain is maximum).
3. Make a decision tree node containing that attribute.
4. Recourse on subsets using remaining attributes.

5 Experimental Results

Datasets Used

Breast cancer datasets are obtained from UCI machine learning repository [37]. The details of used datasets are provided in Table 1. The details include the name of dataset, number of instances and number of attributes. The number of attributes for all datasets is 9 plus class attribute (Table 2).

Table 2 Datasets used for empirical study

Dataset name	Number of instances	Number of attributes
Breast Cancer	286	9
Breast Cancer-Dataset1	286	9
Breast Cancer-Dataset2	286	9

K Means Cluster Analysis:

See Table 3, Fig. 2, Table 4, Fig. 3, Table 5 and Fig. 4.

Table 3 k Means cluster analysis with Breast-Cancer.arff

# Of clusters	Number of attributes (Excel class)	Num classes	Num instances
3	1	3	286

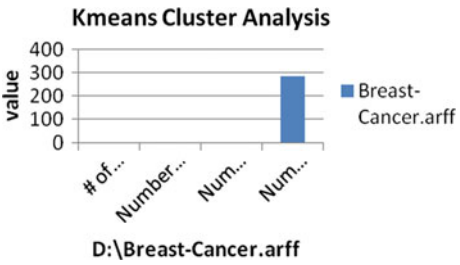

Fig. 2 k Means cluster analysis with Breast-Cancer.arff

Table 4 k Means cluster analysis with BreastCancer-DataSet1.arff

# Of clusters	Number of attributes (Excel class)	Num classes	Num instances
3	1	3	100

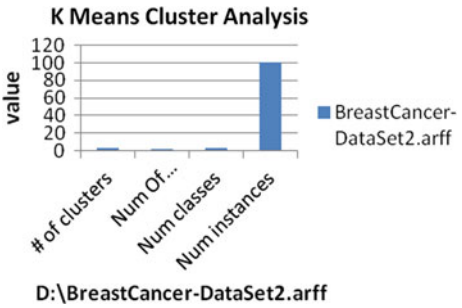

Fig. 3 k Means cluster analysis with BreastCancer-DataSet1.arff

Table 5 k Means cluster analysis with BreastCancer-DataSet2.arff

# Of clusters	Number of attributes (Excel class)	Num classes	Num instances
3	1	3	100

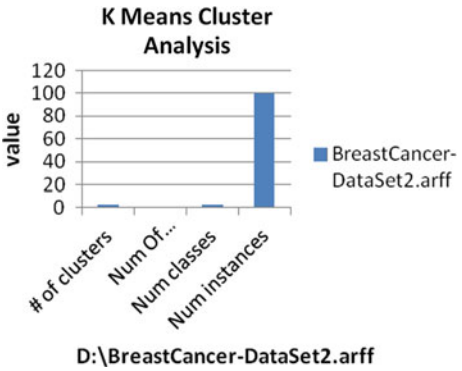

Fig. 4 k Means cluster analysis with BreastCancer-DataSet2.arff

Id3 Classifier:

See Table 6, Fig. 5, Table 7, Fig. 6, Table 8 and Fig. 7.

Table 6 ID3 classifier with Breast-Cancer.arff

Number of attributes	Num classes	Num instances	Instances.sumOfWeights()
1	3	286	286

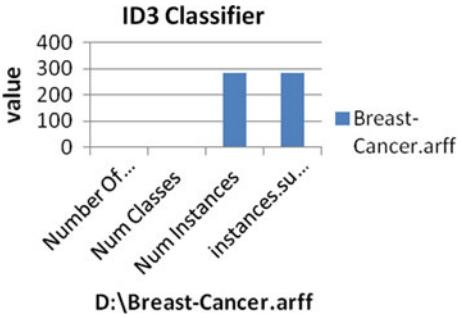

Fig. 5 ID3 classifier with Breast-Cancer.arff

Table 7 ID3 classifier with BreastCancer-DataSet1.arff

Number of attributes	Num classes	Num instances	Instances.sumOfWeights()
1	3	100	100

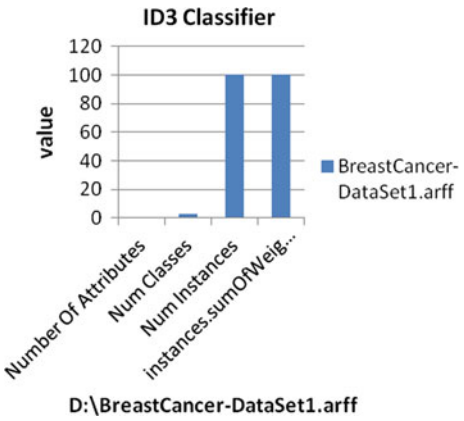

Fig. 6 ID3 classifier with BreastCancer-DataSet1.arff

Table 8 ID3 classifier with BreastCancer-DataSet2.arff

Number of attributes	Num classes	Num instances	Instances.sumOfWeights()
1	3	100	100

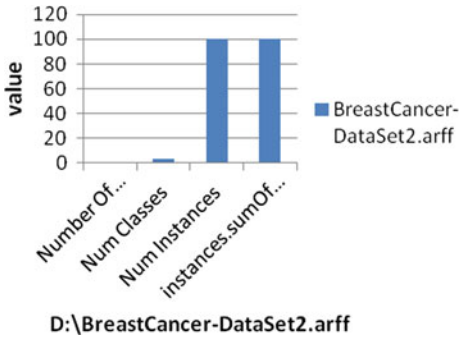

Fig. 7 ID3 classifier with BreastCancer-DataSet2.arff

J48 Classifier:

See Table 9, Fig. 8, Table 10, Fig. 9, Table 11 and Fig. 10.

Table 9 J48 classifier with Breast-Cancer.arff

Class	TP rate	FP rate	Precision	Recall	F-Measure
It40	0	0	0	0	0
ge40	0.93	0.248	0.755	0.93	0.833
premeno	0.78	0.074	0.921	0.78	0.845

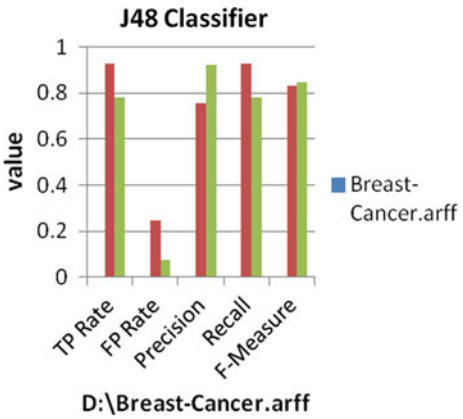

Fig. 8 J48 classifier with Breast-Cancer.arff

Table 10 J48 classifier with BreastCancer-DataSet1.arff

Class	TP rate	FP rate	Precision	Recall	F-Measure
It40	0	0	0	0	0
ge40	0.913	0.296	0.724	0.913	0.808
premeno	0.76	0.08	0.905	0.76	0.826

Fig. 9 J48 classifier with BreastCancer-DataSet1.arff

Table 11 J48 classifier with BreastCancer-DataSet2.arff

Class	TP rate	FP rate	Precision	Recall	F-Measure
It40	0	0	0	0	0
ge40	0.927	0.085	0.884	0.927	0.905
premeno	0.947	0.07	0.947	0.947	0.947

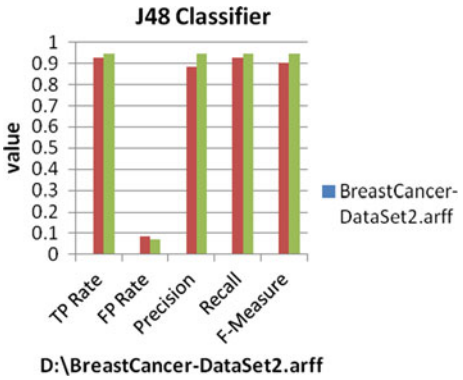

Fig. 10 J48 classifier with BreastCancer-DataSet2.arff

Prediction On Test Set:

See Table 12, Fig. 11, Table 13, Fig. 12, Table 14 and Fig. 13.

Table 12 Prediction on test set with Breast-Cancer.arff

# Of clusters	Number of attributes (Excel class)	Num classes	Num instances
3	1	3	286

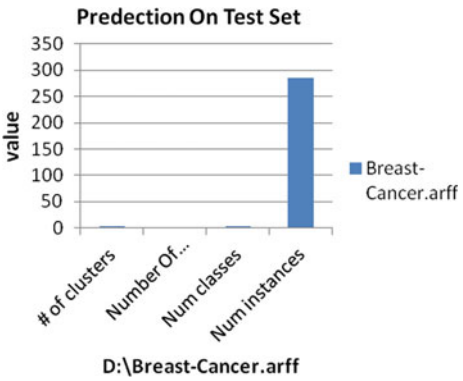

Fig. 11 Prediction on test with Breast-Cancer.arff

Table 13 Prediction on test with BreastCancer-DataSet1.arff

# Of clusters	Number of attributes (Excel class)	Num classes	Num instances
3	1	3	100

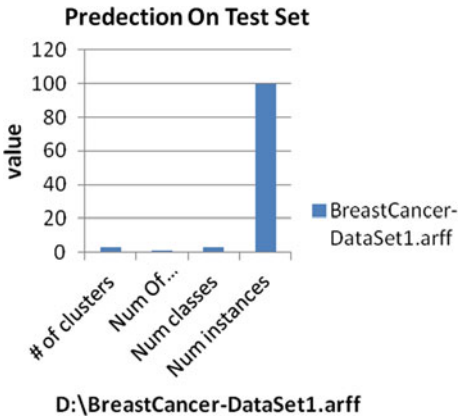

Fig. 12 Prediction on test with BreastCancer-DataSet1.arff

Table 14 Prediction on test with BreastCancer-DataSet2.arff

# Of clusters	Number of attributes (Excel class)	Num classes	Num instances
3	1	3	100

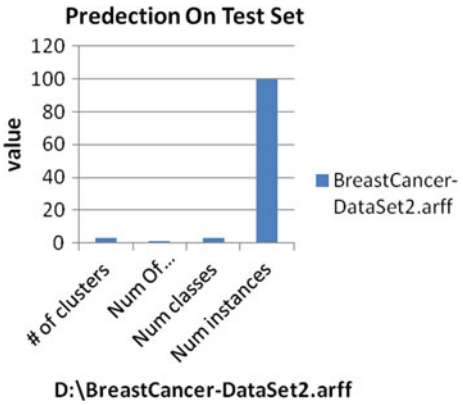

Fig. 13 Prediction on test with BreastCancer-DataSet2.arff

6 Conclusion

This research paper has provided information pertaining to the need for research on breast cancer prognosis using data mining techniques in bioinformatics. As biological processes can provide required knowledge to devise solutions to real world problems, it is essential to have mechanisms that can explore biological processes such as DNA sequencing. This kind of research with respect to breast cancer can help improve risk assessment, recurrence estimation and survivability prediction. A methodology is presented to complete the research in systematic approach. The

research is completed using SEER datasets pertaining to breast cancer incidences and other datasets recently shared by American Cancer Society.

Appendix A–Acronyms or Symbols Used

Acronyms (Table 15).

Table 15 Acronyms and symbols used

Acronym	Description
ACS	American Cancer Society
ANN	Artificial Neural Network
BBD	Benign Breast Disease
BCA	Breast Composition Assessment
BV	Breast Volume
C-SVC	C-Support Vector Classification
DSS	Decision Support System
DT	Decision Tree
FTV	Fibrograndular Tissue Volume
NCHS	National Centre for Health Statistics
PD	Percent Density
SEER	Surveillance, Epidemiology, and End Results
SSL	Semi-Supervised Learning
WDBC	Wisconsin Diagnostic Breast Cancer
wFDT	Weighted Fuzzy Decision Trees
WPBC	Wisconsin Prognostic Breast Cancer

References

1. American Cancer Society (2016). http://www.cancer.org/cancer/breastcancer/detailedguide/breast-cancer-what-is-breast-cancer. Accessed 10 Oct 2016
2. Shin H, Nam Y (2013) A coupling approach of a predictor and a descriptor for breast cancer prognosis. Oncology, pp 1–12
3. Jemal A, Siegel R, Ward E, Hao Y, Jiaquan X, Murray T, Thun MJ (2008) Cancer statistics. CA Cancer J Clin 58(2):71–96
4. Duffy (2012) The benefits and harms of breast cancer screening: an independent review. LANCET 380(0):1778–1786
5. Hilgart JS, Coles B, Iredale R (2012) Cancer genetic risk as assessment for individuals at risk of familial breast cancer. Cochrane Database Syst Rev 2:1–57
6. Aune D, Chan DSM, Vieira AR, Navarro Rosenblatt DA, Vieira R, Greenwood DC, Norat T (2012) Dietary compared with blood concentrations of carotenoids and breast cancer risk: a systematic review and meta-analysis of prospective studies. Am Soc Nutr 96(2):357–373
7. Khan U, Shin H, Choi JP, Kim M (2008) wFDT - weighted fuzzy decision trees for prognosis of breast cancer survivability, pp 1–12

8. Anothaisintawee T, Teerawattananon Y, Wiratkapun C, Kasamesup V, Thakkinstian A (2012) Risk prediction models of breast cancer: a systematic review of model performances. Breast Cancer Res Treat 133:1–10
9. Delen D, Walker G, Kadam A (2005) Predicting breast cancer survivability: a comparison of three data mining methods. Artif Intell Med. 34(2):113–127
10. Abraham A (2005) 129: artificial neural networks. ISBN, pp 1–8
11. DiSipio T, Rye S, Newma B, Hayes S (2013) Incidence of unilateral arm lymphoedema after breast cancer: a systematic review and meta-analysis, vol 14. IEEE, pp 1–16
12. Cruz JA, Wishart DS (2006) Applications of machine learning in cancer prediction and prognosis. Cruz and Wishart, pp 1–20
13. Berliner JL, Fay AM, Cummings SA, Burnett B, Tillmanns T (2013) NSGC practice guideline: risk assessment and genetic counseling for hereditary breast and ovarian cancer. J Genet Couns 22(2):155–163
14. Xu G, Zhang Y (2007) Breast cancer survivability via AdaBoost algorithms. IEEE, pp 1–11
15. Kaufmann M, von Minckwitz G, Mamounas EP, Cameron D, Carey LA, Cristofanilli M, Denkert C, Eiermann W, Gnant M, Harrisan JR, Thoma K (2011) Recommendations from an international consensus conference on the current status and future of neoadjuvant systemic therapy in primary breast cancer. NST, pp 1– 9
16. Thongkam J, Xu G, Zhang Y, Huang F (2009) Toward breast cancer survivability prediction models through improving training space. Comput Sci 36 1–10
17. Maglogiannis I, Zafiropoulos E, Anagnostopoulos I (2007) An intelligent system for automated breast cancer diagnosis and prognosis using SVM based classifiers. Springer Science, pp 1–13
18. Amadou A, Ferrari P, Muwonge R, Moskal A, Biessy C, Romieu I, Hainaut P (2013) Overweight, obesity and risk of premenopausal breast cancer according to ethnicity: a systematic review and dose-response meta-analysis. International Association for the Study of Obesity, pp 1–14
19. Neuhouser ML, Aragaki AK, Prentice RL, Manson JE, Chlebowski R, Carty CL, Ochs-Balcom, HM, Thomso CA (2016) Breast cancer risk a secondary analysis of the women's health initiative randomized clinical trials. IEEE, pp 1–11
20. Kim J, Shin H (2013) Breast cancer survivability prediction using labeled, unlabeled, and pseudo-labeled patient data. IEEE, pp 1–6
21. He J, Carbonell J, Liu Y (2010) Graph-based semi-supervised learning as a generative model. IJCAI, 1–6
22. Belkin M, Matveev I, Niyogi P (2004) Regularization and semi-supervised learning on large graphs. Springer, pp 1–15
23. Chapelle O, Weston J, Scholkopf B (2005) Cluster kernels for semi-supervised learning. IEEE, p 1–8
24. Shin H, Cho S (2006) Neighborhood property based pattern selection for support vector machines. IEEE, pp 1–46
25. Wu Y, Zhang D, Kang S (2012) Physical activity and risk of breast cancer: a meta-analysis of prospective studies. Springer Science, pp 1–14
26. Wang J, Shen X (2007) Large margin semi-supervised learning. J Mach Learn Res 8:1867–1891
27. Krop IE, Kim S-B, González-Martín A, LoRusso PM, Ferrero J-M, Smitt M, Yu R, Leungm A, Wildiers H (2014) Trastuzumab emtansine versus treatment of physician's choice for pretreated HER2-positive advanced breast cancer (TH3RESA): a randomised, open-label, phase 3 trial. IEEE, pp 1–11
28. Senkus E, Kyriakides S, Ohno S, Penault-Llorca F, Poortmans P, Rutgers E, Zackrisson S, Cardoso F (2015) Primary breast cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. IEEE, pp 1–23
29. Itoh H, Iwasaki M, Sawada N, Takachi R, Kasuga Y, Yokoyama S, Onuma H, Nishimura H, Kusama R, Yokoyama K, Tsugane S (2014) Dietary cadmium intake and breast cancer risk in Japanese women: a case–control study. Int J Hyg Environ Heal 217(1):70–77

30. Chatpatanasiri R, Kijsirikul B (2009) A unified semi-supervised dimensionality reduction framework for manifold learning. IEEE, pp 1–22
31. Kunkler IH, Williams LJ, Jack WJL, Cameron DA, Michael Dixon J (2015) Breast-conserving surgery with or without irradiation in women aged 65 years or older with early breast cancer (PRIME II): a randomised controlled trial. IEEE, pp 1–8
32. Dyrstad SW, Yan Y, Fowler AM, Colditz GA (2015) Breast cancer risk associated with benign breast disease: systematic review and meta-analysis. Springer, pp 1–7
33. Chan DSM, Bandera EV, Greenwood DC, Norat T (2015) Circulating C-reactive protein and breast cancer risk – systematic literature review and meta-analysis of prospective cohort studies. IEEE, pp 1–23
34. Cardoso F, van't Veer LJ, Bogaerts J, Slaets L, Viale G, Delaloge S, Pierga J-Y, Brain E, Causeret S, DeLorenzi M, Glas AM, Golfinopoulos V, Goulioti T, Knox S, Meulemans EMB (2016) 70-gene signature as an aid to treatment decisions in early-stage breast cancer. IEEE, pp 1–13
35. Rhodes DJ, Breitkopf CR, Ziegenfuss JY, Jenkins SM, Vachon CM (2015) Awareness of breast density and its impact on breast cancer detection and risk. J Clin Oncol 33(10):1143
36. Schmachtenberg C, Hammann-Kloss S, Bick U, Engelken F (2015) Intraindividual comparison of two methods of volumetric breast composition assessment. Acad Radiol 22 (4):1–6
37. UCI Machine Learning Repository (2017). http://archive.ics.uci.edu/ml/

Role of Advanced Glycated End Products (AGEs) in Predicting Diabetic Complications Using Machine Learning Tools: A Review from Biological Perspective

Vamsi Krishna Battula, P. Satheesh, B. Srinivas, A. Chandra Sekhar, and V. Aswini Sujatha

Abstract AGEs are highly stable products formed by glycation of reducing sugars, proteins and lipids. Diabetes mellitus is the condition; where the cells cannot utilize the glucose present in body tend to glycate free proteins in surroundings and cause various complications. Once, the AGEs glycate tissue proteins, they accumulate over lifetime and therefore contributing to complications such as neurodegeneration, polyneuropathy, retinopathy, nephropathy and other macrovascular complications. AGEs can be formed in many ways and bind with RAGE cell surface receptor. Since the etiology of these diseases is now well understood and the biomarkers of the disease are available, it is important to consider them in all machine learning disease prediction tools. Machine learning and deep learning algorithms and tools are being used in predicting various diseases mostly on basis of medical history and symptoms. This review focuses about how different AGEs play role in pathogenesis of different diabetic complications and discusses the why these glycated proteins should be considered in prediction of diabetic complications using machine learning or by other means.

Keywords AGEs · Diabetic complications · Machine learning · Prediction

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_138

Abbrevations

AGEs	AGEs
RAGEs	Receptors of AGEs
DM	Diabetes mellitus
HbA1C	glycated hemoglobin
PD	Parkinson's disease
CML	Carboxy methyl lysine
BMI	Body Mass Index

1 Introduction

1.1 Advanced Glycated End Products (AGEs)

AGEs are formed through non enzymatic glycation of reducing sugars such as glucose, proteins and lipids. This reaction forms an unstable Schiff base which is reversible in conditions with less glucose and results in ketomaine amadori product when there is abundant glucose [1]. This reaction can lead to protein adducts and protein-AGE cross links [2]. They are also formed through carbonyl stress pathway, in which the oxidation of sugars and lipids generate dicarbonyl intermediates binding to aminoacids. They are completely heterogeneous and follow different mechanisms of origin [3]. Hyperglycemic and insulin resistance conditions can increase the glucose levels in body and this free glucose can form covalent adducts with plasma proteins [4]. Glycation may change protein conformation, alters functional activity, decreases degradation capacity and interferes with receptor recognition [5]. They form at a very slow rate in human body, accumulate in different tissues, and triggers in diabetic patients due to presence of excess glucose [1].

They can interact with proteins in cellular matrix, basement membranes, binding receptors, and vessel wall components altering both structural and functional properties and are capable of inducing organopathy by accumulating in tissue, denaturing receptor targets, generates oxidative and carbonyl stress [6]. AGEs interact with their receptors known as RAGEs which are found on smooth muscle cells, macrophages, endothelial cells, astrocytes, etc. These are also present on amyloid β peptide, β sheet peptides, β sheet fibrils, calgranulins, amphoterin and mac1 proteins [4]. The factors that affect the formation of AGEs are oxygen levels, physiological pH, and temperature, nature of metal ions present and unfolding mechanisms. Accessibility and availability of free amino acid residues in its surrounding area also effect glycation reaction. It was observed that AGE formation will be increased during high temperatures [1].

2 Diabetes

There is an estimate that by 2040, Diabetes will affect more than 640 million people across the world. In the year 2015 alone, 5 million deaths associated to diabetes were recorded and more than 400 million people were affected by diabetes. So, the complications associated with diabetes were being worrisome to people [7]. Type 1 diabetes comprises only 10% of total diabetes cases in world [8]. It is actually caused by autoimmune destruction of pancreatic β cells which play a crucial role in insulin signaling and glucose uptake [9]. Factors causing destruction of pancreatic β cells can be genetic, immunologic, and environmental [8]. Insulin resistance was observed along with β-cell failure in type 2 diabetes causing hindrance in insulin pathway [10]. Production of defective or mutated insulin or abnormal insulin receptor is the main reasons for conditions in type 2 diabetes [11]. Insulin uptake by cells generally occurs upon binding to heterotetrameric insulin receptor. This phosphorylates Insulin receptor substrate protein (IRS) which in turn phosphorylates Phosphotidyl inositol 3 kinase (PI3K) enzyme [12]. PI3K synthesizes Phosphatidyl inositol tri phosphate which binds to PDK1 activating *Akt* and *Pka* genes [13]. These products regulate the production of Glucose transporter (GLUT4) which travels to surface and sends glucose inside the cell. Also, PKA protein activates glycogen synthesis, decreases expression of gluconeogenesis enzymes such as PEPCK & G6Pase in liver [14]. When *Akt2* gene was knocked out, mice cells showed insulin resistance and diabetes mellitus like condition [15]. This shows the importance of *Akt* gene activation and insulin signaling. Also, it was found that severe mitochondrial dysfunction can cause diabetes [16]. Insulin targets skeletal muscle, adipose, and liver tissues in body since these are places for glucose deposition and storage [17]. There is evidence suggesting that formation of AGEs may play an important role in impaired wound healing [18]. The complications associated with diabetes can be classified into three types: microvascular, macrovascular, and miscellaneous. Neuropathy, nephropathy, and retinopathy come under microvascular complications. Cardiovascular diseases, hypertension, cardiomyopathy, oxidative stress, and peripheral artery disease lie under macrovascular [19]. Our main aim in this review is to discuss why machine learning algorithms should also consider the levels and characteristics of different AGEs and to predict the risk of diabetic complications in a biological perspective.

2.1 AGEs in Diabetes

It is well known that protein AGEs can form different diabetic complications through interactions with surface receptors causing conformational changes resulting in oxidative stress in organs [20]. Hyperglycemic conditions along with insulin resistance increases blood glucose. The free glucose in the body reacts with plasma proteins and form AGEs. Elevated circulatory concentration and deposition

of lipids was seen in skeletal muscles of type 2 diabetes patients. When AGEs bind to their receptors it activates p21 RAS and MAPK pathway which leads to activation of NFK β protein complex. This generates IL-1, IL-6, and TNF α cytokines along with activation of ICAM1, VCAM1, thrombomodulin, and tissue factor endothelin 1 leading to inflammation. The cytokines increase oxidative stress and cause inflammation too. In this manner, AGEs are capable of causing vascular dysfunctions through fibrinogen [21, 22]. Glycation of IgG antibody can result in autoimmune diseases, inflammations, and immune-suppressors [20]. Glycation of collagen can result in aging of skin, atherosclerotic development, and fibrosis in diabetic patients [20, 23]. Whereas, albumin glycation result in long chain fatty acids, platelet activation and aggregation and reduces intracellular glucose uptake leading to aggravate conditions in diabetic patients [4, 23]. Most of the studies using artificial intelligence don't provide reliable risk prediction due to consideration of very common and physiological symptoms as variables in machine learning study [24–27]. One recent study had included more than 24 factors and trained the machine in such a way to analyze relationships between the factors too. They have considered albumin, low density lipoproteins (LDL), high density lipoproteins (HDL) RBC, WBC counts, glomerular filtration rate (GFR), glycated haemoglobin, aspartate transaminase (AST) alanine transaminase (ALT) ratio, creatinine, carbon dioxide, along with systolic blood pressure and blood glucose levels [28, 29] (Fig. 1).

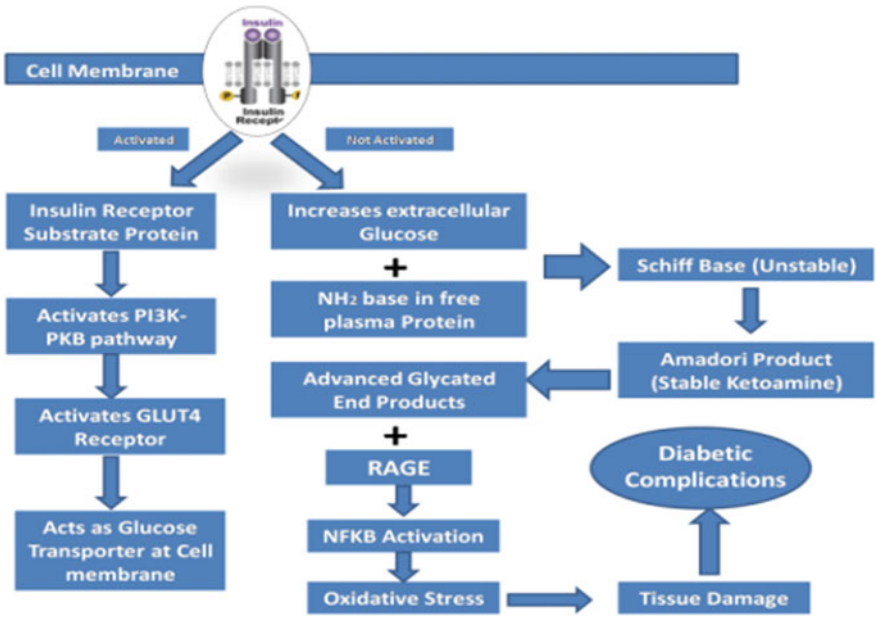

Fig. 1 AGEs formation in diabetic patients

3 Machine Learning in Predicting Diseases

Artificial intelligence comprises two wings: Virtual and Physical. The physical intelligence involves robotics which can be used in surgeries and the virtual can be used in informatics, diagnosis, decision management [30]. Machine learning is a rapidly evolving branch of artificial intelligence used to emulate human intelligence by automated learning from surrounding environment and input training given [31]. In disease prediction, pipelines of data mining algorithms are used combining clinical profiling, predictive model targeting, construction, and model validation [32]. In the EU MOSAIC project to design a machine learning tool to predict diabetic complications have used only one glycated protein (HbA1c) in their list of variable factors [32]. The role of machine learning in disease prediction and healthcare these days is evolving rapidly. Analysis of patient's health medical records, physical symptoms, biochemical parameters and different biomarkers involves dealing with Big Data [28]. Convoluted and Artificial neural networks, multimodal algorithms, logistic regression models are regularly used in designing algorithms and performing data analysis.

3.1 AGEs in Neurodegenerative Disorders

The main source of energy for human brain is glucose which enters the brain directly through GLUT1 receptor. It was also discovered that disturbed glucose metabolism can be the culmination for neurodegenerative disorders [33]. But, regular and extreme hyperglycemic conditions may lead to diverse metabolic pathways and gives rise to reactive dicarbonyl species contributing to chronic complications [34]. Also the receptors for AGEs are well expressed by microglial cells, astrocytes, neurons in a normal brain of human being giving more scope for reaction with AGEs [35]. Several studies have confirmed that AGEs play a crucial role in formation of Alzheimer's, Parkinson's, Huntington's, Amyotrophic lateral sclerosis, familial amyloid polyneuropathy and Creutzfeld–Jakob disease (CJD) [36].

3.2 AGEs in Alzhiemers Disease

Alzheimer's disease is the most common type of dementia, effecting cognitive skills and behavior. It takes more than 8–10 years from initiation to progress, express symptoms and also to diagnose [37]. It was reported that 50% people aged over 85 have Alzheimer's disease and usually seen in old aged group [38]. Degeneration of neurons in forebrain and hippocampus, protein aggregation occur in disease progression of Alzheimer's [39]. Pathologically, Alzheimer's is characterized with

deposition of amyloid β peptides forming plaques, tau protein forming neurofibrillary tangles [40]. The small amyloid β peptide chains as monomer, dimer, or multimer deposits at the neuronal and glial cell membranes and block the neurotransmitter signals. Later, the multimeric β amyloid peptides fold into a β pleaded sheet aggregates to form plaques inside brain [41]. On the other hand, neuronal cell death and dysfunction occurs due to accumulation of phosphorylated tau proteins in neurons forming Neuro-Fibrillary Tangles (NFTs). The abundant presence of these tangles in brain and axons is directly proportional to the neural cell death and the stage of dementia [42].

Several studies proved that AGEs are profoundly available both in β amyloid plaques and neurofibrillary tangles [43–47]. Glycation of globular α helical structured albumin can produce β pleaded sheets and form cross β confirmations [43]. Amyloid β recognizes the receptors of AGEs and accumulate in one part of astrocytes causing neuronal stress [35]. Cross linked β sheets and AGEs in brain may give rise to resistance against proteases. These cross linked peptides can then block the axon motility and intracellular protein movement [48]. It is well known that Amyloid precursor protein is modified into plaques by γ and β-secretase [49]. And now, it is proved that AGEs are able to activate these enzymes by increasing reactive oxygen species (ROS) and trigger several other genes such as *Sirt1* and *Grp7* which can induce neuronal cell death [50]. Amyloid precursor protein's levels were upregulated by glyceraldehydes derived AGEs, finds a study [51].

Recently developed deep learning model algorithm can predict the Alzheimer's disease with 82% specificity, 75 months before the start of disease by analyzing PET scans [52]. Most of these predictions use brain imaging techniques such as structural and functional magnetic resonance imaging, Diffusion tensor imaging, and Magnetic resonance spectroscopy [53, 54]. All these deep learning and artificial intelligence algorithms are still in developmental stage and prediction at the stage of diabetes and hyperglycemia is under extensive research.

3.3 AGEs in Parkinson's Disease

Parkinson's disease occurs due to degeneration of dopaminergic neurons in substantia nigra of mid brain and monoaminergic neurons in brain stem exacerbating regular movement and motility [55]. It is also the rarest disease to occur as a diabetic complication. This gradually slows down the actions and spontaneous movement of a person, bradykinesia, which decreases the control and coordination between organs slowly [55]. Many genes such as *LRRK2, SNCA, Parkin, DJ-1, pink1,* etc. are found to be associated with Parkinson's disease [56]. Mutations in *SNCA* gene can lead to formation of incomplete protein which cannot bind to membrane, but accumulates to form Lewy bodies [57].

Glycated α-synuclein is well known for formation of Lewy bodies and progresses to Parkinson's disease even without mutations in *SNCA* gene [58]. The major reason for the effect of glycation towards α synuclein is because it has 15

lysine residues and is the targets of glycation. The levels of glycation observed in amygdale, cerebral cortex, substantia nigra is too high in Parkinson's patients when compared with control sample [59]. Glycated α-synuclein and oligomerized α-synuclein creates oxidative stress by reactive oxygen species and can cause direct neuronal cell death. The oligomeric glycated α-synuclein can also damage the permeability of the membrane pores, imbalance and cell death. Oligomers can hinder neurotransmission by forming fibrils; can cause neuro-inflammation by activating microglial cells and several cytokines [56, 57, 59]. Several Cohort and Meta analysis studies reported that diabetes is an associated risk factor for the progression of Parkinson's disease [60–62]. Several studies in 1960s & 70s have observed abnormal glucose tolerance, impaired glucose metabolism, hyperglycemic and diabetic conditions in patients with Parkinson's disease [63–66]. Machine learning methods used to predict Parkinson's mostly rely on patient's medical history and Unified Parkinson's Disease Rating Scale (UPDRS) [67]. Very few studies have considered peripheral cytokines [68], blood glucose levels, and uric acid metabolism as factors in predicting Parkinson's disease [68].

3.4 Role of AGEs in Cardiovascular Diseases

Many studies in different countries for years have found that AGEs like pentosidine, malonodialdehyde, CML, and creatinine have an important pathological role and causing morbidity in cardiovascular diseases [69–72]. When compared with diabetic neuropathy, inclusion of few advanced glycated products in prediction models of cardiovascular diseases have been in use. In a study in Maryland, it was observed that AGEs are potential target for intervention and potential treatment [73]. One more study found that serum pentosidine levels were high in patients with heart failure and are almost similar to normal people of that age, so it was concluded as an independent prognostic factor [73, 74]. Artificial intelligence systems considered glycated haemoglobin, blood sugar, kidney dysfunction, duration of diabetes, and blood pressure when predicting the chances of cardiovascular diseases in diabetic patients [75]. Where, glycated haemoglobin showed 2% increased risk for heart failure for each mmol increase in concentration in body [75].

Many cardiovascular disease prediction algorithms were not so reliable although the complete set of factors causing the disease is well understood [76–79]. Several studies have considered triglycerides levels [67], glycated haemoglobin [68], inflammatory proteins like C reactive protein and fibrinogen [57], and natural peptides [58] in predicting different cardiovascular diseases. The drawbacks in these studies were covered in another study recently, which is special because they have considered 423 variables and created an automated machine learning frameworks called 'Auto prognosis'. The authors say that selecting the appropriate machine learning model and careful tuning of parameters is very important to get valuable outcomes [80].

3.5 AGEs in Diabetic Nephropathy and Kidney Disease

Frequent hyperglycemic events, dyslipidemia, hypertension, and smoking are related to progression of diabetic kidney disease and can activate cellular signaling pathways such as diacylglycol (DAG), Protein Kinase C pathway, AGEs, polyol pathway, hexoseamine pathway leading to oxidative stress [81, 82]. For years urine albumin is being considered as a biomarker for detecting kidney damage, but by the time their levels rise, it indicates that the damage has started already [83]. Biomarkers such as α-1microglobulin, β-1microglobulin, nephrin, cystatin C are sensitive indicators of tubular damage, but were not considered due to various reasons in many studies [84]. Radioreceptor screening assay to detect AGEs was done in kidney disease patients involving both diabetic and non diabetic study groups. It was found that AGEs accumulate at a fast rate in diabetic people than in non diabetic patients, showing the importance of AGEs in pre diagnosis of diabetic complications [85]. Only two machine learning based studies till now have used most of the factors to predict diabetic kidney disease, but still have to consider more different types of AGEs while selection of factors [28, 29]. They characterized that data into Structured, which includes lab tests and medications, Text Data, which has

Diabetic Complications		Advanced Glycated Proteins as key Biomarkers
Micro vascular Complications	Neuropathy	Diacarbonyl Species, Glyoxal and methylglyoxal lysine dimers, Glycated Amyloid β peptide, Glycated α synuclein,
	Nephropathy	Glycated Haemoglobin, Diacylglycol, Glycated Albumin, Nephrin, Cystatin C, Fibrinogen
	Retinopathy	Hydraimidazole, Methyl glyoxal, N-ε-Carboxymethyl lysine
Macro Vascular Complications	Cardiomyopathy	Carboxy methyl lysine (CML), Penosidine, Melanodialdehyde derived AGEs Glycated Fibrinogen C Reactive Protein
	Peripheral Artery Disease	
	Coronary Artery Disease	
	Hypertension	
Other Complications	Skin Ageing, Atherosclerosis, Fibrosis	Collagen
	Autoimmune diseases, Inflammations	Glycated IgG Antibody

Fig. 2 AGEs as key biomarkers in various types of diabetic complications

diagnosis and treatment records, and finally longitudinal data includes past family history, biomarkers through laboratory tests [28].

3.6 AGEs in Diabetic Retinopathy

The most common microvascular complication of diabetes is retinopathy [86]. This disease is characterized in two different stages: early non proliferative stage (NPDR) and advanced proliferative stage (PDR) [87]. Microaneurysms, retinal hemorrhages, intraretinal microvascular abnormalities, venous caliber changes are seen in NPDR while preretinal neurovascuarization is seen in PDR. Due to constant elevated glucose levels in the cells, mitochondrial electron chain produces superoxides in cell and causes oxidative stress. This also increases the precursors of AGEs in inflammatory substances [88]. N ε Carboxymethyl lysine (N-εCML), Methylglyoxal derived hydroimidazole is found to be elevated in diabetic retinopathy and are also considered as major biomarkers for early detection and risk prediction [89–91]. In a multivariate analysis, a mixture of furosine and Carboxymethyllysine (CML) predict the progression of retinopathy and also proved that glycated proteins in skin are independent risk prediction factors [92]. Most of the machine learning tools used in diagnosis of this disease use retinal image processing algorithms considering diameter of optic disk, lesion specific micro aneurysms. High dimensional images, t-distributed stochastic neighbor embedding (t-SNE) techniques, algorithms like alternating decision tree, adaBoost, Naïve Bayes, Random Forest & SVM were found to diagnose prior to NPDR stage [93, 94]. But, prediction of the risk before the disease culminates is feasible if the constant rise of above mentioned biomarkers are diagnosed regularly (Fig. 2).

4 Conclusion

In disease prediction using machine learning and artificial intelligence algorithms, the number of studies considering the levels of these AGEs was observed to be very few [31]. AGEs are the very early biomarkers for any kind of diabetic complications. Identifying their types, levels of accumulation and circulation in body and their correlation with different diabetic complications results have to be calibrated with experimental limits to apply perfectly in machine learning predicting algorithms. Construction and development of models which use multiple factors and biomarkers are predicting the disease with more accuracy [29, 80]. When different AGEs are also implicated in such good machine learning models, they can be used to predict the disease before a decade in diabetic patients.

References

1. Peppa M, Uribarri J et al (2003) Glucose, Advanced glycation end products, and diabetes complications: what is new and what works. Clin Diab 21(4):186–187
2. Gkogkolou P, Böhm M (2012) Advanced glycation end products: key players in skin aging? Dermato-Endocrinology 4(3):259–270
3. Thornalley PJ, Minhas HS (1999) Rapid hydrolysis and slow alpha, betadicarbonyl cleavage of an agent proposed to cleave glucose-derived protein cross-links. Biochem Pharmacol 57:303–307
4. Singh VP, Bali A et al (2014) Advanced glycation end products and diabetic complications. Korean J Physiol Pharmacol Off J Korean Physiol Soc Korean Soc Pharmacol 18(1):1–14
5. Hsieh CL, Yang MH et al (2007) Kinetic analysis on the sensitivity of glucose- or glyoxal-induced LDL glycation to the inhibitory effect of Psidium guajava extract in a physiomimic system. Biosystems 88:92–100
6. Yonekura H, Yamamoto Y et al (2005) Roles of the receptor for advanced glycation endproducts in diabetes-induced vascular injury. J Pharmacol Sci 97:305–311
7. International Diabetes Federation (2015) IDF Diabetes Atlas. 7th Brussels, Belgium: International Diabetes Federation
8. Paschou SA, Papadopoulou-Marketou N et al (2017) On type 1 diabetes mellitus pathogenesis. Endocr Connect 7(1):R38–R46
9. Paschou SA, Petsiou A, Chatzigianni K et al (2014) Type 1 diabetes as an autoimmune disease: the evidence. Diabetologia 57:1500
10. Saini V (2010) Molecular mechanisms of insulin resistance in type 2 diabetes mellitus. World J Diab 1(3):68–75
11. Saltiel RA (2001) New perspectives into the molecular pathogenesis and treatment of type 2 diabetes. Cell 104:517–529
12. Cheatham B, Vlahos CJ et al (1994) Phosphatidylinositol 3-kinase activation is required for insulin stimulation of pp70 S6 kinase, DNA synthesis, and glucose transporter translocation. Mol Cell Biol 14:4902–4911
13. Alessi DR, Cohen P (1998) Mechanism of activation and function of protein kinase B. Curr Opin Genet Dev 8:55–62
14. Shepherd PR, Navé BT, Siddle K (1995) Insulin stimulation of glycogen synthesis and glycogen synthase activity is blocked by wortmannin and rapamycin in 3T3-L1 adipocytes: evidence for the involvement of phosphoinositide 3-kinase and p70 ribosomal protein-S6 kinase. Biochem J 305(Pt 1):25–28
15. Cho H, Mu J et al (2001) Insulin resistance and a diabetes mellitus-like syndrome in mice lacking the protein kinase Akt2 (PKBβ). Science 292(5522):1728–1731
16. DiMauro S, Schon EA (2003) Mitochondrial respiratory-chain diseases. N Engl J Med 348:2656–2668
17. Klip A, Pâquet MR (1990) Glucose transport and glucose transporters in muscle and their metabolic regulation. Diabetes Care 13:228–243
18. Peppa M, Stavroulakis P, Raptis SA (2009) Advanced glycoxidation products and impaired diabetic wound healing. Wound Repair Regen 17(4):461–472
19. Papatheodorou K, Banach M et al (2018) Complications of diabetes 2017. J Diab Res 2018:3086167
20. Negre-Salvayre A, Salvayre R, Augé N, Pamplona R, Portero-Otín M (2009) Hyperglycemia and glycation in diabetic complications. Antioxid Redox Signal 11:3071–3109
21. Zhang Q, Ames JM et al (2009) A perspective on the Maillard reaction and the analysis of protein glycation by mass spectrometry: probing the pathogenesis of chronic disease. J Proteome Res 8:754–769
22. Halliwell B (2009) The wanderings of a free radical. Free Radic Biol Med 46:531–542
23. Khan N, Bakshi KS et al (2009) Ameliorative potential of spironolactone in diabetes induced hyperalgesia in mice. Yakugaku Zasshi 129:593–599

24. Coleman RL, Stevens RJ et al (2007) SCORE, and DECODE risk equations do not provide reliable cardiovascular risk estimates in type 2 diabetes. Diabetes Care 30(5):1292–1293
25. McEwan P, Williams J et al (2004) Evaluating the performance of the Framingham risk equations in a population with diabetes. Diabet Med 21(4):318–323 PMID 15049932
26. Martín-Timón I, Sevillano-Collantes C et al (2014) Type 2 diabetes and cardiovascular disease: have all risk factors the same strength? World J Diabetes 5(4):444
27. Buse JB, Ginsberg HN et al (2007) Primary prevention of cardiovascular diseases in people with diabetes mellitus: a scientific statement from the American Heart Association and the American Diabetes Association. Circulation 115(1):114–126
28. Thomas PB, Robertson DH, Chawla NV (2018) Predicting onset of complications from diabetes: a graph based approach. Appl Netw Sci 3(1):48
29. Makino M, Yoshimoto R, Ono M, Itoko T, Katsuki T, Koseki A, Kudo M, Haida K, Kuroda J, Yanagiya R, Saitoh E, Hoshinaga K, Yuzawa Y, Suzuki A (2019) Artificial intelligence predicts the progression of diabetic kidney disease using big data machine learning. Sci Rep 9(1):11862
30. Hamet P, Tremblay J (2017) Artificial intelligence in medicine. Metabolism 69:S36–S40. https://doi.org/10.1016/j.metabol.2017.01.011
31. Murphy MJ, El Naqa I, Li R, Murphy MJ (2015) What is machine learning? In: El Naqa I, Li R, Murphy M (eds) Machine learning in radiation oncology: theory and applications. Springer, Cham, pp 3–11
32. Dagliati A, Marini S, Sacchi L, Cogni G, Teliti M, Tibollo V, De Cata P, Chiovato L, Bellazzi R (2018) Machine learning methods to predict diabetes complications. J Diabet Sci Technol 12(2):295–302
33. Mergenthaler P, Lindauer U, Dienel GA, Meisel A (2013) Sugar for the brain: the role of glucose in physiological and pathological brain function. Trends Neurosci 36(10):587–597
34. König A, Vicente Miranda H, Outeiro TF (2018) Alpha-synuclein glycation and the action of anti-diabetic agents in Parkinson's disease. J Parkinson's Dis 8(1):33–43
35. Sasaki N, Toki S, Chowei H et al (2001) Immunohistochemical distribution of the receptor for advanced glycation end products in neurons and astrocytes in Alzheimer's disease. Brain Res 888(2):256–262 ISSN 0006-8993
36. Li J, Liu D, Sun L, Lu Y, Zhang Z (2012) Advanced glycation end products and neurodegenerative diseases: mechanisms and perspective. J Neurol Sci 317(1–2):1–5 ISSN 0022-510X
37. Ulep MG et al (2018) Alzheimer disease. J Nurse Pract 14(3):129–135
38. Grossman H, Bergmann C, Parker S (2006) Dementia: a brief review. Mt Sinai J Med 73:985–992
39. Campion D, Dumanchin C et al (1999) Early-onset autosomal dominant Alzheimer's disease: prevalence, genetic heterogeneity, and mutation spectrum. Am J Hum Genet 65:664–670
40. Khachaturian ZS (1985) Diagnosis of Alzheimer's disease. Arch Neurol 42:1097–1105
41. Seeman P, Seeman N (2011) Alzheimer's disease: β-amyloid plaque formation in human brain. Synapse 65:1289–1297
42. Brion J-P (1998) Neurofibrillary tangles and Alzheimer's disease. Eur Neurol 40:130–140
43. Obrenovich ME, Monnier VM (2004) Glycation stimulates amyloid formation. Sci Aging Knowl Environ 2:3
44. Wong A, Luth HJ, Deuther-Conrad W et al (2001) Advanced glycation end products co-localize with inducible nitric oxide synthase in Alzheimer's disease. Brain Res 920:32–40
45. Reddy VP, Obrenovich ME, Atwood CS, Perry G, Smith MA (2002) Involvement of Maillard reactions in Alzheimer's disease. Neurotox Res 4:191–209
46. Vitek MP, Bhattacharya K et al (1994) Advanced glycation end products contribute to amyloidosis in Alzheimer's disease. Proc Natl Acad Sci USA 91:4766–4770
47. Smith MA, Taneda S et al (1994) Advanced Maillard reaction end products are associated with Alzheimer's disease pathology. Proc Natl Acad Sci USA 91:5710–5714
48. Takeuchi M, Kikuchi S et al (2004) Involvement of advanced glycation end-products (AGEs) in Alzheimers disease. Curr Alzheimer Res 1:39

49. Lendon CL, Ashall F, Goate AM (1997) Exploring the etiology of Alzheimer disease using molecular genetics. JAMA 277:825–831
50. Ko SY, Ko HA et al (2015) The possible mechanism of advanced glycation end products (AGEs) for Alzheimer's disease. PLoS ONE 10(11):e0143345
51. Ko SY, Lin YP, Lin YS, Chang SS (2010) Advanced glycation end products enhance amyloid precursor protein expression by inducing reactive oxygen species. Free Radic Biol Med 49:474–480. https://doi.org/10.1016/j.freeradbiomed.2010.05.005
52. Ding Y, Sohn JH et al (2019) A deep learning model to predict a diagnosis of alzheimer disease by using ^{18}F-FDG PET of the brain. Radiology 290(2):456–464
53. Khvostikov A, Aderghal K, Benois-Pineau J, Krylov AS, Catheline G (2018) 3D CNN-based classification using sMRI and MD-DTI images for Alzheimer disease studies. arXiv, abs/1801.05968
54. Mandal PK (2007) Magnetic resonance spectroscopy (MRS) and its application in Alzheimer's disease. Concepts Magn Reson 30:40–64
55. Triarhou LC (2000–2013) Dopamine and Parkinson's disease. In: Madame Curie bioscience database. Landes Bioscience, Austin (TX). https://www.ncbi.nlm.nih.gov/books/NBK6271/
56. Salahuddin P, Rabbani G, Khan RH (2014) The role of advanced glycation end products in various types of neurodegenerative disease: a therapeutic approach. Cell Mol Biol Lett 19 (3):407–437
57. Hegde ML, Jagannatha Rao KS (2003) Challenges and complexities of alpha-synuclein toxicity: new postulates in unfolding the mystery associated with Parkinson's disease. Arch Biochem Biophys 418:169–178
58. Guerrero E, Vasudevaraju P, Hegde ML, Britton GB, Rao KS (2013) Recent advances in α-synuclein functions, advanced glycation, and toxicity: implications for Parkinson's disease. Mol Neurobiol 47:525–536
59. Padmaraju V, Bhaskar JJ, Prasada Rao UJ, Salimath PV, Rao KS (2011) Role of advanced glycation on aggregation and DNA binding properties of alpha-synuclein. J Alzheimers Dis 24:211–221
60. Yang YW, Hsieh TF, Li CI et al (2017) Increased risk of Parkinson disease with diabetes mellitus in a population-based study. Medicine 96(3):e5921
61. Yue X, Li H, Yan H, Zhang P, Chang L, Li T (2016) Risk of Parkinson disease in diabetes mellitus: an updated meta-analysis of population-based cohort studies. Medicine 95(18): e3549
62. Gang H, Jousilahti P et al (2007) Type 2 diabetes and the risk of Parkinson's disease. Diabetes Care 30(4):842–847
63. Barbeau A (1961) Experience clinique avec le tolbutamide dans la maladie de Parkinson. Union Medicale Canada 90:147–151
64. Boyd AE, Lebovitz HE, Feldman JM (1971) Endocrine function and glucose metabolism in patients with Parkinson's disease and their alteration by L-dopa. J Clin Endocrinol Metab 33:829–837
65. El'ner AM, Kandel EI (1965) Study of the carbohydrate metabolism in Parkinsonism. W Nervopatol Psikhiat IM SS Korsakova 65:46–50
66. Lipman IJ, Boykin ME, Flora RE (1974) Glucose intolerance in Parkinson's disease. J Chronic Dis 27:573–579
67. Nilashi M, Ibrahim O, Ahmadi H, Shahmoradi L, Farahmand M (2018) A hybrid intelligent system for the prediction of Parkinson's Disease progression using machine learning techniques. Biocybern Biomed Eng 38:1–15 ISSN 0208-5216
68. Ahmadi Rastegar D, Ho N, Halliday GM, Dzamko N (2019) Parkinson's progression prediction using machine learning and serum cytokines. NPJ Parkinson's Dis 5(1):1–8
69. Nin JW, Jorsal A, Ferreira I, Schalkwijk CG, Prins MH, Parving HH, Tarnow L, Rossing P, Stehouwer CD (2011) Higher plasma levels of advanced glycation end products are associated with incident cardiovascular disease and all-cause mortality in type 1 diabetes: a 12-year follow-up study. Diabetes Care 34(2):442–447. https://doi.org/10.2337/dc10-1087

70. Lapolla A, Piarulli F, Sartore G, Ceriello A, Ragazzi E, Reitano R, Baccarin L, Laverda B, Fedele D (2006) Advanced glycation end products and antioxidant status in type 2 diabetic patients with and without peripheral artery disease. Am Diabet Assoc 30(3):670–676
71. Kilhovd BK, Juutilainen A, Lehto S, Rönnemaa T, Torjesen PA, Hanssen KF, Laakso M (2007) Increased serum levels of advanced glycation endproducts predict total, cardiovascular and coronary mortality in women with type 2 diabetes: a population-based 18 year follow-up study. Diabetologia 50(7):1409–1417
72. Semba RD, Bandinelli S, Sun K, Guralnik JM, Ferrucci L (2009) Plasma carboxymethyl-lysine, an advanced glycation end product, and all-cause and cardiovascular disease mortality in older community-dwelling adults. J Am Geriatr Soc 57(10):1874–1880. https://doi.org/10.1111/j.1532-5415.2009.02438.x
73. Semba RD, Ferrucci L, Sun K, Beck J, Dalal M, Varadhan R, Walston J, Guralnik JM, Fried LP (2009) Advanced glycation end products and their circulating receptors predict cardiovascular disease mortality in older community-dwelling women. Aging Clin Exp Res 21(2):182–190
74. Koyama Y, Takeishi Y et al (2007) High serum level of pentosidine, an advanced glycation end product (AGE), is a risk factor of patients with heart failure. J Cardiac Fail 3:199–206 ISSN 1071-9164
75. University of Gothenburg (2019) AI study of risk factors in type 1 diabetes. ScienceDaily, 6 March 2019. www.sciencedaily.com/releases/2019/03/190306100629.htm. Accessed 30 Aug 2019
76. Assmann G, Cullen P, Schulte H (2002) Simple scoring scheme for calculating the risk of acute coronary events based on the 10-year follow-up of the prospective cardiovascular Münster (PROCAM) study. Circulation 105(3):310–315
77. Eeg-Olofsson K, Cederholm J et al (2010) New aspects of HbA1c as a risk factor for cardiovascular diseases in type 2 diabetes: an observational study from the Swedish National Diabetes Register (NDR). J Intern Med 268(5):471–482
78. Collaboration ERF (2012) C-reactive protein, fibrinogen, and cardiovascular disease prediction. N Engl J Med 367(14):1310–1320
79. Willeit P, Kaptoge S, Welsh P et al (2016) Natriuretic peptides and integrated risk assessment for cardiovascular disease: an individual-participant-data meta-analysis. Lancet Diabetes Endo 4(10):840–849
80. Alaa AM, Bolton T et al (2019) Cardiovascular disease risk prediction using automated machine learning: a prospective study of 423,604 UK Biobank participants. PLoS ONE 14(5): e0213653
81. Gæde P et al (2016) Years of life gained by multifactorial intervention in patients with type 2 diabetes mellitus and microalbuminuria: 21 years follow-up on the Steno-2 randomised trial. Diabetologia 59:2298–2307
82. Ni WJ, Tang LQ, Wei W (2015) Research progress in signaling pathway in diabetic nephropathy. Diabetes Metab Res Rev 31(3):221–233
83. Molitch ME, DeFronzo RA et al (2004) Nephropathy in diabetes. Diabetes Care 27(Suppl 1): S79–S83
84. Ballantyne FC, Gibbons J, O-Reilly DS (1993) Urine albumin should replace total protein for the assessment of glomerular proteinuria. Ann Clin Biochem 30(1):101–103
85. Makita Z, Radoff S et al (1991) Advanced glycosylation end products in patients with diabetic nephropathy. N Engl J Med 325(12):836–842
86. Antonetti DA, Klein R, Gardner TW (2012) Diabetic retinopathy. N Engl J Med 366 (13):1227–1239
87. Duh EJ, Sun JK, Stitt AW (2017) Diabetic retinopathy: current understanding, mechanisms, and treatment strategies. JCI Insight 2(14):e93751
88. Brownlee M (2005) The pathobiology of diabetic complications. Diabetes 54:1615–1625
89. Mishra N, Saxena S, Shukla RK et al (2015) Association of serum N-ϵ-Carboxy methlylysine with severity of diabetic retinopathy. J Diabet Complications 30:511–517

90. Choudhuri S, Dutta D, Sen A et al (2013) Role of N-ϵ-carboxy methyllysine, advanced glycation end products and reactive oxygen species for the development of nonproliferative and proliferative retinopathy in type 2 diabetes mellitus. Mol Vis 19:100–113
91. Fosmark DS, Torjesen PA et al (2006) Increased serum levels of the specific advanced glycation end product methylgyoxal-derived hydroimidazole are associated with retinopathy in patients with type 2 diabetes mellitus. Metab Clin Exp 55:232–236
92. Pusparajah P, Lee L-H, Abdul Kadir K (2016) Molecular markers of diabetic retinopathy: potential screening tool of the future? Front Physiol 7:200
93. Bhatia K, Arora S, Tomar R (2016) Diagnosis of diabetic retinopathy using machine learning classification algorithm. In: 2nd international conference on next generation computing technologies (NGCT), Dehradun, pp 347–351
94. Somasundaram SK, Alli P (2017) A machine learning ensemble classifier for early prediction of diabetic retinopathy. J Med Syst 41. https://doi.org/10.1007/s10916-017-0853-x

A Comparative Study of Performance Metrics of Data Mining Algorithms on Medical Data

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Abstract Computers have brought about significant technological improvements leading to the creation of enormous volumes of data, particularly in health care systems. The availability of vast amounts of data contributed to a greater need for data mining techniques to produce useful knowledge. Accurate analyzes of medical data are gaining early detection of illness and patient care with the increase of data in biomedical and health care communities. The data mining is one of the major approaches for developing sophisticated algorithms for classification of data. Some have castigated Data mining for not meeting all of the humanistic statistics specifications [5]. Classification of diseases is that one of the main applications of data mining and many important attempts have been made in recent years to improve the accuracy of the diagnosis of diseases through data mining. We used four prominent data mining algorithms such as Naive Bayes Classifier, K-Nearest Neighbors (KNN) Classifier, Artificial Neural Networks (ANN) and Support Vector Machine (SVM) algorithms to develop predictive models using that the ILPD (Indian Liver Patient Data Set) from the UCI Machine learning repository. For performance comparison purposes, we used the 10-fold cross validation method to calculate the estimation of six predictive models. We find that the support vector machine delivers the best results in a 74.82 percent accuracy classification and 56.55 percent accuracy of the Naive Bayes performed the worst. The performance metrics of classifiers were analyzed on medical dataset further sections below.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_139

Keywords Classification · Naive Bayes · KNN · SVM · ANN · ILPD · Data mining

1 Introduction and Literature Survey

Early detection of diseases accurately using supervised Classification Algorithms becomes easy to cure rather than critical stages. The classification techniques are extremely popular in various tools for an automated medical diagnosis. There is a significant increase in mobile devices that are used to track the body conditions of humans. With the aid of automated diagnosis methods for liver diseases it is possible to detect the disease at an early stage and it is easy to cure the disease, according to the SVM classifier.

Lung-Cheng reported that for the CDC Chronic fatigue syndrome dataset, Nave Bayesian classifier produces a high performance as compared to SVM and C4.5 [3]. Harper [2] stated that a single best classification method is not appropriate but that the best performing algorithm depends on the features to be evaluated. Sorich [1] stated that for the chemical datasets, SVM classifier produces the best predictive results. In this paper we demonstrate the efficiency of four data mining algorithms: Naive Bayes, KNN classifier, Support vector machines and ANN classifier algorithm [5].

2 Classification Algorithms

Supervised Learning techniques are popular in different clinical outcome predictions. A Classifier is a supervised learning approach for building classification models for a given data set. Classifiers are used for solving classification problems. Initially the Training Dataset is used to build a classification model and applied to the test data set which contains records of unknown labels. Below we introduce all the algorithms which we demonstrate further.

A. *Naive Bayes Classifier*
The Naive Bayes Classifier is the wellknown representation of the statistical learning algorithm. The Naive Bayes model is the massively simplified Bayesian probability model [13]. Naive-Bayes Algorithm uses the probability theory as an approach to the concept classification. Naive Bayes given its simplicity can often out perform more sophisticated classification methods [14]. Naive Bayes classifier are a group of Bayes Theorem based classification algorithms [9]. It is not a single algorithm, but a group of algorithms in which they all share a common concept, i.e. each pair of features is independent of each other. The classificator Naive Bayes works on a firm presumption of

independence [13]. It is very simple and demonstrates high precision and speed when used in large databases.

This assumption is called independence conditional probability by class. Using a few statistical tests such as Chi-squared and mutual knowledge tests, we can find the relationships of conditional independence among the features and use these relationships as constraints to create a Bayesian network.

B. *K-Nearest Neighbors (KNN) Algorithm*

KNN are also known as K-Nearest Neighbors is one of the simplest supervised Machine Learning algorithms which is mainly based on the feature similarity, it is mainly focused on the classification problems in the industry. That is, it classifies a data point based on the classification of its neighbours. KNN stores all available cases and classifies new cases based on a similarity measure from the existing ones. KNN algorithm is a commonly used algorithm as it is known for its easy interpretation, effectiveness in predicting and low calculation time. In the KNN algorithm the value of "k" is a factor that refers to the number of neighbors closest to include in a majority voting process. Choosing the correct value of "k" is a process called Parameter Tuning and for greater accuracy it is necessary. When the data is labeled the noise free and the data set is small the KNN algorithm is well used.

This algorithm also allows Euclidean Distance to be determined to find the nearest neighbors of the unknown data point from all the points in the data set [12]. The most common classification is contained in the data set from the samples, so that this classification is applied to the new sample.

C. Support Vector Machine (SVM)

Support Vector Machine is defined in the supervised approach of the machine learning which is used mainly in the classification. SVM manages the data sets to sort the data into one of the groups. In this process, every element is represented as a point in the given data set that is plotted in n-dimensional space. The value of each characteristic reflects the value of a particular plane coordinate. Here, n is the number of data set functions. Then, [9] classification is performed to find the appropriate hyper plane which differentiates between the two classes of support vectors. Support Vectors in the plane are simply the coordinate points which represent the individual observation of data items in a given set of data. For the given support vectors, the primary objective in the classification is to identify the right hyper plane to distinguish the two groups better. Generally speaking, when the distances between the nearest point or class and the hyper-plane are maximized, the right hyper-plane is well regarded. The difference is called margin. SVM is therefore a boundary the better distinguishes the two support vector groups. The benefits of using SVM are that it supports High-Dimensional Input Space, Sparse Document Vectors and Parameter Regularization.

D. Artificial Neural Networks (ANN)

Artificial neural networks are widely known to biologically influence highly refined analytical techniques, and are capable of modeling nonlinear functions

that are extremely complex [6]. Formally developed analytical techniques are focused on learning processes in the mental system and neurological functions of the brain, and are able to predict new observations after a phase of so-called learning from existing data. We now used a common ANN architecture called multilayer (MLP) in the paper with back propagation. The multilayer is sometimes colloquially referred to as "neural networks" especially when they have a single hidden layer. The back Propagation Algorithm is a multilayered Neural Networks for learning the rules credited to Rumelhart and McClelland.

3 Methodology

3.1 Identify Data Set

We used the dataset from UCI Machine Learning data repository named as Indian Liver Patient Data to implement research experiments mentioned in the paper below. The ILPD data set consists of 416 records of liver patients with the disorder and 167 records of patients with no illness. This data set comprises 11 attributes and is considered one of Andhra Pradesh most comprehensive data sets.

3.2 Understand and Clean the Data

Data acquisition and pre-processing is important step in data mining process. In this paper, we understand the distribution of each variables, if the distribution of variable not good we use log transformation on that variables. The data for the ILPD contained an 583 instances with 11 features. The design matrix of the Dataset given I the following Table 1:

This study shows that the distribution of the other variables did not change significantly. For example, the histograms shown in Fig. 1 below show the distribution plot before deletion, and Fig. 2 shows the distribution plot after the records have been deleted. Comparing the two plots we find that there is no Comparing the two plots, we find that there is no significant change in the age attribute distribution and the Total Bilirubin attribute before and after these missing valued records are deleted.

Table 1 Dataset description

Dataset	Design matrix size	Features names
Indian Liver Patient Dataset	583 * 11	Age, Sex, Total Bilirubin, direct Bilurubin, Alkaline, Sgpt, Alanine Aminotransferase, Aspartate, all Protein, Albumin, A/G Ratio etc.,

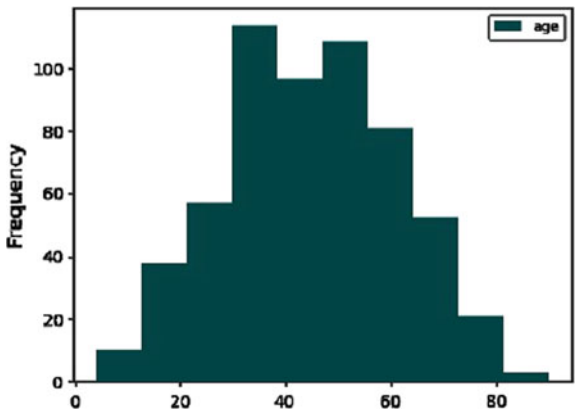

Fig. 1 This figure shows the histogram of the distribution of the age variable before deleting the missing data from the data set

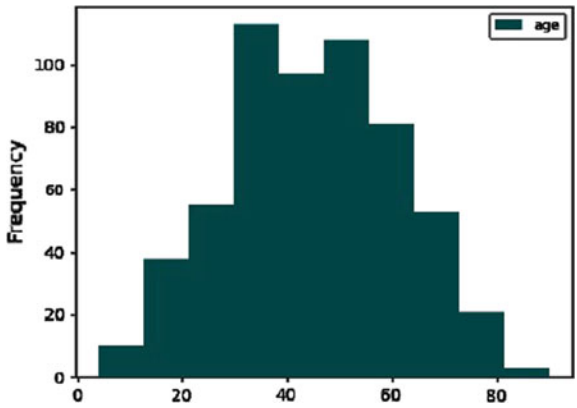

Fig. 2 This figure shows the histogram of the distribution of the age variable after deleting the missing data from the data set

3.3 Select Features and Model Building

Learning Accuracy or other performance of a Classifier depends on the data and significant diversity in identification of important features. When trying to improve the performance of a classifier we need better features. Select the best features and if it is significant, remove high correlated features with target class label. Select a subset of features which retains most of the relevant information. Select the significant feature subset and build a model using data mining classification algorithm, Create training data set and test data set based on the feature subset, Train the classifier with the training data set, Find accuracy or other performance metrics with validation data set, repeat for all feature subsets and select the best feature subsets which leads to improve the predictive accuracy of the classifier.

3.4 Performance Metrics

We evaluate the performance of different data mining algorithms on medical dataset using the following metrics

(1) ***True positive rate:*** *The ratio of Positive examples estimated correctly by the classifier*

$$TPR = \frac{True\ Position}{True\ Position + False\ Nagative} \tag{1}$$

where

True Positive = the set of positive examples correctly estimated by classification model

False Negative = the set of positive examples wrongly estimated by classification model

(True Positive + False Negative) = Total set of test results for the model being considered *2)* ***True Negative Rate***: The fraction of negative examples predicted correctly by the model

$$TNR = \frac{True\ Nagative}{True\ True\ Nagative + False\ Positive} \tag{2}$$

where

True Negative = the set of negative examples estimated correctly by the classifier

False Positive = the set of negative examples predicted as positive.

(True Negative + False Positive) Total set of test results for the model being considered

(2) **Accuracy:** The fraction of number of correct predictions and Total number of predictions

$$\text{Accuracy} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{TN} + \text{FP} + \text{FN}} \tag{3}$$

K-fold Cross Validation: Dealing bias and Variance Problems which are associated with the training data set and testing data set. To avoid the variance problem take number of training examples should be at least 10 times the number of variables. This system the complete was divided into approximately equal size of k

Table 2 Classification of various algorithms on the data sets

Mean of ten-fold cross validation				
S.No.	Name of classifier	Accuracy	Sensitivity	Specificity
1	Artificial neural networks	0.5559	0.8621	0.3493
2	Naive Bayes classifier	0.6878	0.2943	0.8756
3	Support vector machines	0.7077	0	0.9975
4	K-nearest neighbors	0.6766	0.3132	0.8197

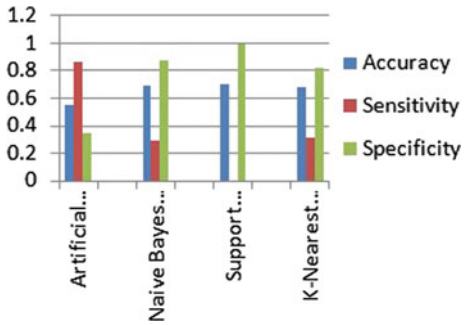

Fig. 3 Performance Metrics on Different Algorithms

subsets. The "k" times must be trained and tested in the classification model. In this analysis the 10-fold cross validation approach is used to estimate the efficiency of classifiers. The whole is split into 10 mutually exclusive subsets in 10-fold cross validation process. We then average the results obtained from the data (Fig. 3).

Classification Results and Future Scope: In this paper, we evaluate the performance of different data mining algorithms on clinical data using different metrics such as Accuracy, True Positive Rate and True Negative Rate. We obtained better results from Support Vector Machine, Artificial Neural Networks. In future, we use Ensembles and Deep learning algorithms on medical data (Table 2).

References

1. Sorich MJ, Miners JO, McKinnon RA, Winkler DA, Burden FR, Smith PA (2003) Comparison of linear and nonlinear classification algorithms for the prediction of drug and chemical metabolism by human UDP-glucuronosyltransferase isoforms. J Chem Inf Comput Sci 43(6):2019–2024
2. Paul R, Harper A (2005) A review and comparison of classification algorithms for medical decision making. Health Policy 71(3):315–331
3. Huang L-C, Hsu S-Y, Lin E (2009) A comparison of classification methods for predicting Chronic Fatigue Syndrome based on genetic data. J Transl Med 7(81)
4. Cios KJ, Moore GW (2002) Uniqueness of medical data mining. Artif Intell Med 26:124
5. Haykin S (1998) Neural networks: a comprehensive foundation. Prentice Hall, New Jersey

6. Yu H, Kim S (2012) SVM tutorial: classification, regression, and ranking. In: Handbook of natural computing
7. Rish I (2001) An empirical study of the Naive Bayes classifier. In: IJCAI workshop on empirical methods in AI
8. Altman NS (1992) An introduction to kernel and nearest-neighbor nonparametric regression. Amer Stat 46(3):175–185
9. Berman JJ (2002) Confidentiality issues for medical data miners. Artif Intell Med 26:25–36
10. Burke HB, Goodman PH, Rosen DB, Henson DE, Weinstein JN, Harrell FE Jr et al (1997) Artificial neural networks improve the accuracy of cancer survival prediction. Cancer 79:857–862
11. Al-Sharafat WS, Naoum R (2009) Development of Genetic-based machine learning for network intrusion detection. World Acad Sci Eng Technol 55: 20–24
12. Eyheramendy JJ, Lewis D, Madigan D (2003) On the Naive Bayes model for text categorization. In: proceedings artificial intelligence statistics

Sentiment Classification on Online Retailer Reviews

Kolli Srikanth, N. V. E. S. Murthy, and P. V. G. D. Prasad Reddy

Abstract Sentiment Classification is a continuing area of research in text mining. Sentiment Analysis the automatic representation of the ideas, emotions and subjectivity of text, whose purpose is to define the polarity of the content of text, and opinion of the expresses in the form of binary ratings such as likes or dislikes, or a more granular set of choices, such as a 1 to 5 rating. This paper focuses primarily on high-level, end-to-end workflow to solve text classification problems using machine learning algorithm such as Naive-Bayes classifier for text classification issues to mining opinions and Amazon User Reviews.

Keywords Sentiment analysis · Text classification · Machine learning · Opinions mining · Naive Bayes Classification · Amazon Product Reviews

1 Introduction

Much of the world's data is in the form of free-text some forms are Small in tweets, Medium in emails, product reviews, and largely in documents and Very largely in books [1]. Some Applications of Text Analytics used in Search engines, Spam classification, News feed management, Document summarization, Language translation and Speech-to-text conversion.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_140

Analysis of sentiment involves opinion mining analyze Twitter Reviews on movies and explore the opinion of the new arrival of Puma shoes from Wal-Mart store review.

Various Un-Structured Data Sources like Blogs and discussion forums, as well as news sources of information, are commonly used in Text mining. These Data Sources are important in communicating people's opinions about a particular topic and product.

The purpose of the work is to identify the customer's reviews on Amazon Product Reviews under Baby Products Category. Our dataset consisting of customer reviews on baby products category sized 56,714 reviews.We extracted the features of our dataset and build supervised models on that.

We categorize this paper as follows. The first section of this paper describes introduction to Text Classification, Identify the Product Reviews, Extraction of Features from reviews and construct structured data in the feature extraction process and select features and analyze distribution.

2 About Dataset

Samples from "Amazon Products Reviews of the Data Set" from Table 1.

Table 1 Samples from "Amazon Product Reviews Data Set"

Product name	Review
Ju-Ju-Be Clear Plastic Zipper Pouch, Shuttle Mess	Haven't used it a lot, but if we need to store a dirty shirt while were out, it's always there
BABY BJORN Baby Carrier Original, Black, Cotton	I really love this product. It's an awesome mesh material so after use it's easy to air out. My baby boy was born in January so unfortunately with all the snow and cold we couldn't use it much at first. During the winter months we used it around the house several times and are just beginning to use it outdoors for walks and short hikes. He is now 5 months old and on the heavier side a bit but this product still works fantastically. It has a terrific back support. I was afraid that I would not be able to get my child in and out of it without another person's help, but that is not the case! I highly recommend this product!!!

3 Sentiment Classification Process

Overall process of Sentiment Analysis [2] process is below Fig. 1.

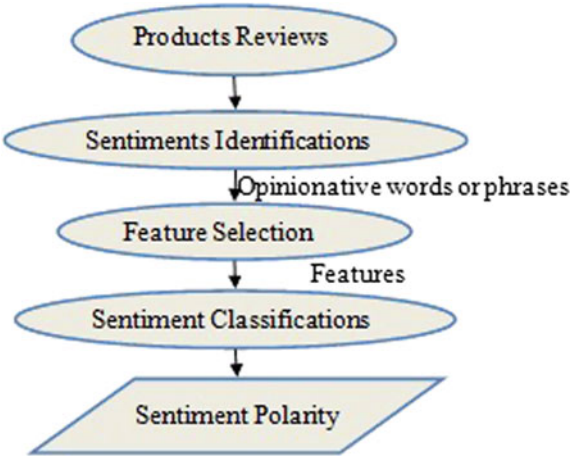

Fig. 1 The process of sentiment analysis on product reviews

4 Text Data Analysis

In this Text Data analysis process we inspect data, apply various text pre-processing techniques like data cleaning, and transform Un-Structured data into structured data.

4.1 Text Mining Pre-processing

Text-mining pre-processing is the initial step of text mining [3] which reads and processes one text document at a time. This step splits up into three key subtasks.

Pre-processing of the text reviews:

1. Confronted with a raw text document, the first step is to stemming.
2. Stop Words Removal with irrelevant text documents.
3. When, and, then, who, then, they, theirs, a, or so on are examples of stopping words that must be eliminated.
4. Remove unusual words like that are extremely rare using "tf-idf" measure.
5. The corpus of n-documents is based on tf-idf (term frequency/inverse frequency of document) score.
6. This can be calculated by using following formula

$$\text{Tf-idf} = \text{fij} * \log(\text{n}/\text{dj})$$

fij = word j (relative) frequency in document i
n is document number
dj the number of documents looping word j

4.2 Tokenization

Text document generally contains multiple sentences. So the whole sentence is divided into words by deleting comma, spaces, punctuations, etc.

4.3 Stop Words Removing

This process removes words like “the,” “are,” “a” or tags such as HTML tags etc.

4.4 Stemming

Stemming is applied after deletion of the word stop by reducing the word to its root. For example, “play” and “play” are stemmed into “play.”

4.5 Text Transformation

The transformation of the text has the function of translating the text document into words in order to be usable for further processing.

5 Feature Extraction

The latest state of the art is the study of phrasing counts from text documents.

6 Feature Selection

It performs the removal of features considered to be unrelated for mining purposes.

7 Pattern Discovery or Analyze Distributions

Discovery of patterns is one of the significant processes that use pattern discovery methods. Classification of Product Reviews using Naive bayes classifier [4].

8 Model Building

In this Paper we build model using Naïvebayes Classifier on training data and validate on test data [5].

Input:
Labeled Data = labeled data (Product Name, Review)

Output:
Accuracy of Classifier and Misclassification Error

1. Load labeled data Product Name and Review
2. Preprocessed data
   TOKENIZATION:
   STOP WORDS REMOVING:
   REMOVE STEMMING WORDS:
   TEXT TRANSFORMATION:
3. for every tf-idf
4. Extract features and generate Bag of Words
5. Model Building on training using Naive.classifier.train() &
6. validate on testing set()
7. Accuracy = Classifier.accuracy()
8. Majority voting(accuracy) using vote classifiers

8.1 Training Data

We can split the data set into the training and testing [5]. In this paper, we split our dataset into 70% of training data. Applied Naive-bayes Classifier on training data and validate on test data.

8.2 Testing Data

In data set remaining 30% are considered as Testing Data Mining. Testing Data Mining is given to the model after training data output will be obtained. Both training and testing data result will be approximately equal.

9 Result

Result for the project is both training and testing data outputs. Both will be approximately equal then data set is fitted to the model [6].

In this paper we were compare our model results with different machine learning algorithms [6] such as the Multinomial naive Bayesian (MNB) on different categories of amazon Product Categories (Fig. 2).

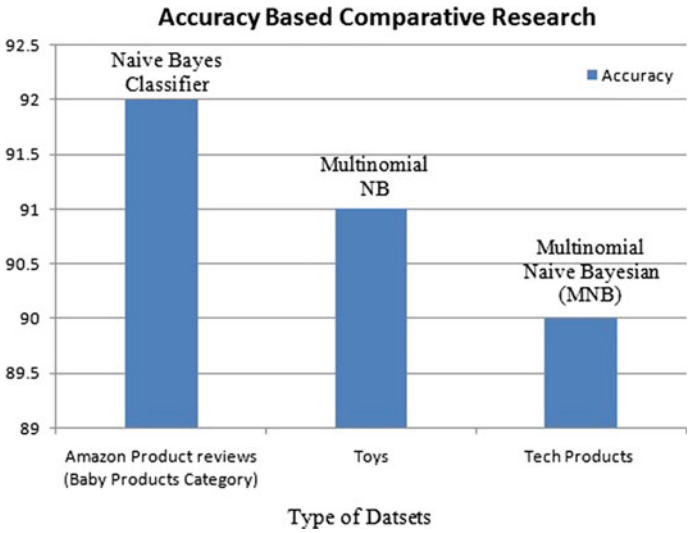

Fig. 2 Performance metrics of the classifier accuracy

Here we implement Sentiment Analysis on Baby product Category reviews and obtained Polarity of the review is Positive or Negative with Naïve Bayes Classification Algorithm [6]. The Performance Metrics of the Classifier Accuracy and Misclassification error presented in Table 2.

Table 2 Accuracy-based Comparative research

Dataset	Classifier	Accuracy	Misclassification error
Amazon Product Reviews (Baby Products category)	**Naive Bayes Classifier**	**92%**	**0.8**
Toys	Multinomi al NB	91%	0.9
Tech Products	Multinomial naive Bayesian (MNB)	90%	1

10 Conclusions/Implecations

This study examined the sentiment classification performance using Naive Bayes Classifier particularly on online retailer like Amazon baby product reviews and getting the polarity of the review with 92% Accuracy. In future we verify the Sentiment Analysis using other machine Learning Ensembles and deep learning algorithms on different categories of Products.

References

1. Yu L-C, Wu J-L, Chang P-C, Chu H-S (2013) Using a contextual entropy model to expand emotion words and their intensity for the sentiment classification of stock market news. Knowl Based Syst 41:89–97
2. Xu T, Peng Q, Cheng Y (2012) Identifying the semantic orientation of terms using S-HAL for sentiment analysis. Knowl Based Syst 35:279–289
3. Maks I, Vossen P (2012) A lexicon model for deep sentiment analysis and opinion mining applications. Dec Support Syst 53:680–688
4. Djaballah KA, Boukhalfa K, Boussaid O (2019) Sentiment analysis of Twitter messages using Word2vec by weighted average. In: Sixth international conference on social networks analysis, management and security (SNAMS)
5. Guner L, Coyne E, Smit J (March, 2019) Sentiment analysis for Amazon.com reviews. https://www.researchgate.net/publication/332622380
6. Haque TU, Saber NN, Shah FM (2018) Sentiment analysis on large scale amazon product reviews. In: 2018 IEEE international conference on innovative research and development (ICIRD)

Effect of Excessive Alchol on Liver: A Comprehensive Approach Using Machine Learning

Pativada Rama Santosh Naidu and Golagani Lavanya Devi

Abstract Long-term use of alcohol can cause liver damage, leading to liver disease such as fatty liver, alcoholic hepatitis, and cirrhosis. Gastrointestinal problems, including pancreatitis and gastritis, can also be side effects of excessive drinking, as can various cancers and cardiovascular diseases complications, such as myocardial infarction, atrial defibrillation, alcoholic cardiomyopathy, and hypertension. Long-term misuse of opioids can lead to respiratory infections, constipation, damage to the liver and kidneys, sexual dysfunction and heart lining infections Both alcohol and opioid addiction can be associated with sleep problems and psychiatric disorders such as depression and anxiety. Alcohol overuse is believed to damage the liver for many years. When the person consumes too much alcohol, the liver of the person begins metabolizing the alcohol so the poison can be released from his or her body. Alcohol is metabolized before other drugs and the liver will work very hard to perform its tasks if a person drinks large amounts of alcohol. Some or no evidence of alcohol-free steatohepatitis is present at these early stages. Gradually, over the period, the patients start to experience boredom, weight gain, and helplessness. Here I build a Python based Machine Learning model that integrates blood tests deemed prone to liver disorders, which may result from excessive drinking of alcohol and comparing it with the amount of alcoholic drinks consumed every day.

Keywords Logistic regression · Gradient boosting classifier · Random forest classifier · K-nearest neighbor classifier · Mcv (Mean corpuscular Volume) · Alkphos (Alkaline phosphatase) · Sgpt (Alamine aminotransferase) · Sgot (Aspartate aminotransferase) · Gammagt (Gamma-glutamyl transpeptidase)

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_141

1 Introduction

In the age of free access to cheap alcohol to anyone above 21 and lenient rules for younger children consuming alcohol [1], we are coming across cases of liver damage, liver failure or other liver disorders among the masses at very young age. It's the need of the hour to address people what liver disorders excessive consumption of alcohol can lead to as well as how much alcohol consumption is excessive and can lead to serious repercussions.

Key Features:

1. Working with UCI Machine Learning Repository datasets.
2. Complex medical problem statement solved using machine learning.
3. 4 supervised learning techniques used with extensive mathematical and graph comparison to yield the best solution.
4. Average Accuracy = 78.611%
5. User friendly machine learning model for users to predict whether they might be suffering from liver disease or not.

2 Background and Related Work

Liver disorders dataset is one of the most popular datasets on UCI Machine Learning Repository [3].

There are seven attributes. The first 5 factors are all blood tests that are known to be prone to liver problems that may result from heavy alcohol use. Each line in the bupa.data file constitutes a single male record. They are broadly defined as follows (Tables 1 and 2):

Table 1 Attribute information

No	Name	Description
1	Mcv	Mean corpuscular Volume
2	Alkphos	Alkaline phosphatase
3	Sgpt	Alamine aminotransferase
4	Sgot	Aspartate aminotransferase
5	Gammagt	Gamma-glutamyl transpeptidase
6	Drinks	No of half pints equivalents of alcoholic beverages drunk per day
7	Selector	Field used to split data into 2 sets

Table 2 Detailed description of attributes is as follows

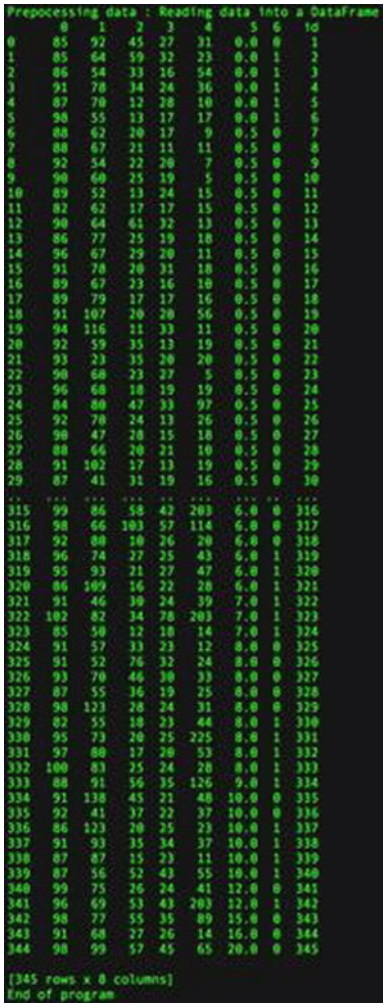
Mean corpuscular volume (mcv)	The scale of your red blood cells is determined by a MCV blood test. It can mean blood disorder if the blood cells are too small or too large
Alkaline phosphatase (Alkphos)	A measurement of ALP tests the blood ALP amount. ALP is a bodywide protein, but is located predominantly in the liver, bones, kidneys and digestive tract
Alamine aminotransferase (Sgpt)	The ALT test measures your blood levels of the ALT. ALT test (ALT). ALT is a liver-based cell based enzyme. High ALT levels aid in the treatment of hepatic problems
Aspartate aminotransferase (Sgot)	In the AST blood test, the AST amount is measured. AST levels increase if the tissues and cells in which the enzyme is contained are harmed
Gamma-glutamyl transpeptidase (Gammagt)	Gamma-glutamyl transpeptidase (GGT) tests the blood's quantity of GGT enzyme. GGT is concentrated in the liver and blood levels of GGT are generally high in the case of damage to the liver

3 Methodology

We are predicting whether drinking affects liver diseases (0) or not (1), so we'll be using machine learning algorithms to predict this value. The language used to code the problem statement is Python 2 and Python libraries used for machine learning are sklearn, matplotlib, pandas and numpy. The Step-wise breakdown of solution is given as follows:

1. Data Pre-Processing:
First, we will read "bupa.data" [4] dataset file into a data frame. A data framework is a two-dimensional data structure, i.e., data in rows and columns is aligned in a tabular way. Since, the 7th attribute is a selector attribute we drop it in data pre-processing and put labels on each column. We also attach an id to each row as part of data pre-processing. We do this by calling "data_preprocessing ()" function in the code (Fig. 1).

Fig. 1 Observation of dataset as data frame



2. Check if attributes are independent:

It's very crucial to realize that all features selected for prediction must be IID (Independent and Identically Distributed).

For e.g. Features such as height of a man and weight of a man might not be always independent but features such as height and color of a man will always be independent.

We draw Scatter plots for all possible features compared with each other. All the graphs are shown below. We use GRAPH_CLASS () to draw all graphs in code.

3. Realizing Trends of Features:

As observed from Fig. 2, We can see that all the features are independent of each other and form an independent and identically distributed space (Figs. 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 and 16).

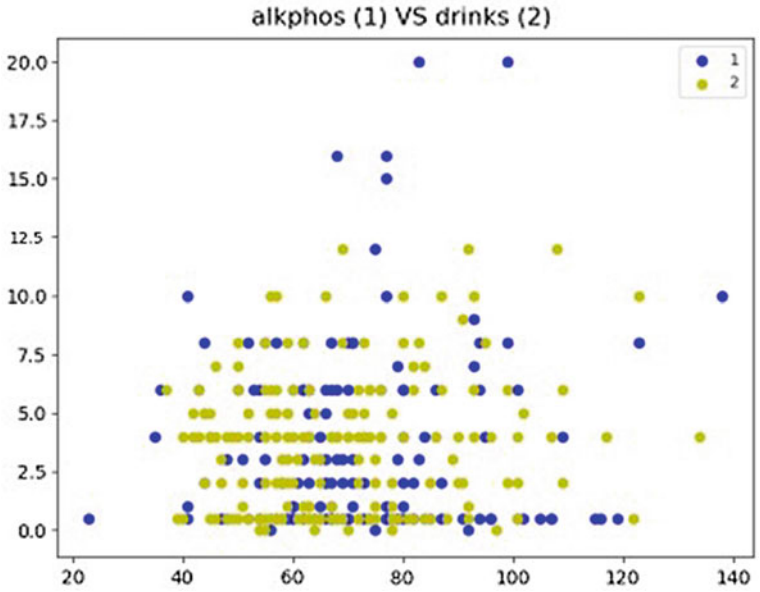


Fig. 2 Alkphos (1) vs drinks (2)

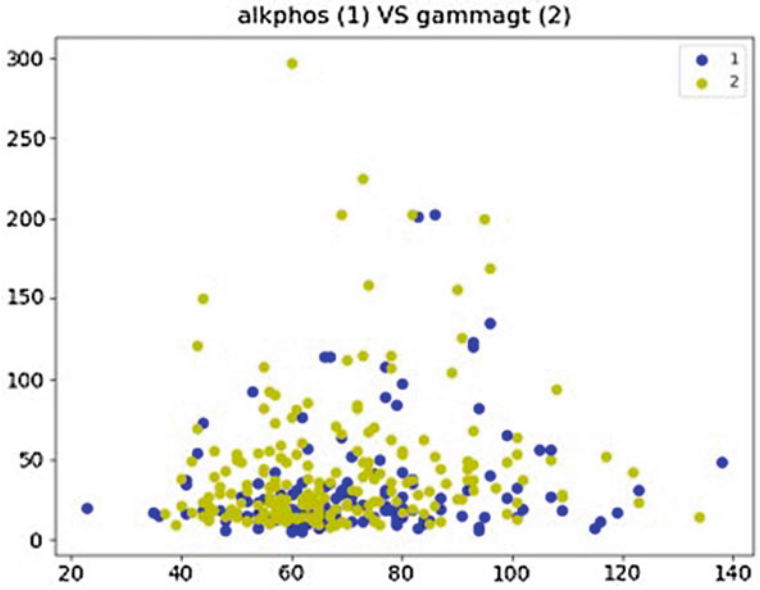


Fig. 3 Alkphos vs gammagt

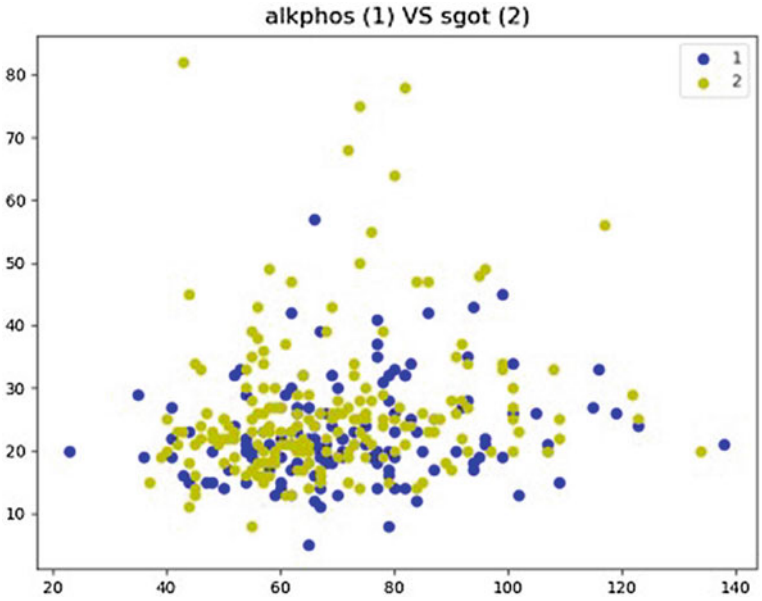


Fig. 4 Alkphos vs sgot

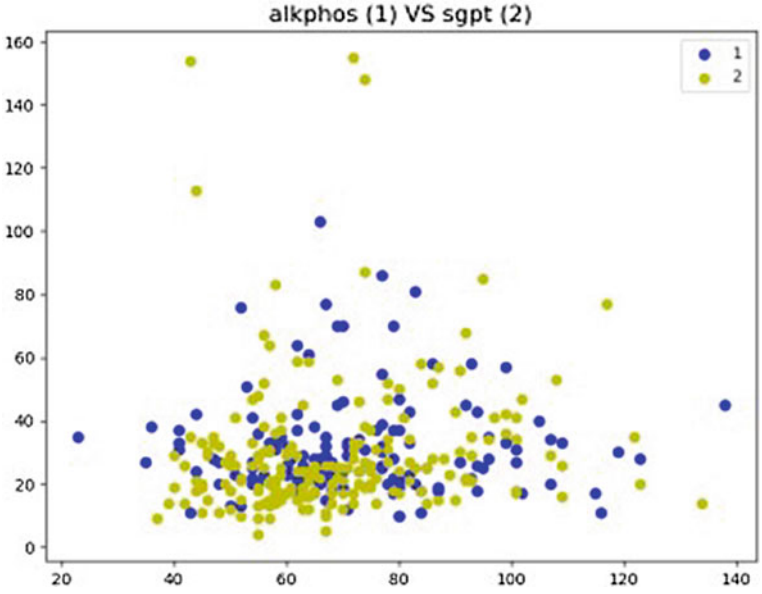


Fig. 5 Alkphos vs sgpt

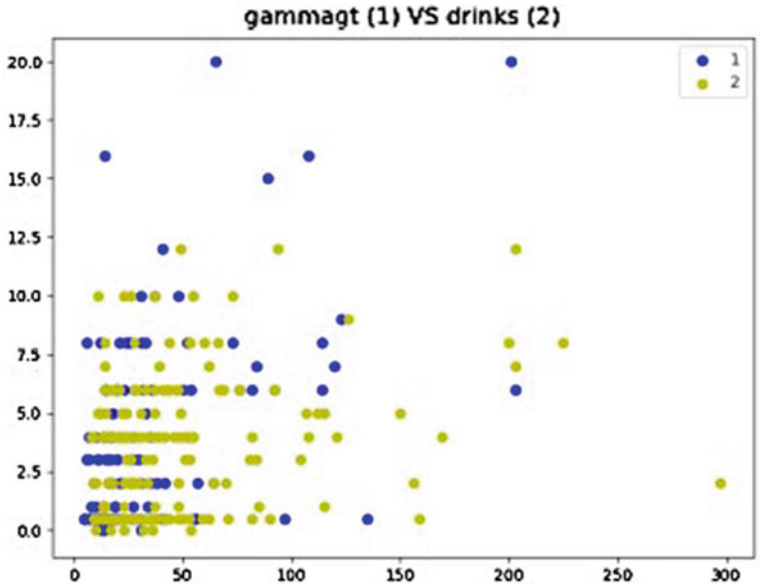


Fig. 6 Gammagt vs drinks

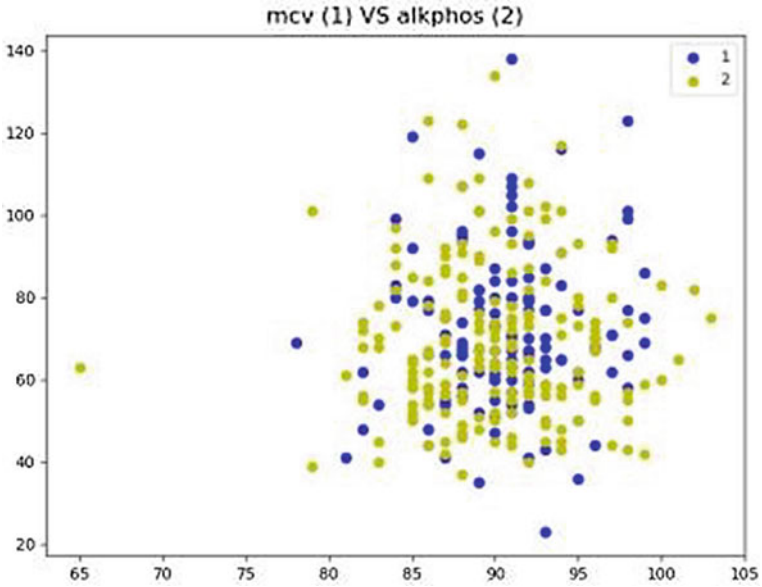


Fig. 7 Mcv vs alkphos

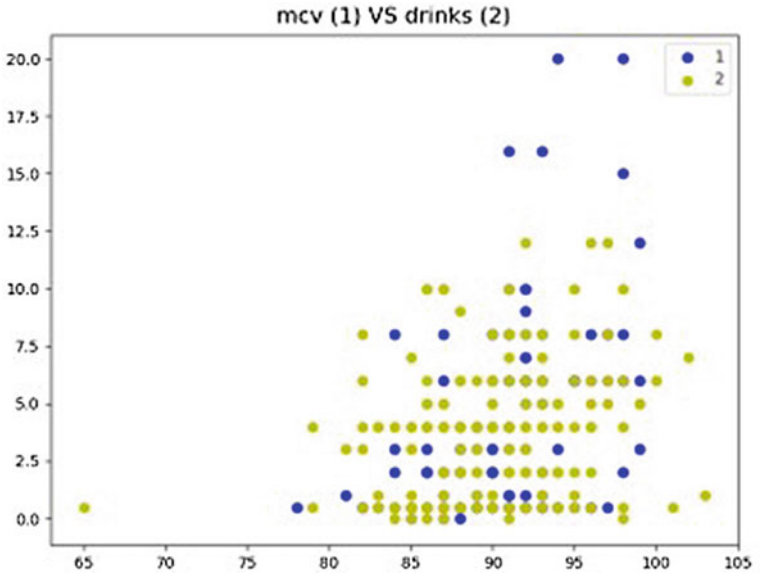


Fig. 8 Mcv vs drinks

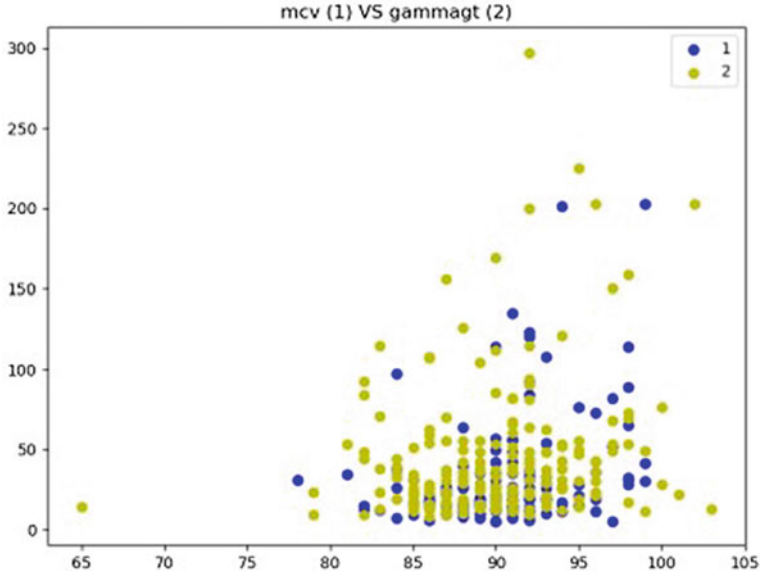


Fig. 9 Mcv vs gammagt

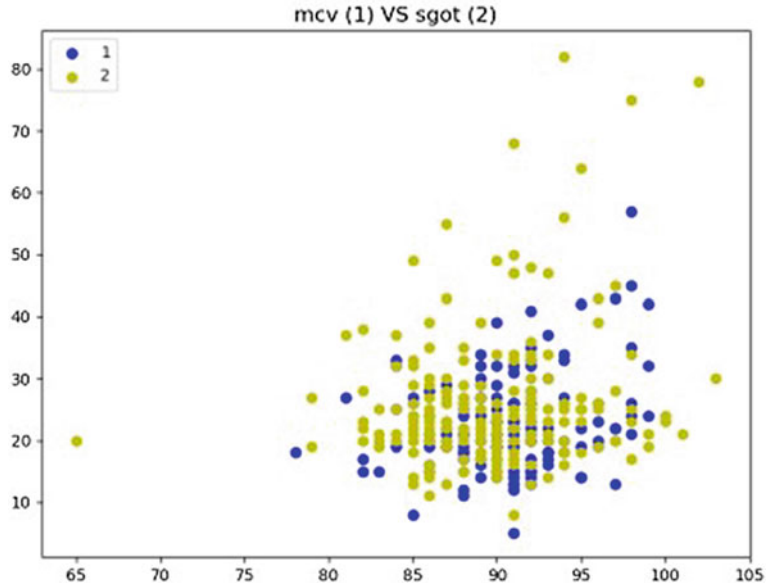


Fig. 10 Mcv vs sgot

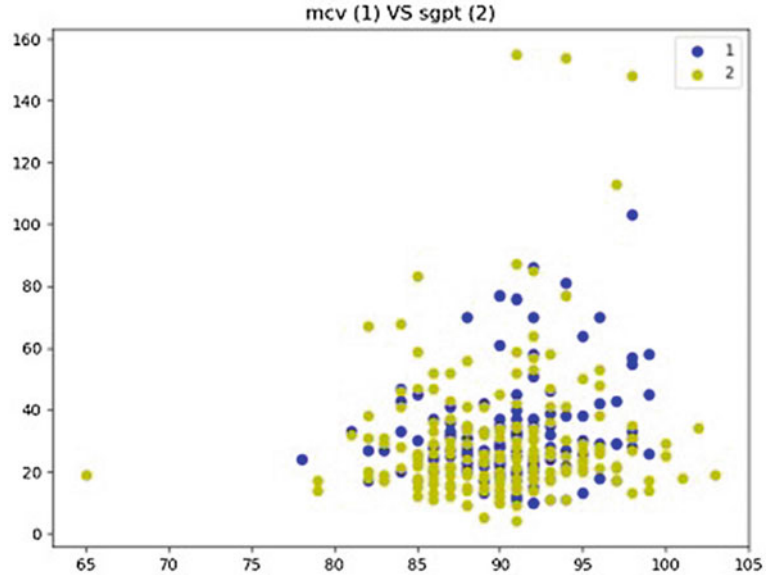


Fig. 11 Mcv vs sgpt

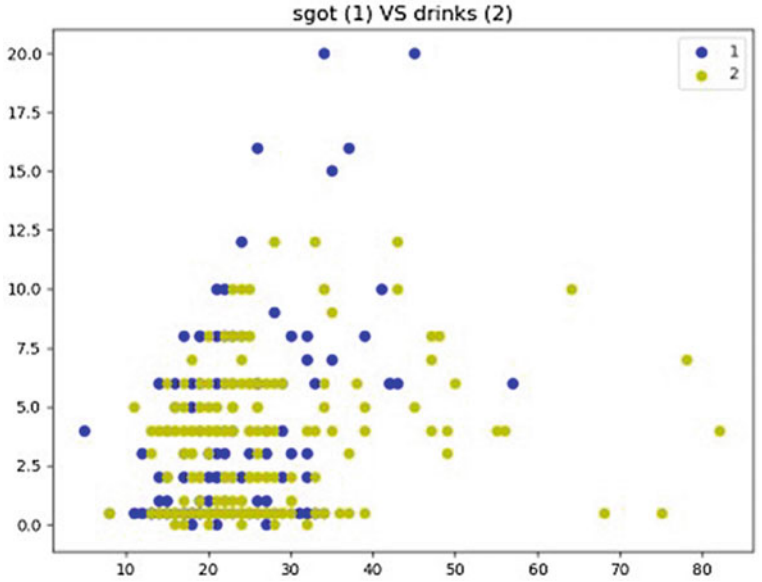


Fig. 12 Sgot vs drinks

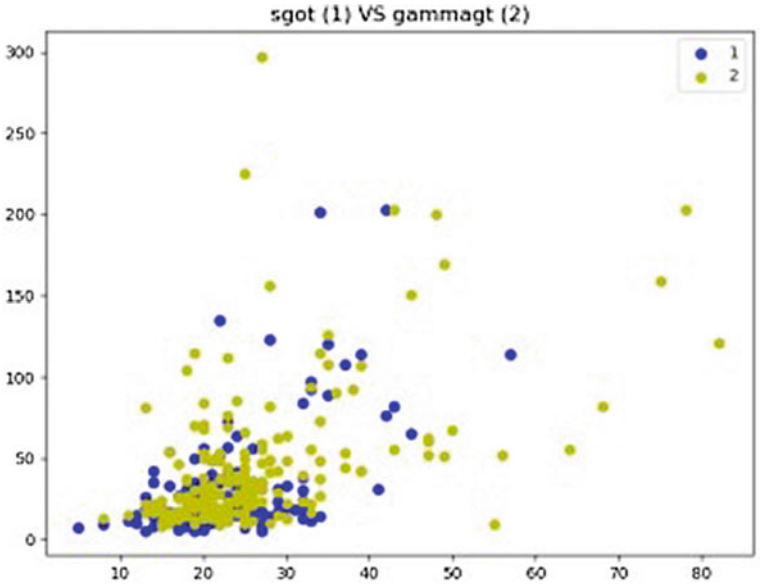


Fig. 13 Sgot vs gammagt

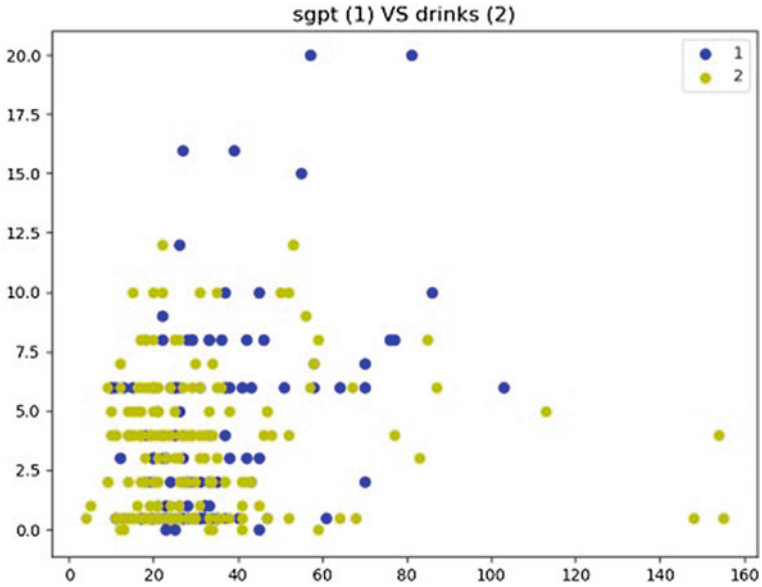


Fig. 14 Sgpt vs drinks

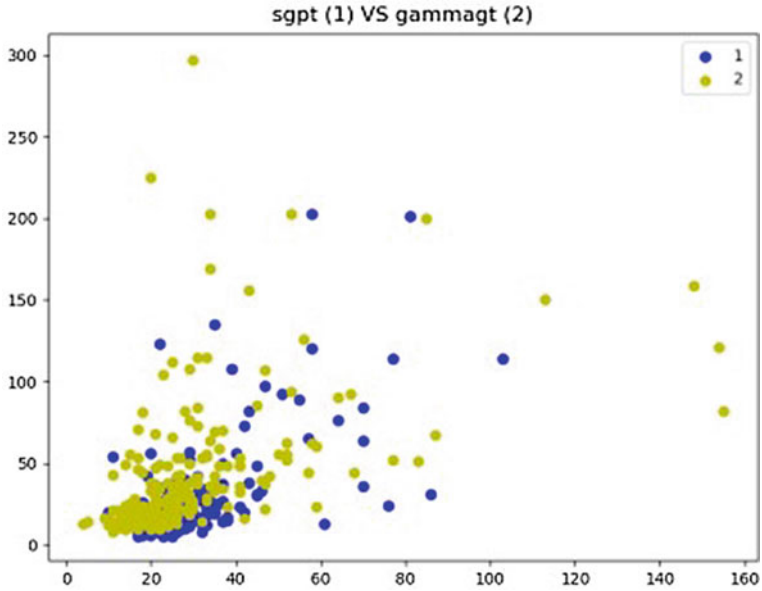


Fig. 15 Sgpt vs gammagt

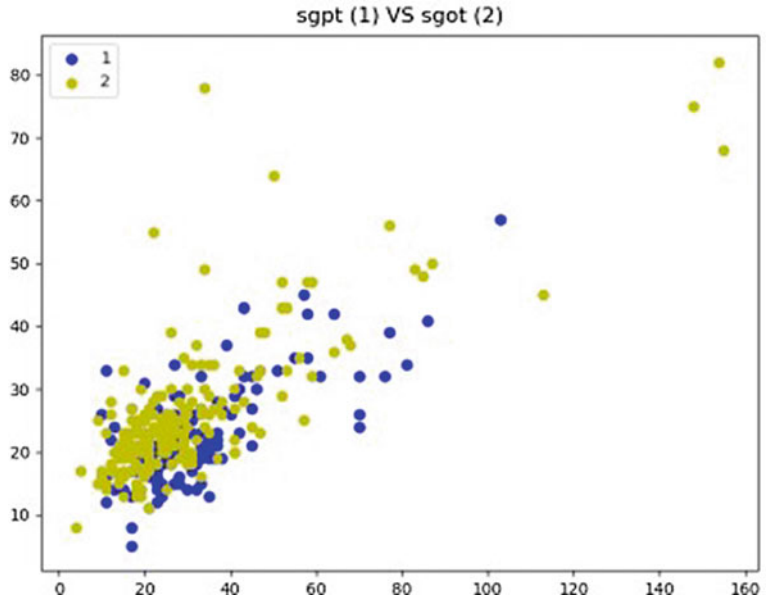


Fig. 16 Sgpt vs sgot

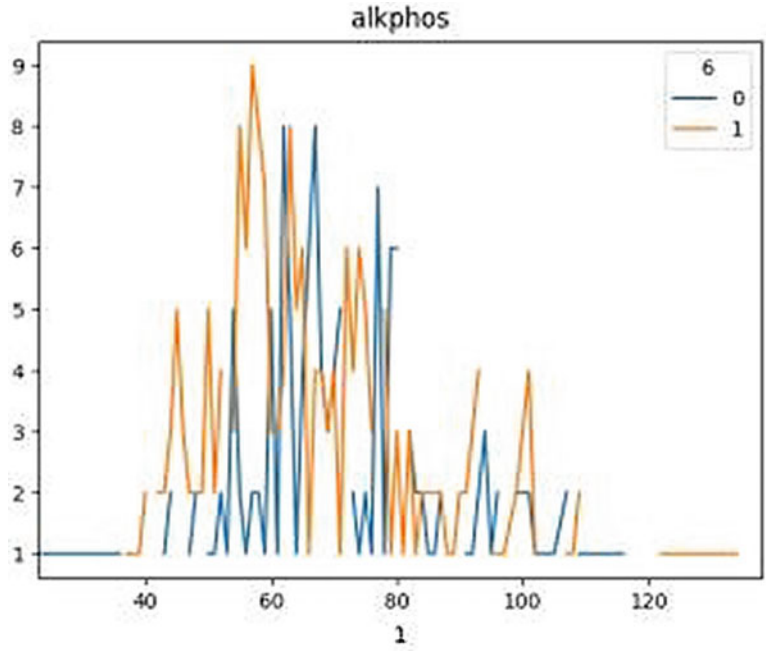


Fig. 17 Alkphos

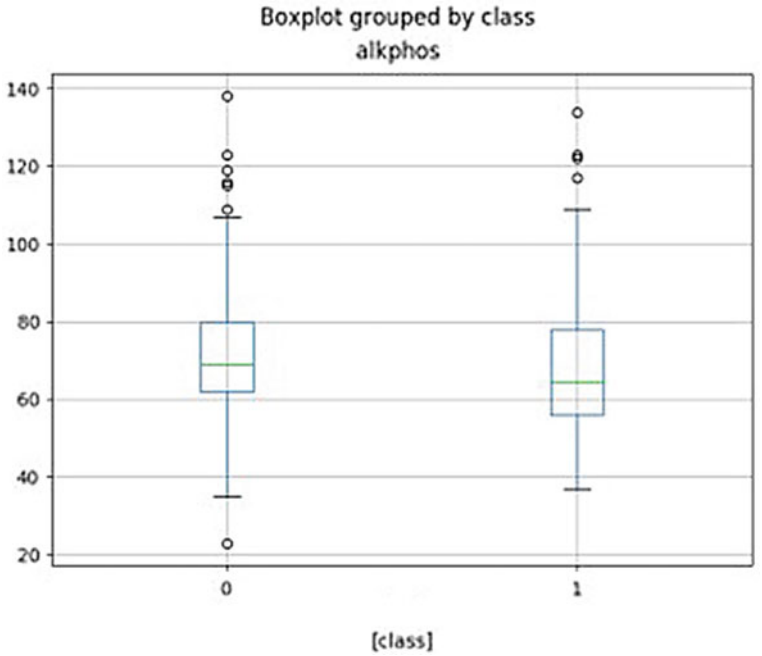


Fig. 18 Boxplot grouped by class alkphos

The most important question encountered while building a machine learning application is the choice of the algorithm used. Different algorithms have different behavior and accuracy. It also largely depends on the datasets as well (Figs. 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27 and 28).

For e.g. Support Vector Machines (SVM) comes in handy for small datasets while sometimes a simple linear regression program beats other complex neural networks. Since This is such an integral part of this program, we will draw the graph and box plots of each class to realize their concentration, distribution, behavior, etc. All the graphs are plotted using CLASS_PLOT () and all the box plots are plotted using BOX_PLOT (). All the graphs (class wise) are shown as below:

The observations from graph analysis is:

a. It can be observed that all the features are sparsely populated throughout the feature space. Hence, we need machine learning algorithms that take in account the entire range.
b. At the same time, every features attains a nonsmooth bell curve. This bell curve has a maximum value where the data is most concentrated.
c. Also, most of these test results when high results in positive diagnose of liver diseases and disorders.

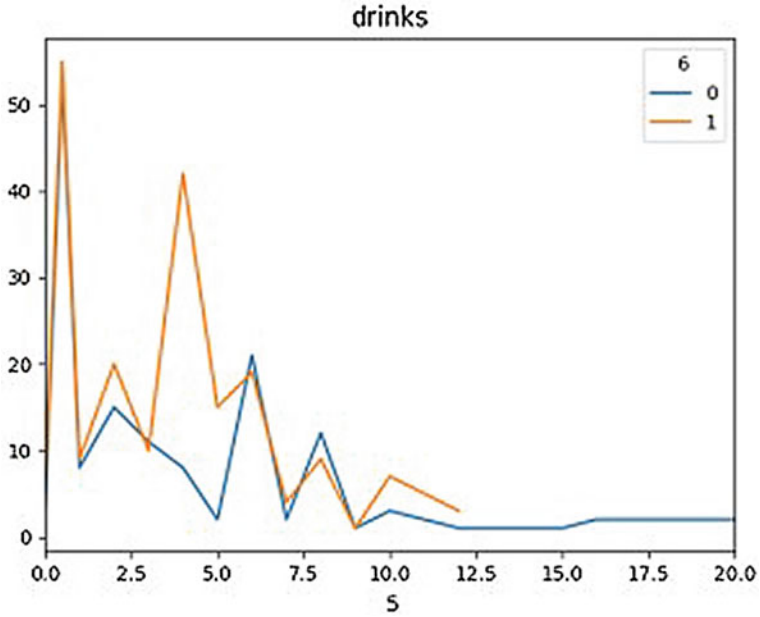


Fig. 19 Drinks

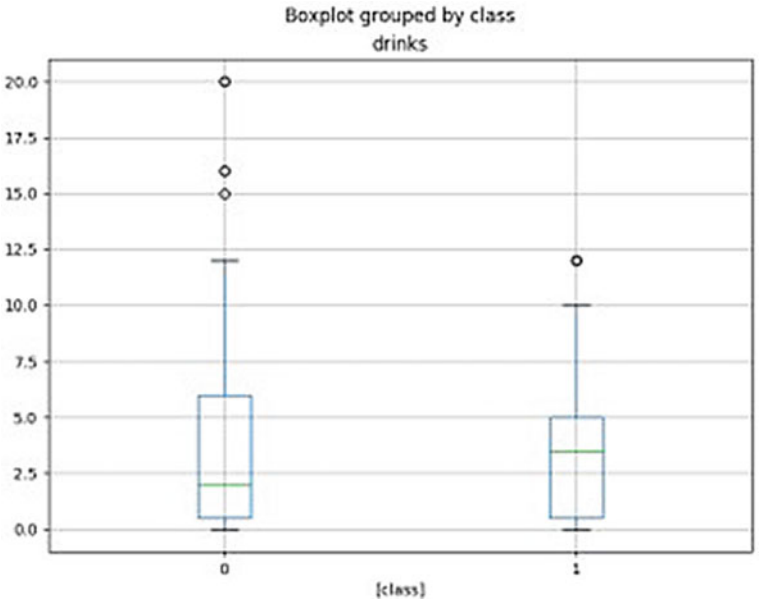


Fig. 20 Boxplot grouped by class drinks

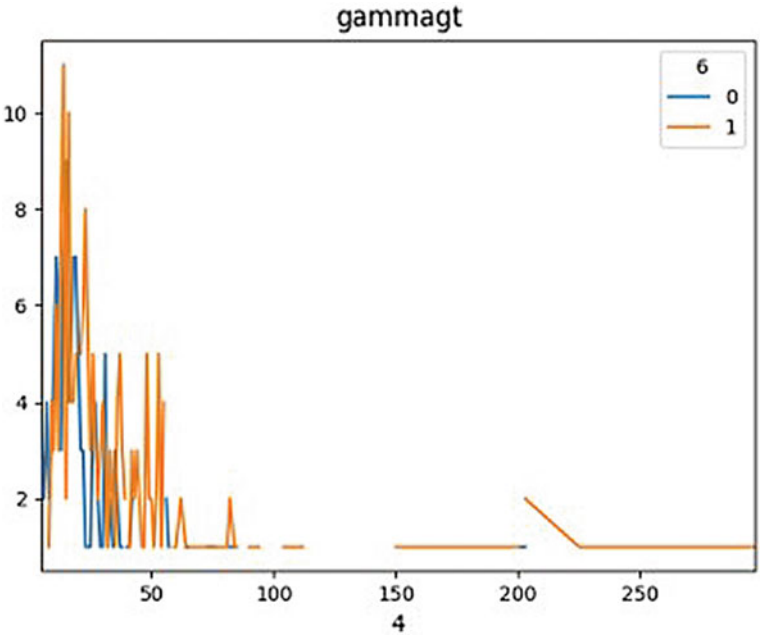


Fig. 21 Gammagt

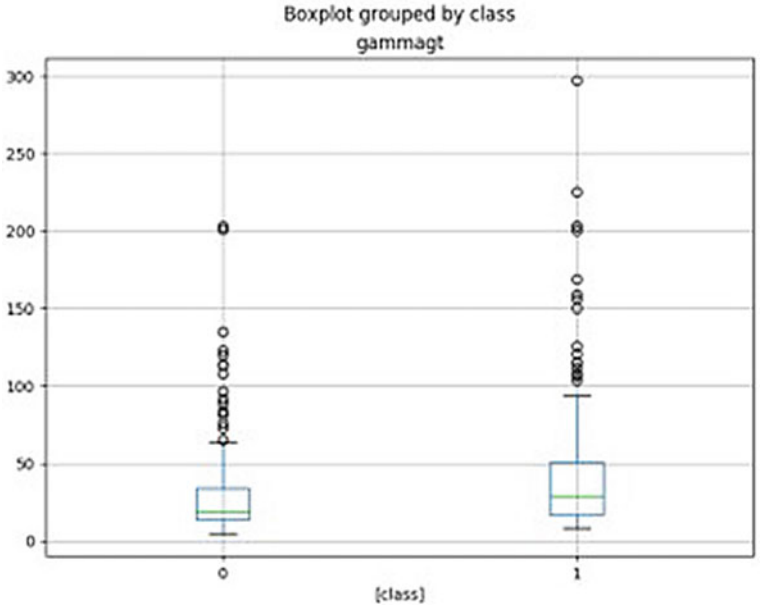


Fig. 22 Boxplot grouped by class gammagt

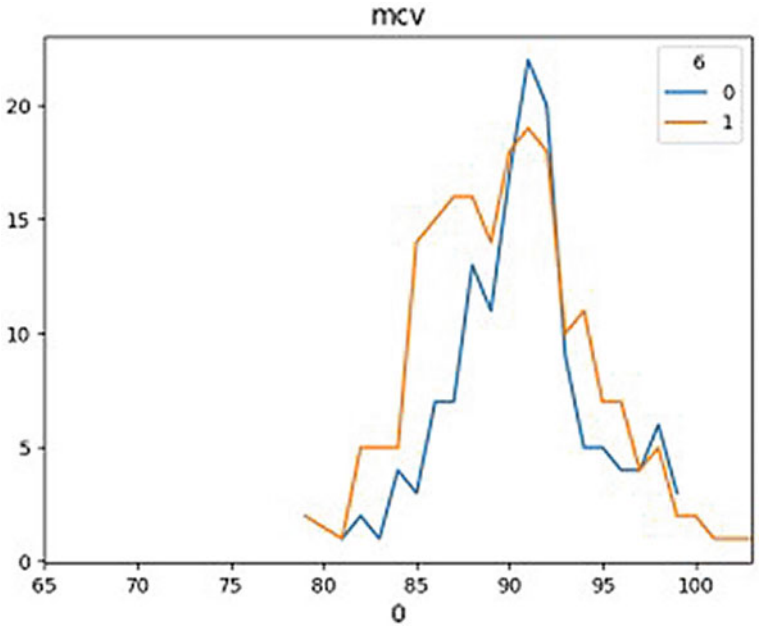


Fig. 23 Mcv

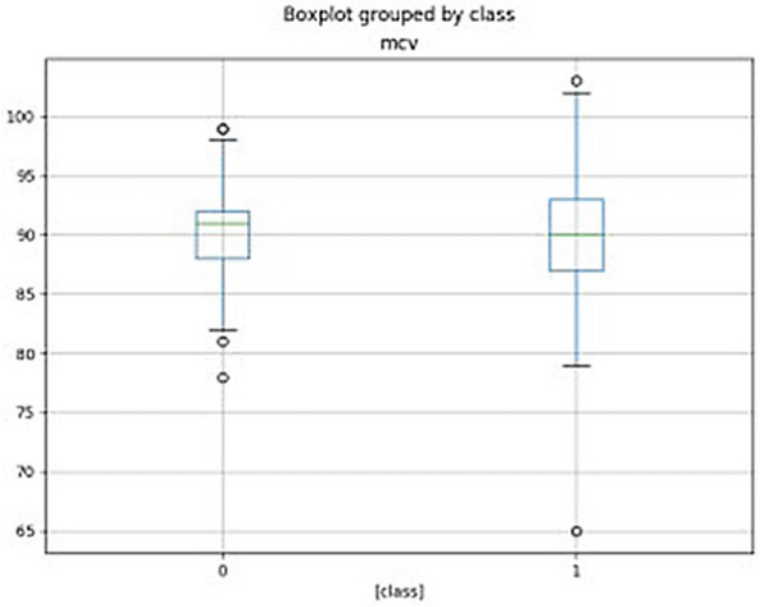


Fig. 24 Boxplot grouped by class mcv

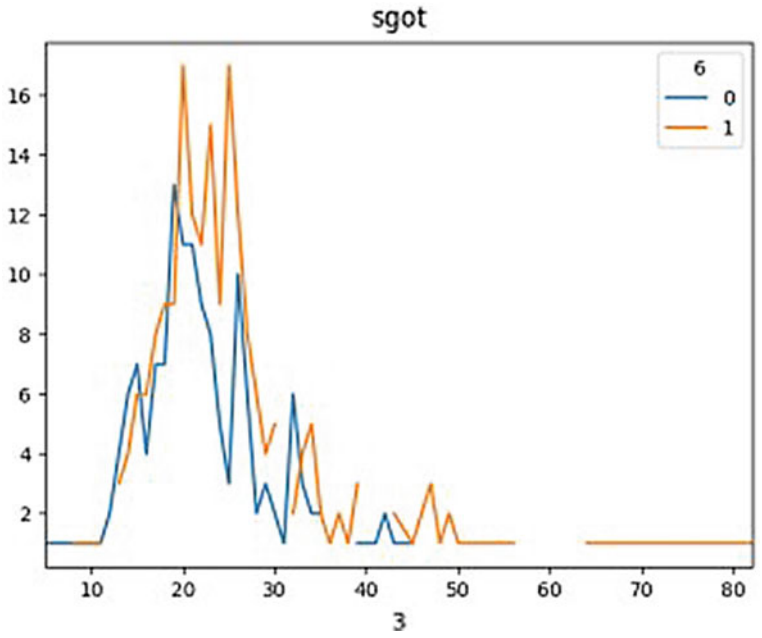


Fig. 25 Sgot

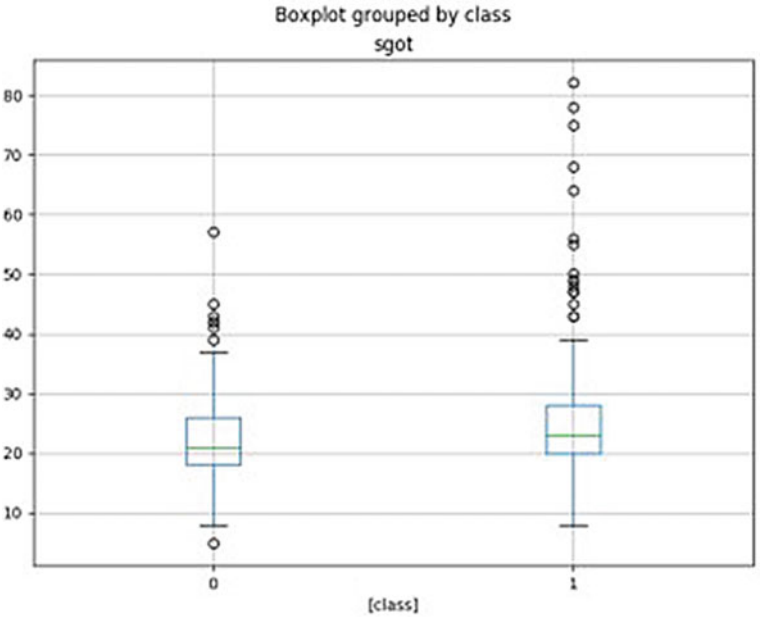


Fig. 26 Boxplot grouped by class sgot

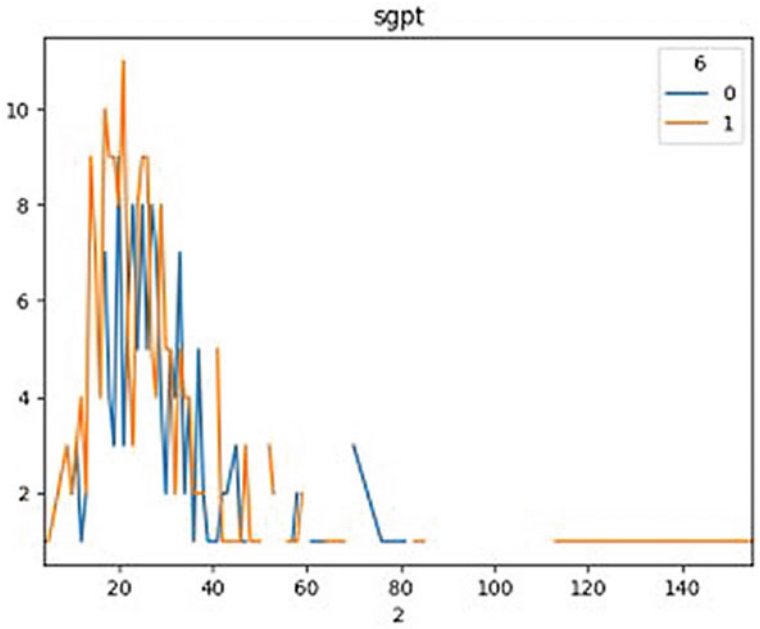


Fig. 27 Sgpt

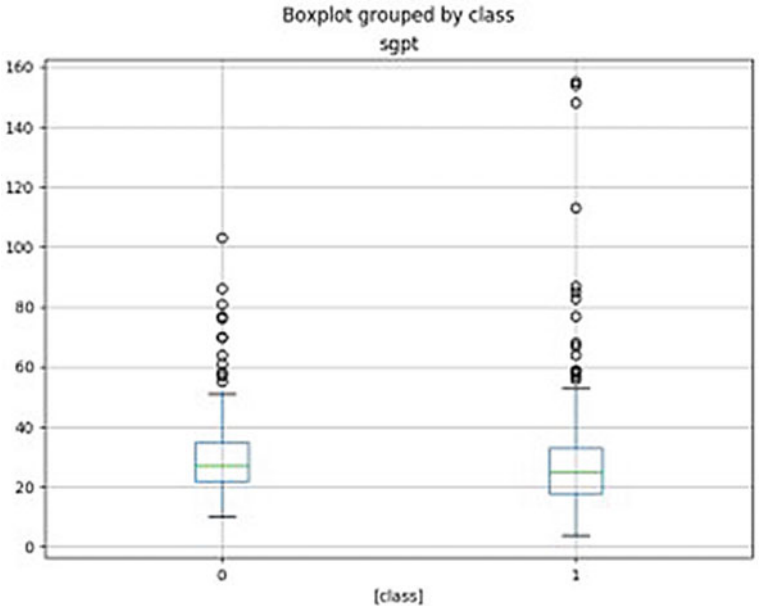


Fig. 28 Boxplot grouped by class sgpt

d. All the features are categorical i.e. binary in nature (0, 1).
e. Since, numeric input and output are given, we need a supervised machine learning technique. Taking in account their distribution and their behaviour, the types of machine learning algorithm we are going to use are:

1. Logistic Regression:
Logistic regression is a statistical method for analyzing a dataset that contains one or more independent variables that determine a result. The result is measured by a dichotomous variable (with just two possible results).

$$logit(p) = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + \ldots b_kX_k$$

$$logit(p) = \ln\left(\frac{P}{1-P}\right)$$

Your training data should be used to estimate the coefficients (Beta values b) of the logistic regression algorithm. This is achieved by measuring the absolute similarity. Maximum likelihood evaluation is a common learning algorithm used by a number of machine algorithms, but it does assume that your data is distributed. It is a monitored algorithm of machine learning. This is the only linear model ML algorithm used. Importing sklearn is a logistic regression. Format linear model with the LogisticRegression class.

2. Gradient Boosting Classifier [2]:
Gradient descent is the ML regression and classification problem technique which generates a prediction model as a set of weak prediction models, typically decision trees. It constructs the model in a storylike way, and generalizes it by enabling an optimization of an arbitrary differentiable loss function. The math of this ML algorithm is highly complicated and is skipped to keep the report shorter and simpler. It's a supervised learning technique. It's implemented by importing sklearn.ensemble package and using GradientBoostingClassifier class.

3. Random Forest Classifier:
Random forests or random decision forests are a whole classification, regression and other task learning system which is based on the construction of multiple decision trees and the classes in class mode (classification) or a mean prediction (regression) for individual trees. The math of this ML algorithm is beyond the scope of this project. It's a supervised classification problem. It's implemented by importing sklearn.ensemble package and using RandomForestClassifier class.

4. K-Nearest Neighbor Classifier:
KNN is a lazy learning algorithm not concealed and supervised. The output is a class member (predict a class,—a discrete value). KNN can be used as a classification. An object is graded by majority vote in favor of its neighbors, which assigns the object to its closest neighbors to the most common class. The value of the object (predicts continuous values) is used for regression output. This value is the average (or median) of the values of its k nearest neighbours. It's implemented by importing sklearn.ensemble package and using KNearestNeighbourClassifier class.

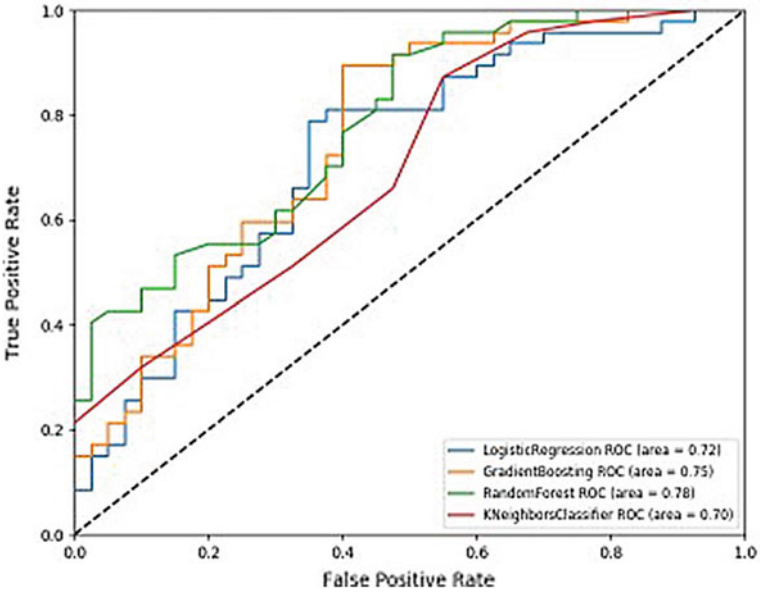


Fig. 29 ROC curve for all ML algorithms. Looking at the ROC curve we realize that the two best algorithms that can be used are Random forest and Gradient Boosting as they yield to True positive state as fast as possible as compared to others. To compare these two, we create another function called COMPARE () in which re-process the data and plot the graph of ROC for random forest vs gradient descent

5. Accuracy of Machine Learning Models:
Any Machine learning model is linked to it's accuracy. More accurate the model, the more appropriate it is for the dataset and the better results we will get. We use the function ROC () to prepare the models and train it. Note: Here the 7th field selector is used for training and splitting the data (Fig. 29).

6. Use of Receiver operating characteristic curve (ROC):
ROC curve is a graphic plot showing the capacity of a binary classifier system to diagnose as the threshold of discrimination is variable. The ROC curve is formed by putting the true positive rate (TPR) on different threshold values against the false positive rate (FPR). The truly positive rate in machine learning is also referred to as sensitivity, alert or detection probability. The falsepositive rate can be calculated as (1) the fall-out or the likelihood of false alarm (1-specifity).We modify the ROC () function to add the ROC functionality by importing python package sklearn.metrics and using roc_curve class. We add this functionality to all the models to get a graph for all models comparing their performances. To differentiate between this type of graph and the rest of the graphs, we create a new folder called algorithm_analysis and keep all the new graph in it and put the old graph in graph_analysis (Fig. 30).

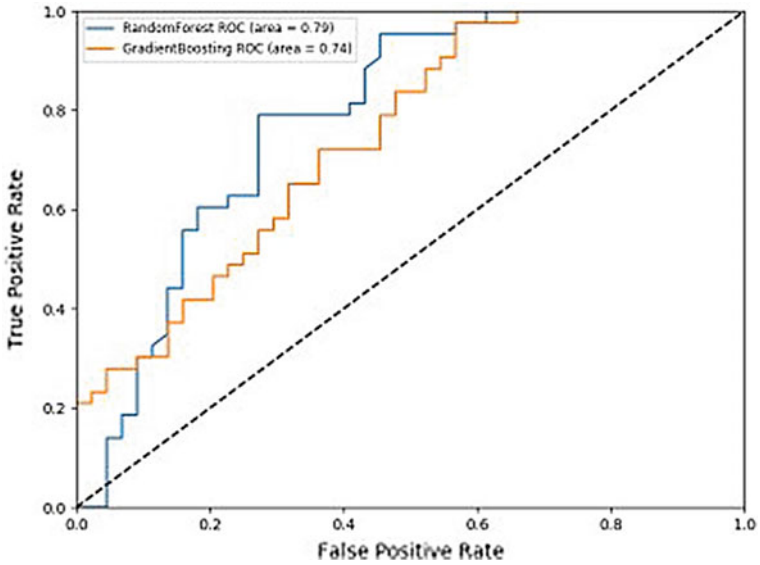


Fig. 30 ROC curve for random forest classifier vs gradient boosting

4 Conclusion

This whole experiment demonstrates how severe the effects of alcohol on liver by using various blood tests. It also allows us to check whether we might be having a liver disease or disorder if we have all the required information. According to National Alcohol and Drug Dependency Council' excessive alcohol use led in the United States every year from 2006 to 2009 to nearly 88,000 deaths and 2,5 million years of possible loss of life (YPLL). In 2016 alcohol drinking was approximately 5.4 billion liters in India and it was projected that by 2020 it will cross about 6.5 billion liters. The persistent rise in the consumption of these beverages can be caused by many factors, including increased revenues for fun and an increasing urban population. Alcohol induced problems include:

- The use of alcohol affects the brain both shortterm and long-term.
- Alcohol can help serious, chronic illnesses.
- Alcohol drinking can cause illness the following day—hangovers.
- Drinking alcohol while pregnant can result in birth defects.
- You could be injured while drinking alcohol.
- Using alcohol can cause dependence.
- Drinking alcohol can make you gain weight.
- Drinking alcohol can kill you, quickly, not just slowly.

References

1. https://justbelieverecovery.com/reasons-not-to-drinkalcohol/
2. http://scikitlearn.org/stable/modules/generated/sklearn.ensemble.RandomForestClassifier.html
3. https://archive.ics.uci.edu/ml/datasets/Liver+Disorders
4. https://data.england.nhs.uk/dataset/ccgois-1-8emergency-admissions-for-alcohol-related-liverdisease

Detection and Analysis of Pulmonary TB Using Bounding Box and K-means Algorithm

Vinit Kumar Gunjan, Fahimuddin Shaik, and Amita Kashyap

Abstract Improving TB studies has long been a overlooked area, partly because of the complexities involved in getting the infection at risk. The novelty of this job lies in the strategy in which both computer vision methods and laboratory-based work are carried out to improve the human race. In this job, the gap between clinical research and technical studies has been decreased by bringing both the job together. Image processing is a field that does not require contact processes to be detected with patients. Over the previous two centuries, several algorithms have been created to extract the contours of homogeneous areas within the digital image. It is possible to acquire the input for image processing algorithms from scanned Lungs X-ray images. To detect the lung region, the fundamental image processing methods are applied to the CT scan picture. In this project, Image segmentation of the input pictures is carried out using a suggested technique developed from the K Means algorithm and bounding box algorithm along with Morphological Image Processing to acquire the output pictures and outcome comparison.

Keywords Image · Tuberculosis

1 Introduction

Tuberculosis (TB) is one of the most antiquated human infections, with atomic confirmation being reversed for more than 17,000 years. The World Health Organization (WHO) regards TB as an overall pandemic. It is a major source of death among HIV-infected individuals. In India, fight against TB can usually be comprehensively organized in three phases: early period, before the revelations of

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_142

x-beam and chemotherapy; post-freedom period, during which TB control projects were began and actualized across the nation; and the current period, during which the advancing WHO-helped TB control system is being established.

Most trials have shown that early physiological parameter measurement helps detect lung-related illnesses. There have been references from many cultures to TB or TB-like diseases from several areas of the globe since ancient times. You can find the earliest TB references in the Samskritam (Sanskrit) language. TB was referred to as Yakshma (meaning wasting disease) in the ancient Indian scriptures, The Vedas. In ancient Chinese and Arabic literature, description of a TB-like disease was recorded [5–7]. The term "consumption" (derived from the Latin term consumer) was also used to define TB in English literature. It appears that the term "tuberculosis" comes from the Latin term tubercula (meaning "a tiny lump") [8, 9]. According to the Indian situation, India was among the 22 elevated TB nations and accounted for an approximately one-quarter (26%) of all TB instances globally [10].

Digital Image Processing was the best way to detect and analyze tuberculosis since images are well perceived even by a common person. Computer Aided Diagnosis (CAD) systems for the lung use automatic lung segmentation from High Resolution Computer Tomography (HRCT) pictures. Automatic lung segmentation in the right and left lungs is a comparatively simple task [1–4]. More of a challenge is the job of labeling distinct areas within the lung. Lung segmentation in Apical, Middle and Basal areas is crucial for differential diagnosis of diffuse lung diseases as it helps radiologists identify the patterns of disease distribution. In the original phases, treating lung cancer and tuberculosis (TB) is simpler but very hard in the advanced phases of the illnesses. Computerized lung X-ray image analysis can assist these illnesses in the early phases of their development. Most cases of cancer and TB begin with the appearance of tiny nodules. Nodule pixels are often brighter than the surrounding areas, but the difference in gray levels is not significant at all in some cases. In addition, ribs and pulmonary arteries, which often have greater gray levels, also lead to lung tissue complexity and often render certain nodules undetectable [11].

There is also no perfect universal algorithm in primary care; however, a screening test accompanied by one confirmatory test could be the answer; or one screening test followed by two confirmatory sequential trials. Active main pulmonary tuberculosis is infant disease, or young adult tuberculosis when not

subjected to Mycobacterium TB bacilli. It can occur as pneumonic consolidation (homogeneous thick opacity or patchy opacification mostly in lobes with or without hilarious lymphadenopathy called the Ghon complex) [12].

2 Methodology

i. Medical visual data base collection:

Collection of TB-related images (Chest X-rays) from the public database, as well as the collection of live data from these images.

ii. Design and Development of algorithm:

a. Adaptive Pillar-K design implies Image Segmentation algorithm by implementing the pillar algorithm to optimize clustering of K-means using MATLAB. The basic algorithms here are algorithms of pillars and algorithms of clustering of K-means.
b. The changes suggested in this algorithm are based on the Pillar algorithm that conducts the positioning of the pillars that should be situated as far as possible from each other to resist the distribution of stress of a ceiling as identical to the amount of centroids between the distributions of information. It identifies the position of the original centroids by calculating the accumulated distance metric between each data point and all prior centroids, and then selects information points that have the highest distance as new original centroids.
c. The design of the algorithm starts with the phase of designating the original centroids for the current K-means algorithm and the outlier detection mechanism.
d. Later the processed image is fed to bounding box algorithm subsequent to morphological operations to yield segmented image with affected area in the lungs with TB.

The process is clearly shown in following Fig. 1.

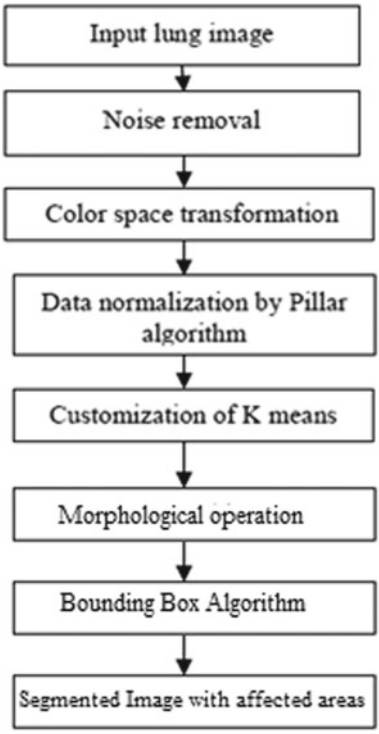

Fig. 1 Block diagram of pillar k-means algorithm

Fig. 2 Original Image

3 Implementation and Testing

a. MATLAB, technical computing language (R2010a), which uses Image acquisition, image processing, fixed point and neural networks toolboxes, is the desired software design platform for application. Simulation includes numerous

phases, such as the acquisition of pictures, the filtering of pictures for the issue involved, and then the segmentation of pictures.

b. The simulation-prepared algorithm will also be tested on the gathered visual medical database. Some algorithms from comprehensive testing may extract significant characteristics.

4 Experimental Investigations

A Chest x-ray showing dense homogenous opacity in right, middle and lower lobe of primary pulmonary TB X-ray is acquired from the open source (Courtesy: Wikimedia commons) is subjected to the methodology explained above section. The original image is shown in Fig. 2 which depicts the x-ray image of a patient with pulmonary TB.

Using the tailored k-means algorithm, the initial picture is clustered to produce the precise impacted region of the lungs owing to TB shown in Fig. 3. The picture is also subject to bounding box algorithm, is a straightforward and common interaction paradigm regarded by many current frameworks for interactive image segmentation. These frameworks, however, tend to utilize the bounding box supplied simply to exclude its exterior from account and sometimes initialize the minimization of energy. Figure 4 shows the resulting picture from the bounding box.

Now the image obtained from the bounding box is carried out with Image Erosion in order to achieve the erosion of the image as shown in Fig. 5. This image is then processed to extract the outline of the affected zone as shown in Fig. 6. Later, this outline is superimposed on the original image to show the affected area in the lungs very precisely because of TB (Fig. 7).

Fig. 3 Clustering via k-means to get affected area

Fig. 4 Application of bounding box algorithm

Fig. 5 Eroded image

The statistical parameter that is primarily considered in this process is based entirely on the bounding box and is known as Solidity. It varies from region to region as shown by the region impacted by the outline. Solidity is measuring an object's density. A solidity measure can be achieved as the ratio of an object's region to the object's convex hull region. This is depicted mathematically by the Eq. 1.

$$\text{Solidity} = \text{area}/\text{convex area} \tag{1}$$

A value of 1 signifies a solid object, and a value less than 1 will signify an object having an irregular boundary, or containing holes.

Fig. 6 Outline of the affected area

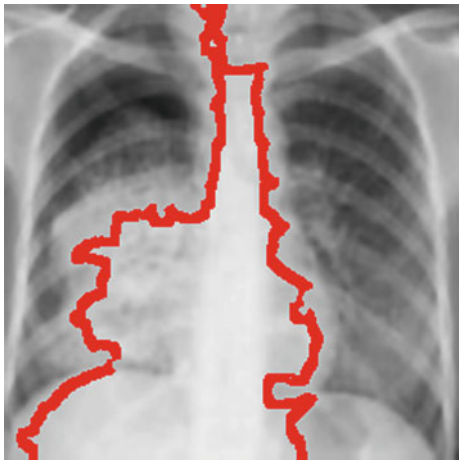

Fig. 7 Output Image showing exact affected zone

In this work this parameter is tabulated for different areas and bounding boxes along the course of outline and is indicated in Table 1.

Table 1 Solidity parameter

S. no	Area (pixels)	Solidity
1.	27	0.931
2.	45	0.900
3.	1096	0.2847
4.	20005	0.7391
5.	68	0.9583
6.	23	0.8718
7.	34	0.8884
8.	191	0.5414
9.	171	0.7596
10.	338	0.7133
11.	199	0.6784
12.	7	1
13.	37	0.8605
14.	1	1

5 Conclusion

In this project Image segmentation of input pictures is carried out using the suggested technique extracted from the K Means algorithm (is an unsupervised clustering algorithm that classifies input information points into various groups based on their intrinsic distance from each other) bounding box with morphological operations. The resulting picture obviously demonstrates the impacted region in the lungs owing to pulmonary TB from experimental studies.

Acknowledgements The authors gratefully acknowledge Department of science and technology (DST)- SERB for its financial support through ECRA scheme vide Diary No. SERB/F/3559/2016-17 dated 30 August, 2016 and Annamacharya Institute of Technology & Sciences, Rajampet, A.P. for providing research facilities.

References

1. Du Bois RM (1994) Diffuse lung disease: an approach to management. BMJ 309(6948):175–179
2. Franks T, Galvin J, Frazier A (2004) The use and impact of HRCT in diffuse lung disease. Curr Diagn Pathol 10(4):279–290
3. Suh R, Goldin J (2006) High-resolution computed tomography of interstitial pulmonary fibrosis. Semin Respir Crit Care Med 27(6):623–633
4. Ko JP, Naidich DP (2004) Computer-aided diagnosis and the evaluation of lung disease. J Thorac Imaging 19(3):136–155
5. Mohan A, Sharma SK (2009) History. In: Sharma SK, Mohan A (eds) Tuberculosis, 2nd edn. Jaypee Brothers Medical Publishers, New Delhi, pp 7–15

6. Rubin SA (1995) Tuberculosis. Captain of all these men of death. Radiol Clin North Am 33:19–39
7. Rosenblatt MB (1973) Pulmonary tuberculosis: evolution of modern therapy. Bull NY Acad Med 49:163–196
8. Dubos R, Dubos J (1952) The white plague. Tuberculosis, man and society. Little, Brown and Company, Boston
9. Waksman SA (1964) The conquest of tuberculosis. University of California Press, Berkeley and Los Angeles
10. Central TB Division, Government of India (2012) TB India 2012. Revised National TB Control Programme. Annual Status Report. New Delhi: Central TB Division, Directorate General of Health Services, Ministry of Health and Family Welfare
11. Le K (2011) Chest X-ray analysis for computer-aided diagnostic. In: First international conference on computer science and information technology, CCSIT 2011, Bangalore, India, proceedings, part III, 2–4 January 2011, pp 300–309
12. Al Ubaidi BA (2018) The radiological diagnosis of pulmonary tuberculosis (TB) in primary care. J Fam Med Dis Prev 4:073

A Tuberculosis Management Through ADR Study, Feature Extraction and Medical Bio Informatics

Vinit Kumar Gunjan, Fahimuddin Shaik, and Amita Kashyap

Abstract Enhanced research into tuberculosis has long been ignored because of the complexity of the risk of infection. The novelty of this project is the approach in which computer vision technology as well as laboratory work for improving mankind are carried out. The techniques of image processing are important for automatic research. In this work, the gap between clinical and technical research has been reduced by the collaboration and successful analysis.

Keywords Adverse drug reactions · Tuberculosis · Image processing · Clinical

1 Introduction

Most studies have shown that early physiological parameter measurements can help to detect lung diseases. From the earliest ages, many civilisations also related to tuberculosis or TB-like diseases from other areas of the world. In the Samskritam (Sanskrit) language the earliest references to TB can be found. TB was called yakshma (meaning a wasteful disease) in the ancient Indian Scriptures The Vedas. TB-like disease classification in ancient Chinese and Arabic literature was documented [5–7]. The word 'consumption' in English literature was also used for the description of TB (from the Latin word consumer). The word "tuberculosis" seems to have come from the Latin word 'tubercula' [8, 9]. Indiana estimates that India was one quarter (26%) of all tuberculosis cases in the world [10] and is among the 22 high tuberculosis countries [10]. Digital image processing was the best way to detect and analyze the TB, as even a common man can perceive images well. An abnormal anatomy images pose a problem for all automated analytical systems, Particularly in cases of missing or altered predicted anatomical structures, so that

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the usable segmentation routines can not be established. Computer Aided Diagnosis (CAD) systems for the lungs use automatic pulmonary segmentation of High Resolution Computed Tomography (HRCT). A fairly clear activity is the automated segmentation of the lungs into the left and right lungs [1–4]. It is more challenging to label separate regions within the lung. It is more challenging to label separate regions within the lung.

Initial treatment for tuberculosis is easier, but in advanced stages of the disease is very difficult. Computerized X-ray lung analysis can assist in the early stages of those diseases. Most cases of cancer and TB begin with small nodules appearing. Nodule pixels are often lighter than the neighboring areas, but the difference between gray levels in some cases is not significant at all. In addition the lung tissue's complexity can also be affected by ribs and pulmonary arteries which are often more gray than in the grays [11].

Picture retrieval is an field not protected by patient communication procedures. Several algorithms have been developed during the past two decades to extract the contour of homogeneous areas from a digital image. The input for the algorithms for image processing can be obtained from scanned Lungs CT images. The CT scan image is used to detect the lung region with core image processing methods such as erosion, average filter, dilation, sketches, lungen border extraction and flood-fill algorithms. And ZN – stained tissue slide images of TB bacilli for the testing of the behavioral characteristics of bacteria were also used at present to study.

In order to estimate the incidence of severe and mortal adverse drug reactions in hospital patients, Pomeranz and colleagues of the University of Toronto analyzed 39 studies in the United States on ADRs. The researchers mixed the occurrence of ADRs at the hospital with the event of ADRs that triggers hospital admission in order to establish a general occurrence of ADRs in hospitalized patients.

2 Need and Significance

One of humanity's oldest diseases is tuberculosis (TB), which is verified by nuclear testing for over 17,000 years. With increasingly modern strategies for identifying and handling TB, people are unfortunately always prevalent and still, it is among the top 10 hijackers, second only to HIV. TB is an overall pandemic by the Health Organization (WHO). It is a big cause of mortality for people who suffer from HIV. In India, the fight against tuberculosis can generally be organized in three periods: the early period prior to x-beam and chemotherapy disclosures; the post-freedom period during which TB control projects across the country have been launched and updated; the current period during which the progressive WHO-aided tuberculosis control system is in place. The DOTS program in India is today the fastest growing and largest patient treatment system on the planet; the second largest, as far as the population is concerned.

True problems with the Indian regulation of TB include a weak base of essential human resources in province areas of various states; unregulating private social

security that causes an irrational and far-reaching usage of first- and fifth-line anti-TB medicines. Multi-drug-safe tubercle disease (MDR-TB) is a further risk for TB annihilation that is a result of a TB control program lacking or disrupting. WHO has dreamt of dispensing TB as a general well-being issue from the world's substance by 2050 with the "STOP TB" methodology.

TB is treated by a surgical examination obtained from the patient to detect Mycobacterium tuberculosis bacteria. While other research may suggest that tuberculosis is strongly a diagnosis, it can not be confirmed. The medical history, physical examination, chest X-ray and microbiological examination (of the sputum or some other appropriate sample) must be included in a comprehensive TB medicine evaluation. It may also include a skin test for tuberculin, other scans and Xray surgery. Tuberculoses can only be definitively diagnosed by the cultivation of Mycobacterium tuberculosis organisms from patient specimens (most of which include sputum but also pus). A non-cultural disorder may only be called "presumed" or "probable" In order for a diagnosis to negate the chance of infection, the majority of protocols require the negative testing of two different cultures. In addition, there is no perfect universal primary care algorithm; however, it could be a screening test with a confirmatory test or a screening test with 2 sequentially confirmed tests.

3 Methodology

The entire methodology is divided into 2 parts in which first 2 subsections belong to clinal laboratory work and the last part belongs to the computational investigations using Digital Image Dispensation Techniques.

a. ***Discovery of new anti TB drugs.***

   i. Screening of different genes and proteins involved in TB with their phylogenetic analysis and Selection of target gene and protein
   ii. Pathway and Disorder studies of selected protein.
   iii. Virtual drug screening and Compilation of candidate ligands from pubchem.
   iv. Ambiguity studies of Ligands.
   v. Docking with receptor on tools like Hex, Argus lab and Molegro and selection of best drug.
   vi. Comparative assessment of selected drug with the conventional one.
   vii. Drug Library Creation.

b. ***To study compliance with DOTS therapy by assessing the quality of life (QOL) scores of tuberculosis patients with and without adverse drug reactions (ADRs) when the DOTS therapy is initiated and completed.***

   i. To inform subject about the study.

ii. To evaluate the individuals for inclusion and exclusion criteria.
iii. To take consent from participant/subjects/patients.
iv. To enroll subjects in the study satisfying inclusion criteria.
v. Demographic data includes information about their Age, Gender and Weight etc.
vi. To fill Case Record Form & measure Quality of life scores of subjects undergoing DOTS at the time of initiation of the treatment by using a planned Questionnaire.
vii. In cases of occurrence of ADR, filling up the ADR form.
viii. To measure QOL score of subjects at the time of completion of DOTS by using SF 12 Questionnaire.
ix. To evaluate QOL scores of tuberculosis patients with ADR against patients without ADR.

c. ***Developed a qualitative automatic medical imaging framework for detecting and forecasting abnormalities in the problem considered for accurate diagnosis by image processing techniques.***

The process of the proposed framework is clearly shown in Fig. 1. Here, Adaptive Pillar-K design implies Image Segmentation algorithm by implementing the pillar algorithm to optimize clustering of K-means using MATLAB. The basic algorithms here are algorithms of pillars and algorithms of clustering of K-means.

The changes suggested in this algorithm are based on the Pillar algorithm that conducts the positioning of the pillars that should be situated as far as possible from each other to resist the distribution of stress of a ceiling as identical to the amount of

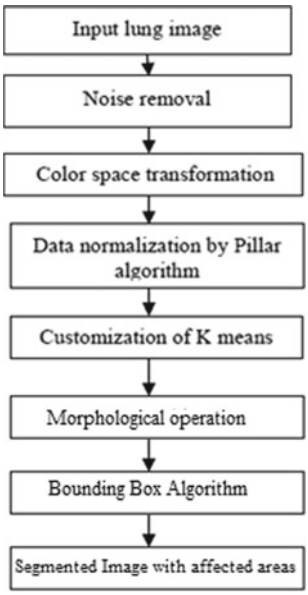

Fig. 1 Block diagram of pillar k-means algorithm

centroids between the distributions of information. It identifies the position of the original centroids by calculating the accumulated distance metric between each data point and all prior centroids, and then selects information points that have the highest distance as new original centroids.

4 Implementation and Testing

a. MATLAB, technical computing language (R2010a), which uses Image acquirement, image processing, fixed point and neural networks toolboxes, is the desired software design platform for application. Simulation includes numerous phases, such as the acquisition of pictures, the filtering of pictures for the issue involved, and then the segmentation of pictures.
b. The simulation-prepared algorithm will also be tested on the gathered visual medical database. Some algorithms from comprehensive testing may extract significant characteristics.

5 Conclusion

Discovery of new drug and educate the common people about DOTS and improve the Quality of Life. This research work aims to improve the TB Diagnostics through several computational techniques and create awareness on DOTs therapy coverage throughout India. In this project Image segmentation of the input images is carried out by proposed method, pillar K means algorithm, K Means algorithm and Fuzzy C Means Algorithm to obtain the output images and result comparison. After testing the modified algorithm, a framework will be prepared using MATLAB in the form of a GUI (Graphical User Interface) which will become an easy module for the researchers and even helpful for easy diagnosis. Our Research aims to improve the accuracy of TB Diagnostics which may prove to be a boon step toward TB Free India

Acknowledgements The authors thankfully admit Department of science and technology (DST)-SERB for its economic support through ECRA scheme vide Diary No. SERB/F/3559/2016-17 dated 30 August, 2016 and Annamacharya Institute of Technology & Sciences, Rajampet, A.P. for providing research facilities.

References

1. Du Bois RM (1994) Diffuse lung disease: an approach to management. BMJ 309(6948):175–179
2. Franks T, Galvin J, Frazier A (2004) The use and impact of HRCT in diffuse lung disease. Curr Diagn Pathol 10(4):279–290
3. Suh R, Goldin J (2006) High-resolution computed tomography of interstitial pulmonary fibrosis. Semin Respir Crit Care Med 27(6):623–633
4. Ko JP, Naidich DP (2004) Computer-aided diagnosis and the evaluation of lung disease. J Thorac Imaging 19(3):136–155
5. Mohan A, Sharma SK (2009) History. In: Sharma SK, Mohan A (eds) Tuberculosis, 2nd edn. Jaypee Brothers Medical Publishers, New Delhi, pp 7–15
6. Rubin SA (1995) Tuberculosis. Captain of all these men of death. Radiol Clin North Am 33:19–39
7. Rosenblatt MB (1973) Pulmonary tuberculosis: evolution of modern therapy. Bull NY Acad Med 49:163–196
8. Dubos R, Dubos J (1952) The white plague. Tuberculosis, man and society. Little, Brown and Company, Boston
9. Waksman SA (1964) The conquest of tuberculosis. University of California Press, Berkeley and Los Angeles
10. Central TB Division, Government of India (2012) TB India 2012. Revised National TB Control Programme. Annual Status Report. Central TB Division, Directorate General of Health Services, Ministry of Health and Family Welfare, New Delhi
11. Le K (2011) Chest X-ray analysis for computer-aided diagnostic. In: First international conference on computer science and information technology, CCSIT 2011, Bangalore, India, proceedings, part III, 2–4 January 2011, pp 300–309

Design and Implementation of System Which Efficiently Retrieve Useful Data for Detection of Dementia Disease

Sandhya Waghere, P. RajaRajeswari, and Vithya Ganesan

Abstract To analyze Hadoop techniques like MapReduce, which will help to process the data faster and in efficient way to detect dementia. For given voluminous dementia dataset, current solution uses different data partitioning strategies which experiences large communication cost and expensive mining process due to duplicate and unnecessary transactions transferred among computing nodes. To clear this issues proposed algorithm uses data partitioning techniques such as Min-Hash and Locality Sensitive Hashing which will reduce processing time and improve efficiency of final result. We are taking help of MapReduce programming model of Hadoop [3]. We implement this technique on a Hadoop platform. For pattern matching we use FPgrowth algorithm. Finally we shows that the proposed system requires less time to finding frequent item sets. The idea behind research is to adopt to cope with the special requirement of health domain related with patients.

Keywords MapReduce · Moving K-means algorithm · Fp-Growth algorithm

1 Introduction

The Classical technique of parallel mining algorithms concentrated on uniform distribution of data across computing nodes. It uniformly partitioned and assigned data to clusters of computing nodes [2]. Due to redundancy cost of network traffic and data shuffling increases which in turn minimizes the productiveness of data partitioning.

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A. Kumar and S. Mozar (eds.), *ICCCE 2020*, Lecture Notes in Electrical Engineering 698, https://doi.org/10.1007/978-981-15-7961-5_144

Improper data partitioning decisions not only affect network and computing overhead but also face problem in load balancing. The key plan of proposed technique is to form single partition of extremely correlated transactions; thus the number of irrelevant transactions is gradually sliced. Basically partitioning and distribution of voluminous dataset across data nodes of a Hadoop cluster will be in such a way that it will reduces the network and computing loads due to duplication of transactions on remote nodes. This is contributing in speed up the performance of mining process on clusters.

By using this approach, we can classify the dementia dataset in different severity rating based clusters. It will show that which symptoms are responsible for the severity of Dementia like age, stress, depression etc. It will be helpful to group the highly related symptoms to that severity rating of Dementia.

2 Motivations

The following examinations give motivation and direction to the research. Around Worldwide approximately 5cr individuals have dementia, and there are nearly 2cr new cases each year. Alzheimer disease is the most common variety of dementia and can contribute to 60–70% of cases.

Dementia is one of the major problems of disability and dependency in older people along the world. Dementia has impact in various aspects such as social, psychological, economical, not only on individual, but also on their families and society. There is a great need for the evolution of parallel mining techniques as far as concern with such type of diseases in healthcare domain. Fast evolution of big data mining can easily handle by MapReduce programming model. Data distribution is very crucial in raising effectiveness while dealing with an application oriented big data.

Mapreduce programming plays a vital role in establishment of parallel data mining algorithms [4–6]. In the era of large-scale cluster, execution parallelism is inhibited through data partitioning in distributed system that successfully provides proper channel require to attain high efficiency and good scalability. Current system of Frequent itemset mining consist of Hadoop, which will managing data processing overhead by disbursing data uniformly among nodes, but in current system when a data partitioning theme partitions the midway outputs, data Distribution and load balancing are completely unnoticed. Unnecessary computation and network overheads are leaning due to unsuitable partitioning of data. In the environment of parallel mining, we propose an algorithm which results in efficient correlations among transactions to minimize network and data processing overhead. In the system we are using a dementia dataset on which data partitioning is performed by Locality-Sensitive Hashing. We get to know the severity using this system whether the dementia is mild or strong [11, 12]. The severity is shown through pie chart. New approach will able to classify the dementia dataset in different severity rating

based clusters in efficient manner. It will able to identify the most relevant symptoms which are contributing to dementia.

3 Methodology

As shown in Fig. 1 Patient's history is processed with the help of input dataset which will then find out symmetric uncertainty and calculate Gain [13]. Based on this data, minimum spanning tree will be constructed. MST will help to retrieve efficient data which will turn in minimizing processing time and improve performance with the help of moving K-means algorithm [10, 14].

Min-hash and Locality Sensitive Hashing techniques of partitioning are used. MinHash gives us a solution to depict the similarity of two sets. MinHash produces smaller representations called as "signatures" of larger sets which contains minhash of the characteristic matrix. Locality sensitive hashing (LSH) is used for boosting the achievement of MinHash by deflecting the observation of a huge number of element pairs.

4 System Architecture

As shown in Fig. 2 collecting patients data from internet, governing agencies or medical devices and upload data on Hadoop hdfc file where we use three mapreduce jobs to sort data which will provide input to FP-Growth algorithm. Final result will help to rate the severity of demensia.

Data collected from patient's history which will get from patient's day to day activities. we store input data on Hadoop HDFS for smooth handling and in parallel perform action on huge amount of data with the help of map-reduce and proposed algorithm [7]. FP-Growth will help for storing condensed and decisive information about frequent patterns collected from large dataset.

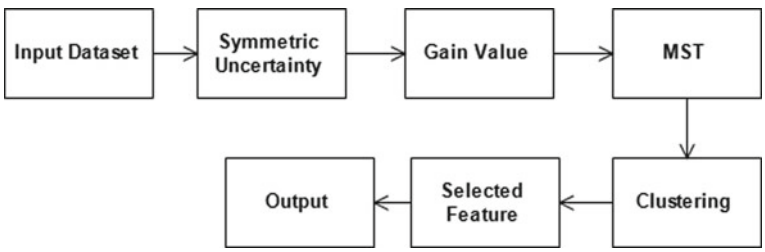

Fig. 1 Flow of the system

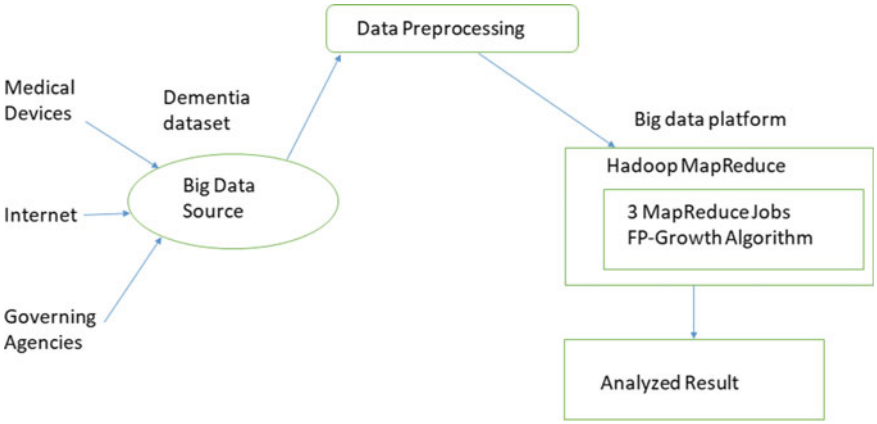

Fig. 2 System architecture

It will improve effectiveness and efficiency of existing system with ease of handling huge amount of data. The system store data into the Hadoop distributed file system (HDFS).Then apply algorithms like Hadoop MapReduce to get parallel co item set. We apply parallel Fp-algorithm on dataset which will give output in form of frequent item set within minimum time. The proposed system helps to cluster data. Reorganize data in cluster format. Then by using fidoop (Min-Hash Technique + LSH Technique + FP Growth algorithm) this improved algorithm will able to generate the frequent item set in minimum time.

5 System Overview

5.1 Problem Statement

We Design the system which uses a dementia dataset as input to proposed algorithm. Algorithm uses Min-hash and Locality-Sensitive Hashing technique. System focuses on rate of severity that whether effect of dementia on patient is mild or strong. The severity is shown through pie chart. To validate the effectiveness of proposed method, classification of dementia dataset has been done efficiently in different severity rating based clusters. System will able to identify the most relevant symptoms which are contributing to dementia.

5.2 Mathematical Model

$S = \{I, O, M, F, K, L, L1\}$;
I = Input
O = output
M = Map Reducing
F = FP growth
K = Moving k-means
L = Locality Sensitivity Hashing

1) *Map Reducing*
$M = \{I\}$;

M1 (Output) = Find the count of every input from dataset

2) *FP growth Algorithm*
$F = \{M1\}$;

F1 (Output) = Find the element of count with different patterns.

3) *Process P3 = Moving K-means*

$$P3 = \{I\};$$

$$J = \sum_{i=1}^{k} \sum_{j=1}^{n} \left(\|x_i - y_j\| \right)^2 = 1$$

Where,

$\|x_i - y_j\|$ Is Euclidian distance between a point x_i and y_j;
Output = Cluster the dataset into different group.

4) *Process = P4 (Locality Sensitivity Hashing)*

$$P4 = \{P3\};$$

$$h : \sum_{n}^{k} \rightarrow [m]$$

m is power of 2;

$$m \rightarrow log_2^m$$

$$\sum^{k} using\ of\ k\ character$$

h(x) = x mod m;

$$JS_t(D_1D_2) = E(1/k)row\ hi\ (D_1 = h_i(D_2))$$

Process P5

$$P5 = \{P4\};$$

Repeat process P2 for process P4 output.
Output = grouping similar data into single unit.

6 Evaluation Measures

6.1 Requirements

We have to used to Patient's History Dataset, As we have large amount of data for mining, We have extracted item that were bought by each activity done by patient on every day. So each row in dataset represent items that observed by single day activity by patient, likewise we got number of rows representing item bought by patients history saved this data in "Patient's History Data" file. Then we convert names of items into numbers where each number represents one item. Preprocess data and convert data into numeric form. Once data is converted to numeric form. We store numeric data in "PatientsMainDataset". We apply different techniques for processing data and after that we get frequent item set. Sample of input dataset is preprocessed. We got numeric values the Fig. 3 shows, snapshot after preprocessing original dataset.

7 Result

Figure 4 shows output of execution of our system. The parallel fp growth algorithm take more time, it take 99 s for finding frequent item set, while our new approach for finding frequent item set it take very less time, it takes only 1 s. So it saves time our Fidoop technique is implemented with the help of local sensitivity hashing technique and moving K-means and Fp-growth algorithm [8, 9].

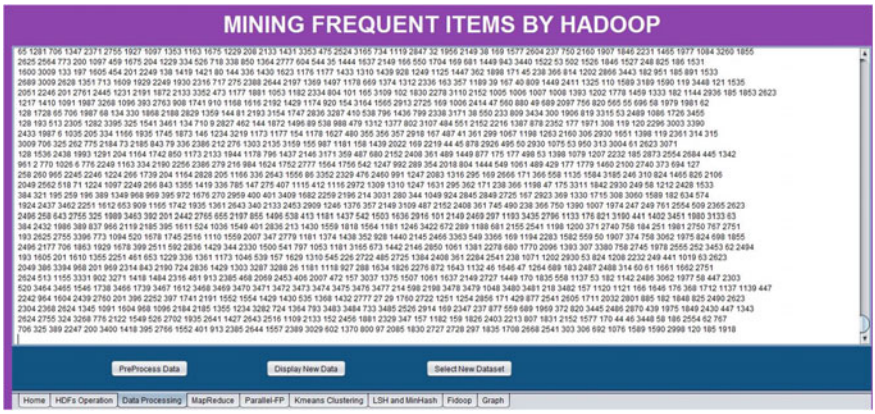

Fig. 3 Snapshot preprocessing dataset

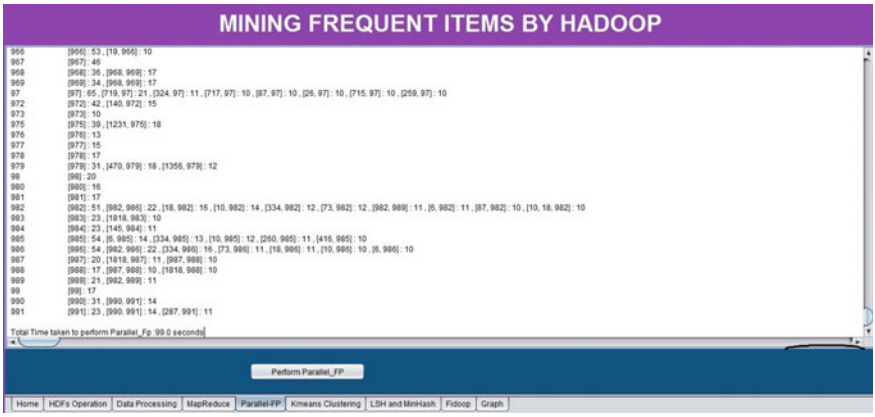

Fig. 4 Snapshot after execution of pfp require 99 s

8 Applications

1. Market Basket Analysis

Using Fidoop (frequent item set mining using Hadoop) [1] on market basket data which gives information about items are frequently purchase by customer and how many times purchase we easily find out using proposed system. This information is useful for analysis purpose and also helpful for increasing profit of organization.

2. Online Book Shopping

Using our proposed system we easily know which books are frequently purchases, so that we increase the stock of this type of book, so this information is helpful for knowing habits of customers.

3. Policy Making

In every sector large amount of data produced so this data is no useful, from that data using our proposed system we find out frequent data so that using, policy making such task are very much easier.

4. Online Product selling

Using our system, if organization wants to give offer for the customer that frequently purchase product from company. So using Fidoop organization easily finds out such customers.

9 Conclusion

We proposed frequent item set mining in minimum time for improving performance. In this System we first perform Hadoop map reduces programming for parallel count of each item followed by algorithm for getting frequent item set which minimizes time. we write an improved k-means algorithm [8] which uses different techniques like Locality Sensitive Hashing, Min-hash and Fp-Growth algorithm. Finally we conclude that proposed system require less time for finding frequent item sets and thus improve efficiency and effectiveness of finding crucial information from large dataset. Thus we detect severity in dementia.

References

1. Xun Y, Zhang J, Qin X, Zhao X (2017) Fidoop-DP: data partitioning in frequent itemset mining on hadoop cluster. IEEE Trans Parallel Distrib Syst 28(1):101–114
2. Agarwal R, Singh S, Vats S (2016) Implementation of an improved algorithm for frequent itemset mining using hadoop. In: International conference on computing, communication and automation (ICCCA2016)
3. Xie J, et al (2010) Improving mapreduce performance through data placement in heterogeneous hadoop clusters. IEEE
4. Thusoo A, et al (2010) Hive-a petabyte scale data warehouse using hadoop. IEEE
5. Zhang J, et al (2015) Research on multiple files input programming method based on MapReduce. Springer
6. Singh N, Agrawal S (2015) A review of research on MapReduce scheduling algorithms in Hadoop. In: ICCCA
7. Gates AF, et al (2009) Building a high-level dataflow system on top of Map-Reduce: the Pig experience. In: Proceedings of the VLDB endowment

8. Qi J, Yu Y, Wang L, Liu J (2016) K*-means: an effective and efficient K-means clustering algorithm. In: IEEE International conferences on big data and cloud computing (BDCloud), social computing and networking
9. Gawwad MA et al (2017) Frequent itemset mining for big data using greatest common divisor technique. Data Sci J 16(25):1–10. https://doi.org/10.5334/dsj-2017-02
10. Waghere S, Rajarajeswari P (2017) Parallel frequent dataset mining and feature subset selection for high dimensional data on hadoop using map-reduce. Int J Appl Eng Res 12 (18):7783–7789 ISSN 0973-4562
11. Dementia Guide, National Health Services (NHS). http://www.nhs.uk/Conditions/dementia-guide/Pages/about-dementia.aspx
12. Dementia Including Alzheimer's Disease, Office of Disease Prevention andHealthPromotion (ODPHP). http://www.healthypeople.gov/2020/topics-objectives/topic/dementias-including alzheimers-diseas
13. Liu H, Motoda H (1998) Feature selection for knowledge discovery and data mining. In: The springer international series in engineering and computer science, vol 454, pp 73–95
14. Waghere SS, Rajarajeswari P (2017) A survey on achieving best knowledge from frequent item set mining using fidoop. Int J Comput Appl (0975 – 8887) 171(9)