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Dinesh Goyal
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Proceedings of the Third International Conference on Information Management and Machine Intelligence

ICIMMI 2021

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Dinesh Goyal · Anil Kumar · Vincenzo Piuri ·
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Editors

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Preface

The third International Conference on **Information Management and Machine Intelligence (ICIMMI-2021)** was organized by Poornima Institute of Engineering and Technology, Jaipur, Rajasthan, India, on December 23–24, 2021.

ICIMMI conference is organized annually to provide a platform for academicians, researchers, scientists, professionals, and students to share their knowledge and expertise in the field of information management and machine intelligence. It also provides an interdisciplinary platform for researchers, practitioners, and educators to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in these fields.

- We encourage researchers, young scientists and academicians in the field of machine learning as this has been contributed in a variety of ways to our daily lives. Even during the outbreak of the coronavirus disease (COVID-19) pandemic, information management and machine learning has played a vital role in fighting against it.
- Propose new technologies to share their experiences and discuss trends for recent development and strategies concerning information management and machine learning.
- Augment technocrats and academicians by presenting their original and productive information.
- Spotlight on pioneering issues at the international level by bringing together experts from different countries.

ICIMMI-2021 was educative with the brilliant knowledge of invited keynote speakers and ideas represented by young researchers. There will be a wide range of sessions being organized throughout the conference schedule. We would like to thank all the organizing staff, the members of the program committee, and the reviewers. They have worked very stiff to review papers with valuable recommendations for authors to improve their ideas.

Prospective authors from academia, as well as industry, have submitted their full papers in the conference ICIMMI-2021 which have not been yet submitted/published

and that illustrate the research, surveying works, and industrial application in all disciplines of engineering for intelligence-based applications and automation activities, especially with the emergence of data analytics, AI, machine learning and deep learning network security using machine learning.

ICIMMI-2021 Highlights

ICIMMI-2021 was organized by Poornima Institute of Engineering and Technology, Jaipur, Rajasthan, India, on December 23–24, 2021.

ICIMMI-2021 has conducted ten sessions:

- Emerging Perspectives of WSN and Artificial Intelligence for IoT Applications.
- Emerging Challenges and Opportunities of Advanced Technologies and High-performance Computing for IoT and Image Processing
- Big Data Analytics, Data Mining, and Computational Intelligence
- Emerging Trends in the Internet of Things, Machine Intelligence, Big Data Analytics, and Cloud Computing
- Machine Learning and Big Data
- Artificial intelligence, Internet of Things ML/DL as a New Paradigm: Issues Opportunities and their Challenges
- Applications of Pattern Recognition and Deep Learning
- Data Analytics and IOT
- Artificial Intelligence and Machine Learning Techniques in Cybersecurity and Digital Forensics
- Intelligent computing in Multidisciplinary Engineering Applications.

The **Third International Conference on Information Management and Machine Intelligence (ICIMMI-2021)** has been a big success and proved to be very beneficial and informational for everyone. At this conference, we received a total of 217 papers including international and national authors.

There are ten technical sessions and five keynote speakers (international and national) conducted in ICIMMI-2021.

Jaipur, India — Dinesh Goyal
Jaipur, India — Anil Kumar
Milan, Italy — Prof. Vincenzo Piuri
Warsaw, Poland — Prof. Marcin Paprzycki
ICIMMI-2021

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About the Editors

Dr. Dinesh Goyal is working as Principal at revered Institute, namely Poornima Institute of Engineering and Technology. Acquiring an experience of 20 years in teaching, and perceive keen interest in research area relating Cloud Security, Image Processing and Information Security. With a mission to append more and better skill set, has organized short term training programs as Convener and Co-Convener within during this short career span. He has been instrument in obtaining accreditations for his institutions, from various agencies like NAAC & NBA, He has received Grants for Research, Development, Conference & workshops worth Rs. 85 Lakh, from agencies like AICTE, TEQIP, etc. He has been awarded by "Elets Excellence Award 2017" at Higher Education & Human Resource Conclave by Higher Education Department of Government of Rajasthan. Under his leadership, Institutions has also excelled in Industry Academia Interface, has established centers with major tech giants like Microsoft, Google & Amazon, etc. He has six full published patents and one copyright under his name. He has successfully published six edited books with big publishing giants like Springer, Wiley, IGI Global, Apple Academic Press, Taylor & Francis and Eureka. He has published three SCI & 21 Scopus indexed papers & is editors of two SCI & five Scopus Indexed Journals, special issues. He has successfully guided eight Ph.D. Scholars & 31 PG Scholars. He has also attended more than 25 International Conferences & has been invited speaker for more than 15 Conferences & Seminars. He is life member of ISC & ISTE and fellow member of CSI & ISTE.

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Dr. Marcin Paprzycki is an Associate Professor at the Systems Research Institute, Polish Academy of Sciences. He has an MS from Adam Mickiewicz University in Poznań, Poland, a Ph.D. from Southern Methodist University in Dallas, Texas, and a Doctor of Science from the Bulgarian Academy of Sciences. He is a senior member of IEEE, a senior member of ACM, and was a Senior Fulbright Lecturer, and an IEEE CS Distinguished Visitor. He has contributed to more than 500 publications and was invited to the program committees of over 800 international conferences. He is on the editorial boards of 12 journals.

Chapter 1
Analysis and Comparison of Swarm Intelligence Algorithm in IoT: A Survey

Shikha Jain and Mohit Agarwal

1 Introduction

IoT is coined from two words, "Internet" and "Things." Internet connects the things to the many people in the network without inconvenience and the outcome is that it takes us further to the new lifestyle with new application such as autonomous vehicle [1], video surveillance [2], smart home, natural language processing and so on. IoT is a convergence of several new technologies that take part in the success of IoT. Devices connected to IoT includes sensors, actuators, smartphones, RFID tags, smart grids and so on [3], in such heterogeneous network of IoT where every application has different demand for the things attached to it, such as resource allocation, task scheduling, low density, low energy consumption and so on. Different objects/nodes of several features have to communicate with each other in the network so it must be ensured that the several resources are accessible to one another. Resource allocation and task scheduling are one of the issues in the IoT, especially when sensors and RFID tag are used. Usage of resources can be reduced by doing proper task scheduling; many researchers have proposed many algorithms to perform task scheduling for the improvement of network performance [4].

IoT establishes a relationship between real-life physical activities and virtual world. These days, many devices are associated with the Internet, and further, the quantities of such devices are increasing quickly [5]. So, to make resources available to these devices in very less time is the big challenge. In past few years, to get the optimized results, many advanced and latest algorithms have been proposed [6] by many researchers, and they proposed many swarm intelligence algorithms like

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particle swarm optimization (PSO), cat swarm optimization [7], simulated annealing (SA), ant colony [8]. Individually, these algorithm does not produce better results; instead, hybridization of these algorithms gives better results. Discussion of different hybrid algorithm has been shown in the literature review, and comparison is shown in Table 1.

Table 1 Performance comparison of resource allocation and task scheduling technique in IoT

References	Author and year	Techniques	Objective	Results and accuracy
[4]	Ren et al. 2021	Hybrid optimization algorithm of SA and PSO	Low power consumption and lower the cost of allocating resources to the users	Increase performance by 2.6
[14]	Liao et al. 2020	PSO base meta-heuristic	Optimal cost for resource mapping in IoT environment	Achieved optimal cost as compared to techniques of SRA and DAG
[19]	Kong et al. 2019	Improved PSO and greedy algorithm	Minimize the execution time, use to arrange the task in order to their execution time from task basket and to find optimal routing solution	Optimal solution is obtained
[12]	Yang et al. 2019	Time and energy minimization scheduler (TEMS)	To decrease energy consumption and reduce execution time	Decrease energy consumption by 51.6%
[17]	Pradeep and Prem Jacob 2018	Harmony and cuckoo search algorithm (CHSA)	Reduce scheduling time in the cloud environment with multi-objective functions	CHSA gives better results compared to CS and HS
[20]	Prasanth et al. 2019	Hybridization of priority non pre-emptive algorithm and (ACO)	Decrease the task performing rate	Hybrid ACO gives better results compared to normal ACO
[21]	Shi and Zhang 2021	Clustering is used with ACO algorithm	Minimize the energy consumption and increase the network lifespan	Results shows that proposed algorithm is 50% more advanced than known algorithms

2 Swarm Intelligence Algorithms in IoT

Swarm intelligence (SI) algorithm is a simulation method to solve complex nonlinear problems inspired from social and biological behavior of numerous animals like fishes, ants, insects, flock and swarm [9]. The group behavior of these insects exhibits collective intelligence from their interaction (cooperation). SI, a kind of meta-heuristic algorithms, is the ability to handle large-scale and multi-objective problems in multidiscipline [10]. Though IoT is the dynamic and it is connected through several other advance developments like WSN, RFID, sensor technology connects physical objects to each other for communication and decision making. Still, there are many concerns to the researchers in the development of IoT due to its complex and dynamic behavior [11], and SI algorithms are investigated and modelled to compute such complex real-world optimization problems like routing resource management and task scheduling which are very common problems in IoT [12]. Scheduling refers to allocation of resources to several task on a single machine or many machines, and routing is to find best path, and the main goal is to reduce the computation time of the entire task. So, various SI algorithms like PSO, BCO, ACO with their variants [13] are used to solve the above-said problem.

3 Literature Review

The task allocation and resource utilization is the main challenge in the field of IoT for better energy consumption and low computation overheads. Several authors have proposed scheduling optimization algorithms to solve the said problems. Some of which are discussed as follows:

In [4], authors presented that individually SI algorithms like PSO and SA do not produce optimized results so they hybridized these two algorithm to get the better task allocation and resource utilization in the network of IoT, particle swarm optimization (PSO) and simulated annealing (SA). The challenges with PSO algorithm are that it does not produce optimized results in local environment and do not achieve the optimal response. So, the ultimate goal of this hybrid algorithm is to achieve low power consumption, minimizes the cost to allocating the resources to the user and reduce the task allocation time. Liao et al. [14] proposed a learning framework with service reliability, energy-aware and data backlog-aware aka SEB-GSI (global-state information) algorithm with CSI and SEB-UCB algorithm with single-MTD scenario and extended it to multi-machine with some optimization and matching theory. This hybrid combination of algorithm shows the improvement in throughput by 30% and 36% as compared with UCB. The dynamic cost model called TEMS is proposed in [15] authors have approached to limit energy utilization and processing time for allocating the resources to different IoT devices in the edge of different computing environments. Time and energy minimization scheduler (TEMS) scheduling algorithm

chooses the suitable option, and results show that energy consumption is reduced by 51.6% and finish time of task is improved up to 86.6%.

In [16], the combination of ant colony optimization and cuckoo algorithm is presented for resolving the task scheduling problem. These algorithms (ACO and cuckoo) combine their best features to give a hybrid algorithm which performs better than the algorithms when applied individually. However, the constraint in ACO algorithm is that it can search in local domain due to which it does not obtain always optimized results. Harmony and cuckoo search algorithm does not exhibit better results individually, so to defeat the deficiencies of the discrete behavior of the Harmony and Cuckoo search author has suggested in [17] hybrid cuckoo search algorithm with harmony search algorithm (CHSA) and analysis represents that memory usage and energy consumption is less than the other approaches. In IoT, resource allocation with effective cost is required. So, in [18], particle swarm optimization (PSO)-based meta-heuristic algorithm is presented which is established in static environment only. Author achieved optimal cost in the multiple level of IoT network such as edge, node, cloud by multi-component application, although the scalability is the issue which is solved by disseminating the cloud load across edge devices such as routers and internet access devices.

In order to minimize the execution time for multiple robot task allocation (MRTA), Kong et al. presented in [19] combination of improved PSO and greedy algorithm (IPSO-G). Improved PSO is used to search combination of task in the network, and greedy algorithm is used to arrange the task from the task combination in order to their execution. After several iterations, optimal solution is obtained. This scheme is not good for local optimal solution with some special cases. Authors in their work [20], proposed the other approach of lowering the task completion rate of IoT based objects, which involves the combination of two algorithms, first is priority non pre-emptive algorithm to prioritize the tasks and second is Ant Colony Optimization (ACO) to find the shortest path. For low energy consumption, in [21], author approached clustering method to increase network life and control sensor node's energy consumption, and ACO algorithm was used to find optimal path for routing.

4 Application of SI Algorithms in IoT: An Overview

Nowadays, IoT is used almost everywhere which include smart homes, health care, autonomous vehicles, transportation smart city and water management. Various resources are used in IoT to perform such application, but IoT gadgets cannot perform complex issues because of their restricted battery. So, by applying SI algorithms, we can resolve many issues related to resource management. SI is the growing technique, which is the collective behavior of social insects. Swarm intelligence algorithm solves the problem related to self-learning, self-adoptability and creativity.

There is rapid development in transportations sector; autonomous connected vehicles share information with each other where optimized solution is a big challenge; SI-based ACO algorithms is the solution for finding the best path for information

interchange, in which the group of ants use the phenomena to transfer the information to the others in the group to find the shortest path. Another application of SI-based PSO algorithm is used in hospitals to collect the patients information to monitor the health of particular patients by enhancing the multi-sensor frequency to measure body temperature, body fat, heart rate [22].

SI-based multi-objective PSO algorithm is used in cloud computing for optimized energy consumption for customer as well as cloud broker. PSO plays out its streamlining interaction to track down the best arrangements between the customers and the cloud brokers. It reduces the response time for clients and increase the profit of the cloud brokers [23]. Another IoT application is home energy management system (HEMS) where the most valuable resource is energy consumption as far as power cost decrease, SI-based grey wolf optimization (GWO) and bacterial foraging algorithm (BFA) methods enlivened by the idea of dark wolf and bacterium individually are used to find best optimal results [24]. Another SI-based cuckoo search algorithm is proposed for the smart homes to tackle the apparent light correspondence (VLC) power inclusion issues [25]. Basically, SI-based algorithms are used to find the best path in different environment; this application of SI algorithms is used in IoT.

5 Conclusion

In this paper, various swarm-based hybrid algorithms are discussed. It can be easy to conclude that hybrid algorithms are more efficient and outperforms the individual algorithms. SI applications give better results to find optimized results in centralized way, when there are so many constraints like scalability, sensors with less energy empowered and many more. With this advancement of technology, SI will assume a significant part to solve complex problems. This paper inspires the researchers and gives idea of combination of algorithms in producing better results beyond the current ones.

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Chapter 2
Implementing Client-Side Encryption for Enforcing Data Privacy on the Web Using Symmetric Cryptography: A Research Paper

J. David Livingston, E. Kirubakaran, and J. Immanuel Johnraja

1 Introduction

Security is the major concern for all users accessing the Web. The Web needs to be secured as valuable information is stored on it. The Web is prone to different forms of attacks, which threats its security. An unauthorized user with malicious intention can threaten the integrity of information on the Web. He may try to connect to competitor's site and download information or business secrets from it. Therefore, it is the duty of every user of the Web to protect his/her valuable information on the Web by protecting the client, server, and the network—the three major components of World Wide Web (WWW). The client on the Web is the computer at the user end. On the client, the Web browser and the local system are at risk. The server is a remote computer on the Internet that hosts the Web server. The data on the server are prone to modification or damage by unauthorized users. The connection between the client and the server is also at risk because the data being transferred between the source, and the destination can be modified maliciously during transit. Hence, security mechanisms are of great importance because they ensure confidentiality and integrity of information on the Web. The basic security mechanism to ensure confidentiality of data on the Web is cryptography. Cryptography is the science of converting data that is in a readable form into an unreadable form. It is used to

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protect information from numerous risks and attacks on the communication medium between transacting parties. In this paper, the client-side encryption—a mechanism using which encryption of data at the client side before its migration onto the Web is discussed.

There are two types of cryptographic techniques, based on the keys used for encryption—symmetric and asymmetric. In symmetric cryptography, the receiver can decrypt the ciphertext using the same key with which the sender encrypted the plain text. On the other hand, in asymmetric cryptography, a pair of keys is used for encryption and decryption process. In this key pair, one key is public to both the sender and the receiver. The sender uses the public key to encrypt the plain text. The second key is private to the receiver with which the decryption of the ciphertext can be done. The following are the two major differences between the symmetric and the asymmetric-key cryptography:

i. The process of encryption and decryption is faster in symmetric cryptography as compared to that of asymmetric cryptographic algorithm.
ii. Key distribution is a big problem in symmetric-key encryption, whereas it is not at all a problem in asymmetric-key encryption algorithm.

Both types of encryption methods have advantages and disadvantages. Though the key management is a big issue in symmetric cryptography, the algorithm is easy to implement since it uses a single key for both encryption and decryption. It also works faster than that of the asymmetric cryptography. Thus, the symmetric-key encryption is recommended for use to encrypt data that are not supposed to be shared with others on the Web. In that case, nobody other than the owner of the data knows the key used for encryption. Thus, other people, without knowing the key, cannot read or modify confidential information stored on the Internet.

2 Client/Server Architecture of Web Application

2.1 Web Client and Web Server

Web browser is a client application that provides the interface using which a Web user can interact with the Web server for Web site navigation. Internet Explorer and Netscape Navigator are some of the commonly used Web browsers. A Web server, on the other hand, is a server application running on a remote machine. Web servers use protocols to enable communication over the Internet. Hyper-text transfer protocol (HTTP), file transfer protocol (FTP), and simple mail transfer protocol (SMTP) are some of the protocols used for the interaction between the Web server and the Web browser (Fig. 1).

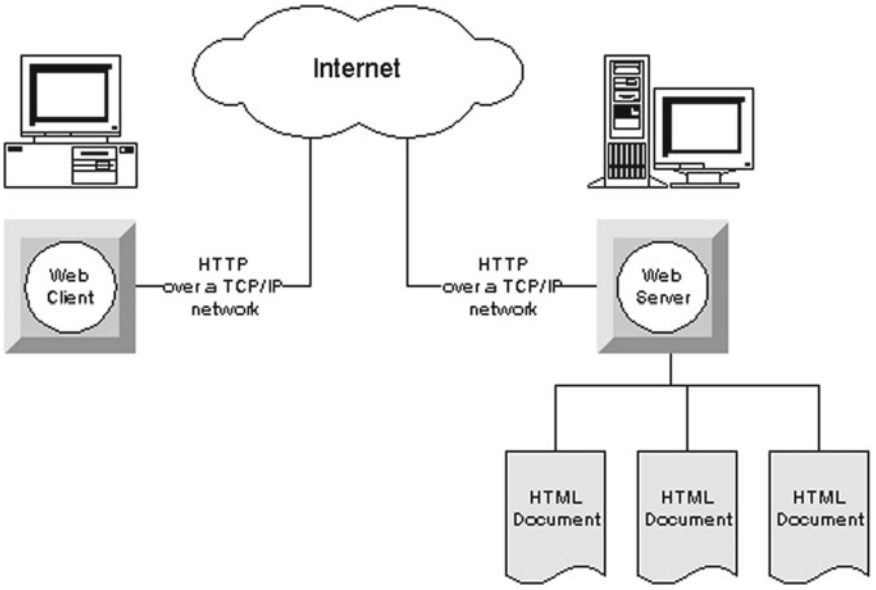

Fig. 1 Interaction between Web client and Web server on the Internet

2.2 Need for Securing the Confidential Data on the Web

The Web is prone to different forms of attacks that threaten its security. At the client side, the Web browser and the local system are at risk. The server, on the other hand, comprises the Web server. The data on the server are prone to modification or damage by unauthorized users. Hence, the confidentiality of data is of utmost importance when using the Web. Data confidentiality can be achieved by applying encryption on data that can be stored and retrieved from Web server. In this research, encryption of confidential data is scheduled to take place at the client side before their migration onto the Web for their storage at the server side.

3 Two Types of Research Approaches

There are three major steps involved in doing a research. They are as follows:

i. Formulation of research question
ii. Reviewing the existing literature and finding the research gap
iii. Articulate and enhance the research question and proposal to others in order to convince them.

A good research is systematic, and at the end, the data collected during the research support very strongly the statements, and the claims, or the arguments that

the researcher put forth on the basis of collected data. Research approaches are plans and procedures that include various steps such as data collection, data analysis, and data interpretation. There are two major classification of research approach based on the methods used for collecting and analyzing the data to be handled in research. They are namely qualitative approach and quantitative approach.

3.1 Qualitative Approach of Research

Qualitative approach makes use of the following methods for data collection and interpretation:

- It makes use of emerging questions and procedures for data collection
- Data collection typically takes place in participant's setting
- Data analysis leads to the interpretation of the meaning of data being collected
- Finally, the qualitative research involves preparing the final written report.

3.2 Quantitative Approach of Research

Quantitative research involves the following steps for collecting and analyzing the data during the research process:

- It makes use of testing objective theories for finding the relationship among variables.
- Data are derived from instruments.
- Data analysis of numbered data is done with the help of statistical procedures.
- At last, the researcher has to prepare the final written report under various headings that include (a) Introduction, (b) Literature and Theory, (c) Methods, (d) Results, and (e) Discussion.

4 Securing Data on the Web

The Web is prone to different forms of attacks that threaten its security. At the client side, the Web browser and the local system are at risk. The server, on the other hand, comprises the Web server. The data on the server are prone to modification or damage by unauthorized users. Hence, the confidentiality of data is of utmost importance when using the Web. Data confidentiality can be achieved by applying encryption on data that can be stored and retrieved from Web server. In cryptography, the sender encrypts plain text into ciphertext by using a mathematical algorithm and a key value. Although the algorithm that a sender uses for encryption might be a general mathematical formula, the keys will be secret values known only to the sender and the receiver. The secrecy of keys prevents people other than the sender and the receiver

from understanding the message, thus preventing unauthorized access on the critical data.

Cryptographic techniques can be classified broadly into two types: symmetric-key cryptography and asymmetric-key cryptography, based on the keys used for encryption. In symmetric-key encryption, single key is used for both encryption and decryption. The receiver can decrypt the ciphertext using the same key with which the sender encrypted the plain text. On the other hand, in asymmetric-key encryption, a pair of keys is used for encryption and decryption process. In this key pair, one key is public to both the sender and the receiver. The sender uses the public key to encrypt the plain text. The second key is private to the receiver with which the decryption of the ciphertext can be done. The following are the two major differences between the symmetric and the asymmetric-key cryptography:

i. The process of encryption and decryption is faster in symmetric cryptography as compared to that of asymmetric cryptographic algorithm.
ii. Key distribution is a big problem in symmetric-key encryption, whereas it is not at all a problem in asymmetric-key encryption algorithm.

Both types of encryption methods have advantages and disadvantages. Though the key management is a big issue in symmetric cryptography, the algorithm is easy to implement since it uses a single key for both encryption and decryption. It also works faster than that of the asymmetric cryptography. Thus, the symmetric-key encryption is recommended for use to encrypt data that are not supposed to be shared with others on the Web. In that case, nobody other than the owner of the data knows the key used for encryption. Thus, other people, without knowing the key, cannot read or modify confidential information stored on the Internet.

Kartit et al. [1] in their journal article identified two algorithms—AES and RSA for securing sensitive data on the cloud. AES is a kind of symmetric cryptography, whereas RSA is of type asymmetric cryptography. With the help of these two existing cryptographic algorithms, the authors proposed a new model for securing data on the cloud. In the proposed model, AES is used for encrypting the plain text, and RSA is used for encrypting the key used by AES. As per this model, plain text is encrypted using symmetric cryptography, and the key used for encrypting the plain text is encrypted using asymmetric cryptography. By applying both symmetric and asymmetric cryptography in encryption, both data as well as the key for encrypting the data are kept secret [2].

5 Client-Side Encryption of Data on the Web

The Internet provides remote access to resources such as storage and computation available worldwide. The virtual interaction of people on the Internet makes it difficult to recognize the identity of a person. In addition, the open-network structure of the Internet might allow third parties to read and change data in a communication over the network. Hence, every organization must maintain the integrity of data by preventing

unauthorized modification. To secure confidential information on the Internet, one must put into practice necessary security measures.

Cryptography is a technique that helps to reduce security risks to the confidentiality and integrity of the data on the Internet. Moreover, the encryption of confidential data can be done either at the client machine (Web client) or on the server (Web server). The side (client/server) at which the encryption has to take place is decided based on the confidentiality of data to be protected. The critical data that need highest security in an organization are considered as in Level 1. In Level 2, we have information that is important but not critical as in Level 1. Level 3 comprises of data that are not important in the daily operations of an organization.

Among the three levels of confidentiality, data exist at Level 1 and Level 2 need encryption so that they can be kept confidential on the Web. As the data in Level 1 is both confidential and important, it must be encrypted at the client-side itself before their migration onto the Web. Whereas, data in Level 2 can be encrypted after their migration since the criticality of data in Level 2 is less compared to that of Level 1.

Encryption of data in the database (at the client side) must be done before moving the data to the remote database. For Level-1 data (having critical and important information), the standard symmetric encryption algorithm—advanced encryption standard (AES)—is suggested. For Level-2 data (having only important but not critical information), an extended play-fair algorithm is proposed [3]. Encrypting the data needs to be done for text files before they are uploaded onto the server. The key used for encryption must be kept secret in a local database for performing decryption process.

For encryption and decryption of text files at the client, either we can go for the standard algorithm like AES or an extended classical algorithm like extended play-fair algorithm. AES is the best option for securing the data which are more sensitive in nature. But, searching a sub-string is not possible when the data are encrypted using AES. This limitation of AES is overcome by using an extended play-fair algorithm, which is meant for encryption of less-sensitive data in a file or database.

The major difference between AES and the proposed extended play-fair algorithm is that the standard algorithm—AES is a block cipher, whereas the extended play-fair algorithm is a stream cipher. AES operates on a block of data (say 128 bits) at a time. But, the extended play-fair algorithm operates on individual character. It considers each and every word (sequences of characters that form a word in English) as a block during encryption. Hence, it allows the searching of encrypted text on the server word by word (word search). Moreover, it considers the ordinal position of each and every character in a single word as a key for encryption of plain text to ciphertext. This results in a polyalphabetic cipher that can map the same character that appears more than once in a word with two different ciphertext characters.

6 Conclusion

In this research, the authors have suggested client-side cryptography for securing data moving from the client onto the server. The scope of this research is to secure data that are stored in any one of the file formats that include text (txt), comma separated values (csv), or Excel Sheet (xls). secure non-sensitive data stored in the cloud database. As a solution to provide security at the client-side itself, it is found that the data which are important as well as critical (Level 1) must be encrypted using advanced encryption standard (AES), whereas data which are important but not critical (level 2) can be encrypted at the client side with the help of an extended play-fair algorithm so that searching is possible on the encrypted data on the server.

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Chapter 3
System to Analyze Electricity Consumption Using IoT and On-Demand Cloud CRM Salesforce

Jasmine Narula, Sunil Kumar Jangir, Shatakshi Singh, Manish Kumar, Dinesh Goyal, and Vijay Kumar

1 Introduction

Consumption of electricity in Indian homes has increased by three times since 2000. The fraction of households with electricity supply access rose up to 55% in 2001 and to more than 80% by the year 2017. In the year 2014, 90 units (kWh) of electricity per month were consumed by an average Indian household which could provide enough power to four tube-lights, four ceiling fans, a television, a small refrigerator, and small kitchen appliances with typical usage hours and efficiency levels in India [1]. It is the need of the hour to control the usage of electricity, but before controlling, we must know the appliance which uses most of the electricity so that either we can

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replace it with an alternate device which uses less electricity or minimize the usage of device.

Earlier, the Internet was barely used by common public, but gradually with time and digitalization, now, the Internet is a dense network of many other network connection, and the number of connected devices is still increasing rapidly every year [1]. The Internet is primarily used to access, process, and operate on the real-time data from any of the remote locations. The implementations of IoT-based systems are inexpensive. The modern IoT systems are also integrated with latest technologies such as cloud computing, visual computing, and big data networks.

Power grid systems which were conventionally used are not capable of leveraging the real-time analysis of any data from the consumer's end. Some of the conventional systems such as the on presented by Ashwin Raj et al. [2]. The smart grid system and smart meters, in which tremendous research has been done, make it possible to meet the incessant fluctuations in the demand of power from the vast number of consumers. The smart meters are used to supply the required data for the smart grid which further helps the grid in providing the response by itself, automatically. This kind of a system itself manages the requirements of energy using the two-way interactive system, which includes the ability of system to fetch the information from user's end and the supply ends and further leverage it to make sure that the overall reliability and efficiency of the transmission lines is efficient. When it comes to real-time data analysis, these conventional systems are not very efficient. Smart meters were mostly used to make sure that automatic energy management is there using the recorded and the real-time reporting of the exact consumption information without any human intervention and from any remote place. By leveraging the ability of the sensors like heat and electricity sensors, environmental sensors, and others, IoT-based devices utilize the data collected at real time, through the real-time analysis of live data, to make it possible to adjust the energy consumption according to various physical and environmental conditions such as temperature and lighting [3]. Thus, the system to analyze electricity usage using IoT and on-demand cloud CRM Salesforce is being used for real-time analysis. But, there is a drawback of smart meters that is they do not provide information of a single gadget which is accomplished with this work.

This system to analyze electricity using IoT and on-demand cloud, CRM is an effective method through which we are able to fix the amount of the bill we want and also save the electricity.

Salesforce is an easy-to-use Web site. It has both apps and Web sites which can be used in mobile phones as well as laptops and desktops. Users can login and access it from any remote place to collaborate with their colleagues and can view or modify the customer data as per their convenience. Salesforce make this process very flexible as compared to other similar software available in market. It has provided users with a very secure and sophisticated cloud infrastructure that further provides unparalleled cloud solutions for different business problems, mainly the sales, marketing, support, and analytics. All the Salesforce users around the globe, irrespective of their location, share the same infrastructure and instance of the software. This makes it possible to automatically and simultaneously update the data for all the users, while keeping

the data safe and secure. The users get the privilege of using the latest and updated features with automatic seamless upgrades, generally three times annually.

Nowadays, personal computers are preferred to be used as the platform to design and implement algorithms due to the simplicity they provide to write, modify, and update software programs that implement a control algorithm [4]. In this paper, we have used Salesforce which guarantees us the security of our data. No other user will be allowed to access the data, maintain the data privacy, and resulting in a secure platform. In case a user installs this system in their house, they will be having access to all their information of the electricity usage of each appliance in Salesforce mobile app as well as on the Salesforce Web site on PC.

2 Related Work

Anamul et al. successfully integrated the digital controller having an analog plant, and a common interface device that can perform the necessary tasks was used within the PC [5]. The interface box/device was in control via the computer by establishing a connection with the parallel port and design any program for different operations in any of the preferable programming language. The program presents a simplified idea of the way in which the devices and monitor events are controlled. Using the program, users can enable the computer to turn electric devices ON/OFF, while they are away from home by using the option to set time. The software developed by them can be executed successfully on Windows 98/ME/NT/2000/2000 Server/XP [4]. In this work, the devices are turned on and off with the help of the personal computer, and the timings are noted according to that. However, this paper notes the timing when we physically start the devices and turn off the devices. It is only design for knowing the timings of the device and not helping the users to know the usage of electricity by each electrical appliance.

Smart meter is an advanced energy meter that measures the energy consumption of consumers and provides information to the utility by two-way communication [6].

Smart metering architecture (SMA)/advance metering infrastructure (AMI) [7] is a very significant task in the smart grid [8, 9]. In a system, where every individual power user is having with a smart meter installed, to make the two-way communications possible, back to the utility company, along with the variable tariffs, outage monitoring, prepayment, and remote disconnect [6].

At a discrete manufacturing company that is based out of Spain, a lot of smart meters were installed at the machine level to acquire the real-time energy consumption data. This data were later analyzed and provided to the stakeholders for the decision to optimize the consumption of energy by leveraging the proposed system in the decisions based on production management. The acquired data are then stored and analyzed using the cloud computing. The analysis of cloud computing and any suggestions or warnings can then be shared with the owner who installed the system. Even the experts working on the energy management can perform real-time assessment as they have a clear picture of real-time energy consumption [10]. The smart

meters give access to the real-time data and assist in decisions-making process [11]. Rather, there are several sustainable practices that can be done by utilizing IoT-based technology for optimizing the energy consumption at the production level [12].

Arijit and Soma addressed the issue of the involuntary privacy breaching risk minimization in smart energy management systems by proposing a novel solution "Dynamic Privacy Analyzer" with an agenda to accomplish a unique privacy metric which is derived from the fundamental principles like robust statistics and information theory. Then, the performance of proposed scheme is further analyzed with a very large open-source dataset of real smart meter before evaluating the criteria for optimality, for example, utility-privacy tradeoff and others [13].

3 Methodology

The system to analyze electricity using IoT and on-demand cloud CRM is designed for such purposes which comprise a microcontroller to which appliances are connected. A microcontroller is simply a very compact-integrated circuit, primarily designed to perform a specific operation. A basic microcontroller mostly includes a processor, memory, and input/output (I/O) peripherals on a single chip.

In this work, a Raspberry Pi is used to connect with the electrical devices that people use in their daily life like bulbs and fans. Raspberry Pi is connected with our PC which is coded in Python, with the help of "simple-salesforce" library, it was connected to Salesforce directly. Through this, all the reading which are taken by the system will be uploaded to the salesforce application automatically ensuring security of our data. One can view usage of electricity of each device in any form like graphs and charts.

To note the values from bulb and fan "datetime," "GPIO," "time," libraries are used in the Python program. After getting the duration till which the bulb or fan is used, the total units consumed by the devices are calculated, and according to that the cost of the electricity usage is found of each device. For example, if a bulb is switched on that uses 1000 W for an hour, consumption of electricity of 1000 W bulb in 1 h (in units) was 1 unit. Cost of 1 unit is Rs. 10.20. Cost of electricity consumed by a 1000 W bulb in 1 h is Rs. 10.20. Now, if a 1000 W bulb is used for 12 h a day, then cost of electricity consumed by that bulb is Rs. 122.40. Similarly, if there are four bulbs of 1000 W each and are being used for 12 h daily, then cost of electricity used by each bulb: Rs. 122.40. Total cost of electricity per day by four 1000 W bulbs will be 4 * 122.40 (in Rupees), i.e., Rs. 489.60.

This means that usage of four 1000 W bulbs for 12 h daily will cost us Rs. 500 approximately. Through this, it can be concluded that if one has to reduce our daily consumption of electricity by bulb, then one should either replace the bulb with another bulb of low watts or need to minimize the use of bulbs.

Workflow of Smart Meters: The primary function of smart meter is to measure the electrical current flow and voltage at constant intervals. Then, it sums up the collected

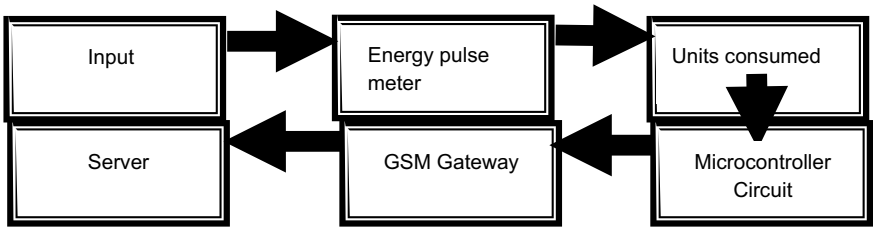

Fig. 1 Workflow of smart meter

data to compute the power used in a half-hour duration. This information is then sent to consumers on our home display or to the suppliers. These meters continuously monitor and improve their performance. Their workflow is taking the input from the electrical devices and then passing it through the energy pulse meter which counts LED pulses from consumers house meter and converts it into watts and accumulated kWh and then calculating the units consumed by the device and sending it to the microcontroller circuits and then to GSM gateway which is any instrument having a SIM card that makes the routing of calls possible from fixed apparatus to mobile equipment by establishing a call from mobile to mobile and ultimately to the server for further usage (Fig. 1).

The data from each appliance is collected and forwarded to Salesforce, which is appreciated for its customer relationship management (CRM) product. The collected data are further visualized mostly using a chart or graph of different kinds including bar chart, donut chart, timeline, or heat map, depending upon the type of data and its specifications. Providing customers with the information in its most simplified form collected using the IoT-enabled devices can boost the adoption of connected home technologies in many ways.

4 Results

As per the results, the data are being collected from the devices, analyzed, and sent to the Salesforce. Figures 2 and 3 show the per day consumption of electricity (in hours) by a normal ceiling fan (75 W) and a bulb (1000 W). These results are stored in the Salesforce and can be used further for the bill estimations.

The device dashboard includes the graphical data as per the device. Figure 4 represents the number of hours each device consumes per day. This dashboard is created in order to have a better look and feel menu for the end user (Fig. 5).

On this device, dashboard user can see graphical data for multiple devices as per the date (Fig. 6).

The bill amount dashboard, which shows the total bill for each day. As on 4/2/2020, the devices fan and bulb were used and created a bill ₹50.7. Similarly, as per the day, the bill is created, and user can see the amount and can easily estimate the bill for a

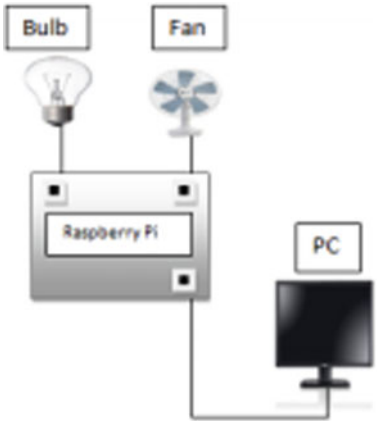

Fig. 2 Connection of Raspberry Pi with bulb, fan, and a PC

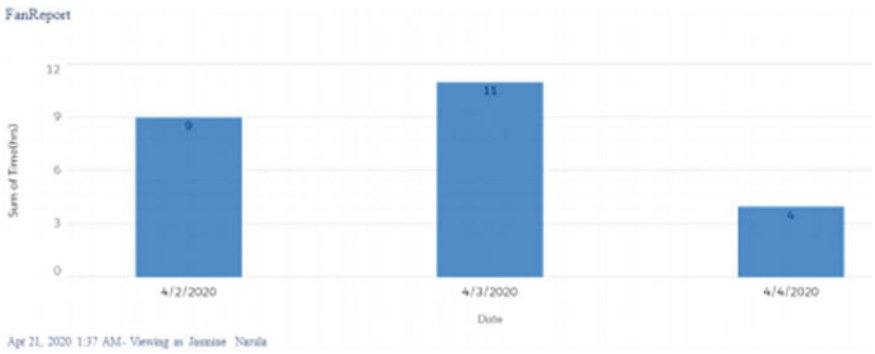

Fig. 3 Date and time graph of fan

Fig. 4 Date and time graph of bulb

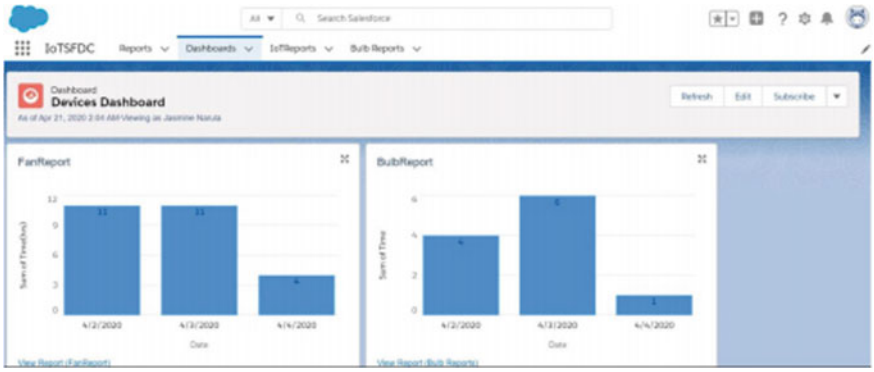

Fig. 5 Devices dashboard

Fig. 6 Bill amount dashboard

month. The dashboard also shows the total bill till today's date. This dashboard's data can be shown in many ways. Figure 5 is representing it in two ways—graphical and donut chart. There are more ways available like vertical bar chart, funnel chart, and line chart. This can be used as per the requirements. In this way, this "out-of-the-box" integration made this system distinct.

5 Conclusion

The twenty-first century has seen many great discoveries and advancements, especially in the field of technology. These advancements also brought many challenges and require approaches to handle these challenges. The system to analyze electricity using IoT and on-demand cloud, CRM is one such approach. It is the most economical implementation to develop mankind in this era of technology. So, this work shows us that how customers can manage electricity bill from IoT-enabled devices. Thus,

by using analytical tools (here, Salesforce), we can explore and visualize electricity used of each appliance and can also discover relationships, patterns, and trends in usage of electricity.

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Chapter 4
Stera—A College Enquiry Chatbot

D. Renuka Devi, T. A. Swetha Margaret, and S. Deshma

1 Introduction

In the early 1980s, researchers were trying to develop a machine that not only accepts user's commands, but also can interact with human. Human–computer interaction (HCI) mainly focuses on the implementation of an interactive machine that can satisfy the user needs. With HCI as the base, a conversational user interface has emerged, that allows users to communicate with the machine through voice or chats. Chatbots are basically the virtual assistant that is capable of answering the user's queries. Some of the chatbots which people use in their everyday lives are Google Assistant, Apple's Siri, Microsoft's Cortana, and IBM's Watson, etc. According to McTear et al. [1], a chatbot must be able to do the following:

- Recognize the text sent by user.
- Interpret the words and discover what the user meant.
- Formulate a response or clarify any doubts with the user.
- Construct the response.
- Display the response.

Additionally, a chatbot must possess intelligence to automate the repetitive tasks and to learn from the environment. Artificial intelligence (AI) makes the chatbots intelligent enough to provide conversation like human being. To make a chatbot think and reply like humans, AI enables the machine to perform cognitive tasks such as reasoning, learning, planning, perception, and linguistic intelligence. Without an AI, chatbot is simply a FAQ answering bot.

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The objective of the proposed work is to develop an educational chatbot that serves the purpose of all educational institute in a proficient way. The paper is split into various fragments covering the background work, the proposed Stera chatbot model, and deployment.

2 Related Work

ELIZA [2] is a chatbot developed by Weizenbaum in 1964 at MIT lab. It was the earliest chatbot intended to provide natural language communication for the patients as psychotherapy. The concept behind ELIZA is, it reads an input text from the user and finds out the keyword, then, replies with the answer. ELIZA was a rule-based model, because it works by storing large number of rules which connects the keywords.

Sample conversation with ELIZA would be like: User: My mother does all the work ELIZA: WHO ELSE IN YOUR FAMILY User: My father. Based on the input keyword "mother," ELIZA tries to find the rules which connects "mother" and "family" and produces output. The objective of ELIZA is to make the conversation lengthier, and it was incapable to build logical reasoning.

Artificial linguistic Internet computer entity which is abbreviated as A.L.I.C.E is the first artificial intelligence mark-up language (AIML)-based personality program, developed by Wallace in 1995 [3]. It works on pattern-matching concept, where it uses AIML templates to make a response. At first, the A.L.I.C.E bot gets the user input text and stores it as category. Each of the categories will contain response templates and context. Then, it performs preprocessing and matches the input text against nodes of the decision trees. To make A.L.I.C.E smarter, it has to be trained with more categories. Also, it is difficult to maintain and does not support natural language understanding (NLU).

UNIBOT [4] is a university chatbot developed to provide information regarding university fee structure, events, address, and other details. UNIBOT uses HTML, CSS, and jQuery for frontend and PHP for backend. The algorithm proposed in [4] starts by accepting an input text from user, then, preprocess the input text and execute SQL to check whether the words found in the database. If the word is found, UNIBOT would retrieve answers to user's queries, and, if the word is not found in the database, it responses with some default answers. It follows dynamic approach by preprocessing the input text before it gives a response. The drawback of UNIBOT is, it is not integrated with college website and could be implemented with advanced NLP concepts.

Susanna et al. [5] designed a college enquiry chatbot using CodeIgniter (PHP framework) and MYSQL. The objective of the chatbot is to answer the student queries online without making them to visit the college in person. User queries would be processed by getting an input text and matching the keywords with the database. The database contains multiple tables that stores keywords and answer sentences. The chatbot allows students, parents, and faculties to get instant messages regarding

college activities. But, the chatbot will be slow in giving response when multiple user's login and accessing at the same time.

3 Proposed Work

The proposed chatbot Stera, is a virtual assistant which assist user's (students) by providing information such as college hostels, campus placements, training, GPA, programs offered, and guides students to select a right course and much more. Stera is developed using RASA NLU [6] which is a framework for developing AI-powered chatbots. Stera uses algorithms such as bag-of-word (BoW) [7] to predict intent and conditional random field (CRF) [8] to identify the entities. When user enters an input query via GUI, the input query is given to the chatbot. Once the bot gets the input query, it uses Whitespace Tokenizer to break the statement into words.

Next, Stera finds an intent that matches the input with highest confidence. It tries to extract the entities present in the user input. Then, it returns the output defined in response knowledge base. If there is a query from student like "calculate my GPA," which needs additional information from students such as department number and password, in this case, the bot will collect necessary parameters using entities, slots and forms. Then, it will automatically trigger the custom action for the specified intents. Custom actions are defined using Python language.

The working of the projected model is depicted in Fig. 1.

Figure 2 shows use case diagram of Stera Chatbot. Use case diagram is the graphical representation of the behavior of each and every entity that interacts with the system. It has three actors: students, admin, and Stera bot. Students act as the primary actor and their goal is to get correct response as quickly as possible. Stera is the assistant that finds the user input, preprocess it, and predicts the next action to be displayed to user. Here, admin is the developer who can add training data to the bot in the future and can debug it.

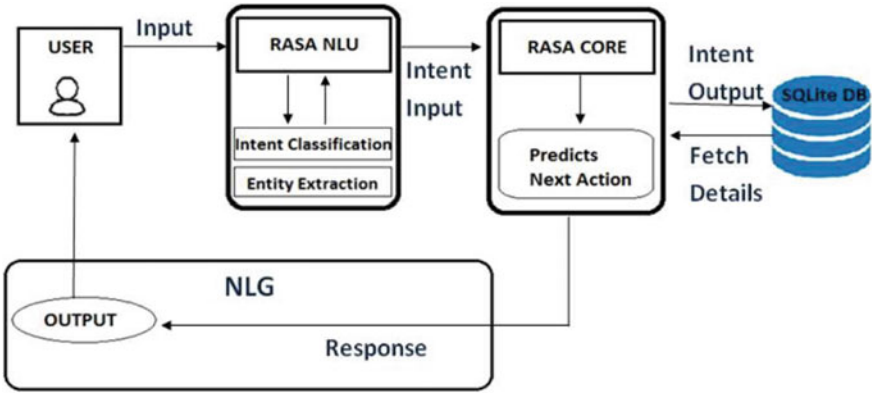

Fig. 1 Stera model

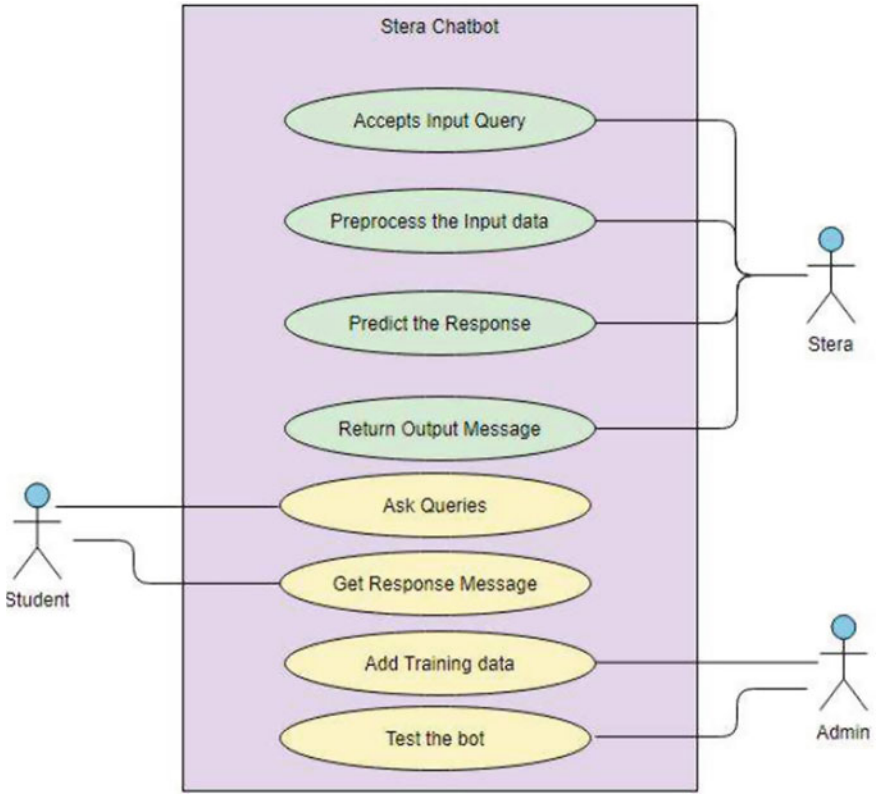

Fig. 2 Stera model—use case

Stera is implemented using Python, RASA NLU [9], RASA Core, SQLite3, HTML, CSS, and JavaScript. The key purpose of creating Stera bot is to allow users to interact easily and get information as quickly as possible.

The main functions of Stera are:

- Greet the user.
- Provide menu with list of options to select.
- Return the most suitable response stored in knowledge base.
- Give users the feel of chatting with real human being.
- Retain the flow of the conversation from begin to end.
- Understand the mood of user and act accordingly.
- Get necessary input parameters from user and validate it.
- Guide the students to select a right course.
- Navigate the students with appropriate links.
- Respond with fall back answers cordially.

The interface of the Stera Chatbot is presented in Figs. 3 and 4.

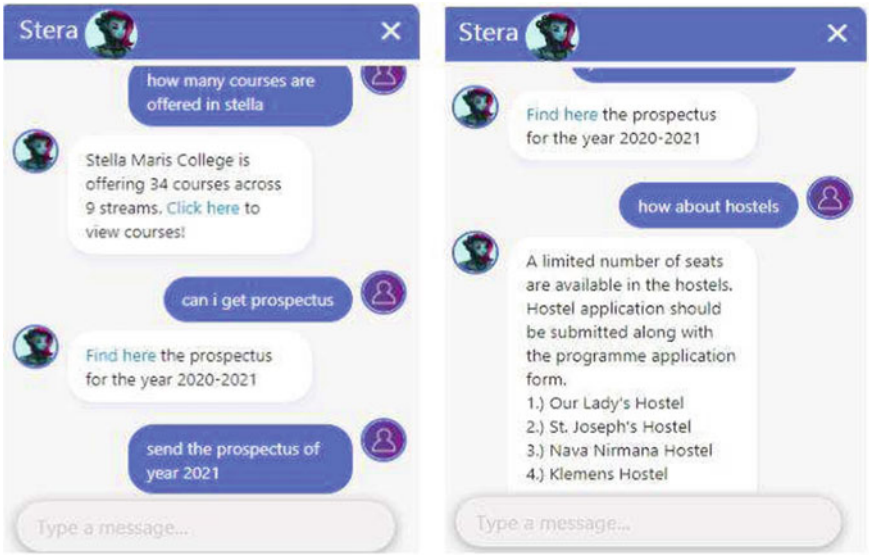

Fig. 3 Stera responses with different user input

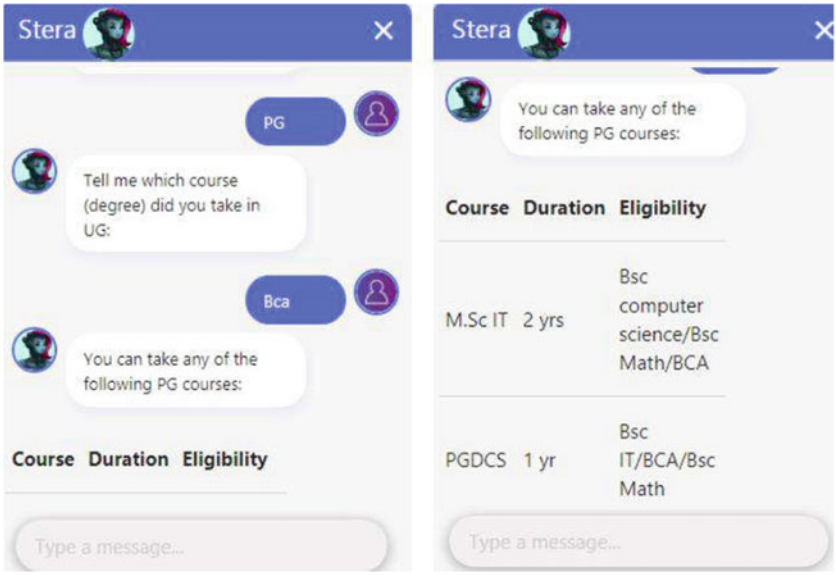

Fig. 4 Stera's guidance on choosing a course

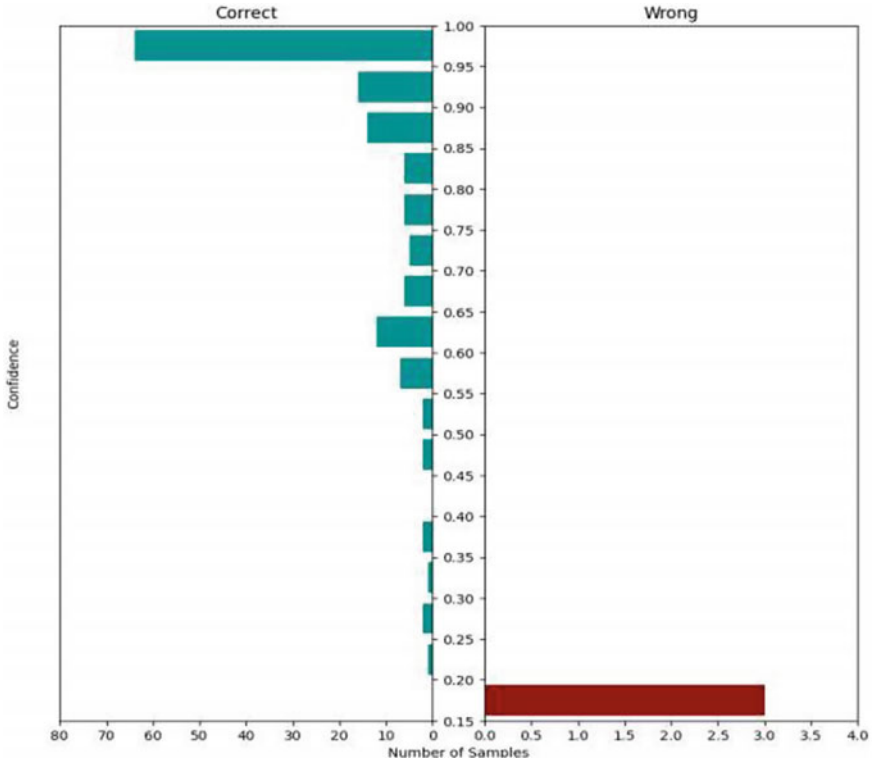

Fig. 5 Intent prediction confidence distribution

4 Performance Analysis

The proposed Stera Chatbot has been successfully tested. Figure 5 shows the intent prediction confidence distribution graph [10]. It denotes effectiveness of the Chatbot as the number of wrong predictions is lesser than the correct predictions.

The action confusion matrix for Stera is presented in Fig. 6.

5 Conclusion and Future Work

Virtual assistant is one of the promising applications of AI and ML. Nowadays, most of us are using Siri to ask something or Alexa [11] to order things through enterprise websites. Chatbots are finding novel applications in today's context as we move toward automation. People are using online chatbots to navigate through websites, get response quickly, get solution for the complex technical issues, order things in

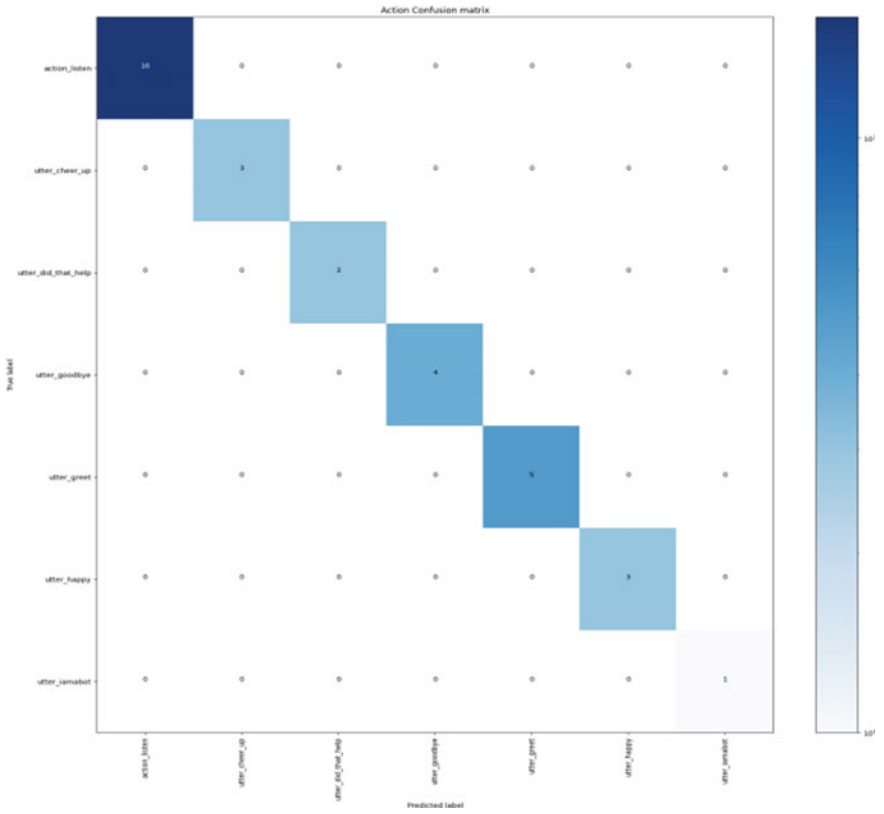

Fig. 6 Action confusion matrix

online shopping sites, etc. But, chatbots are less used in educational websites as it may reduce one-on-one communication between student and higher officials.

It is essential to implement AI-based technologies such as chatbots in college [12], so that, students will get quick response for college-related queries. In this project, a chatbot called Stera is developed. It can accept student queries in the form of text and returns output using the trained data. It is integrated in a website which provides an effective GUI for students to communicate seamlessly. Stera is able to greet the students, navigate them by providing appropriate links, calculate GPA for students, and guide them to select a course, understand the mood of students and act accordingly. This work can be extended to include voice input and output in order to make it more real. Further, the knowledge base can also be expanded by including more data for multiple modules. Since the chatbot is for the college related questions, teachers or staffs may also have queries. So, chatbot can also include staff module to improve Stera's capability.

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Chapter 5
Mobile Image Analysis for Detecting Melanoma

S. Gowri, R. Surendran, J. Jabez, and Senduru Srinivasulu

1 Introduction

Accessible melanoma detection mainly focuses on the work by using mobile image analysis. Melanoma could be coming under carcinoma variety which is produced from the epidermis of pigment cells. Skin cancers are of three kinds: malignant melanoma, epithelial cell carcinoma and basal cell carcinomas. The most dangerous one is malignant melanoma. Image processing could be a method to reinforce cameras which is in satellites, aircraft and photographs captured on daily basis for different applications using raw images. In the last five to six decades, a huge number of applications have been developed in image processing techniques. Images obtained from unmanned spacecraft and space probes and also in military flights are developed for image enhancing the easy accessibility of computers, huge devices and graphical software. To convert a signal from the picture into an image in physical nature is accustomed to image processing. The image signal is of two ways that are digital and analog. In this process, a picture is being captured and scans the employing camera to form analog and digital imaging and to provide the picture and the techniques supported by the sources of input. So, to provide the picturing, the processed image is used by the acceptable techniques which are supported by the source-type input. In the image capturing the data, the file is stored by seeing the picture [1]. The file is being translated as photographic software which comes up with the original image. The information about the picture is translated as color, darkening and sound which

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are captured at the photography time [2]. At the time when the image is created by analog photography, the photograph is turned into a movie by employing a chemical process that is maintained by light exposure [3].

The familiarity of the process is getting decreased because of the availability of variant photographs that needs very low effort and training to unique images [4]. The sector of imaging using digital processes has been developed for a range of entire recent applications that were considered as not possible. Because of the event of image processing using digital imaging method, the recognition of face software, remote sense method and processing of medical image is available.

The proper images are getting enhanced for special capability computers and enhance even better. There are two types of photographic purposes; they are grayscale and color. The images of grayscale are the product of pixels that remains to be gray, and the colour images are made up of pixels that are colored. The image of grayscale is formed by pixels where every pixel holds one number which admires the gray level at the chosen location. The span of the total range of the gray levels from black to the color of white in the series of fine steps is normally up to 256 various grays. Considering 256 grays, where every black and white pixels are stored in a byte, that is 8 bits of memory.

The colored image is formed by pixel in which it holds three numbers R, G and B levels in the location of selection. All these levels are stored in three bytes, that is twenty-four bits of memory. The point is that for identical size, the black and white version uses three times lower memory than that of the version of the color. The images in binary use a single bit to represent an individual pixel. Every pixel in the image in binary should be one in every color of two which is black and white. The inability to exhibit intermediate balance limits its use to addressing the images.

The main objective of the proposed work is to detect the melanoma in the skin using fasted K-means segmenting method.

2 Related Works

In automated melanoma recognition, analyzing the monitored images captured from ELM is developed to boost identification of skin cancer [5]. The skin injury has been decided by using various segmentation algorithms. The collection of property has a form and radiometric quality and it also has local and global parameters, so it is calculated to explain the state of the injury [6]. In the early diagnosis of melanoma by using the image captured from a smartphone, we are introducing the detection system that fully runs on that phone [7]. By using two segmentation processes and also by binding the fusion detection, we can localize the skin injury [8]. Here, we introduce new attributes to catch the variation of color and irregularity of the boundary, and they are useful for images captured by smartphones [9]. This evaluation approves the advantage of the algorithms and attributes of the proposed system. In the visual

search, here, we study color. A mixture of voice note text, pictures, video and animation are included by multimedia [10]. Through media and request text, multimedia searches queries. Multimedia attributes can be found with small information [11].

3 The Proposed System

In the system of proposed segmentation model which is designed, henceforth, classification is further done by resilient neural network that will improve the classification quality. Figure 1 shows the flow diagram of melanoma detection.

In the process of pre-processing, we are uploading an image as an input and then we have to convert that color image into a grayscale image. By seeing the image of output, dark areas become light colors and lightweight areas become dark colors. By using the resilient neural network classifier it will display either it is normal or abnormal. The segmentation of the image is the very most important operation of pre-processing in the recognition of image and vision of computer. Here, we use the K-means segmentation method, by doing a simple operation that gives the perfect segmentation results. The K-means is the only kind of algorithm that algorithm is being used by most of the researchers in the field of mining. The method of K-means is great and effortless thanks to specifying a data set using clusters. The K-means clustering might be a method that will not allow dividing as n patterns in the picture in dimensional space converted into *k* clusters. This gives the results as a category of clusters supported by *k* centers. All of those are founded in the centroid of the dataset.

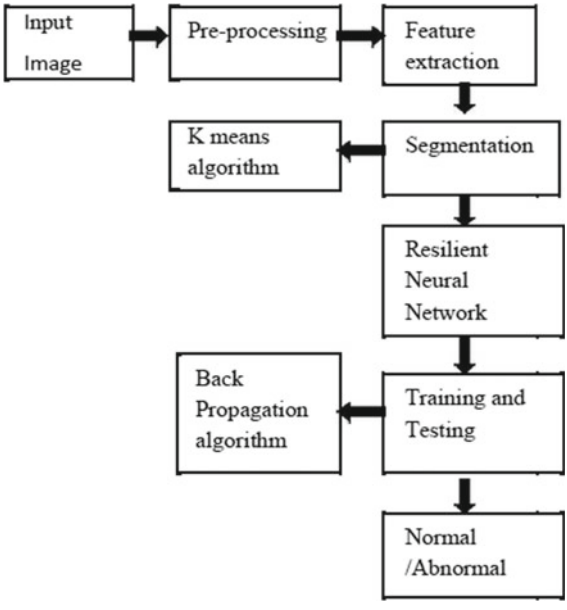


Fig. 1 Flow diagram of melanoma detection

Then, side by side, the centroid values of all clusters are upgraded one by one until it reaches the most powerful results of clustering are obtained. K-means segmentation algorithm is normal representative of the method of clustering supported function of the prototype.

The K-means algorithm takes a distance of Euclidean because of the similar measure, which is used to seek out the classification of a first cluster; then, it is presented as the minimum of evaluation. The clustering criterion function is defined from the error square criterion function. And, the algorithm of K-means is better; K value should lean before, and also the K value selection is extremely difficult to estimate. In many cases, it is unknown before what number groups the data set should be divided. As we declare, K-means is defined as the typical clustering algorithms within the method of partitioning. This presents as a high-efficiency algorithm, but because of the requirement to watch the number of clusters, it brings some difficulties for the calculations of automation. This technique binds the most attached domain algorithm to see the values of k in the K-means method. A neural network is a method of scientific discipline model which is inspired by the nervous systems like brain and information of process. A neural network is computing for a particular app, like finding a pattern or arranging data through a process of learning.

4 Results and Discussions

In this section, we take a couple of inputs and process them to examine the output. Here, we are giving input as a defective skin image and that is referred to as an original image. We are resizing the image which means we are selecting only the portion which is needed. It is displayed in Fig. 2. After resizing, we have to change the image to a binary image [12]. The binary image will change the affected position as black and non-affected as white.

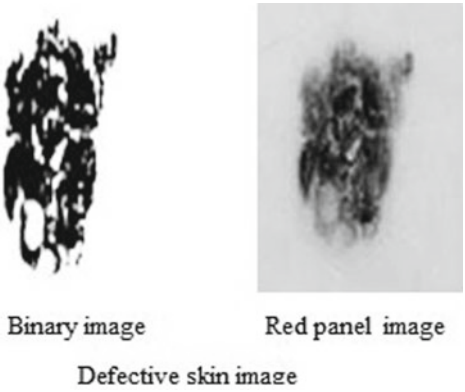
Here, we are including the RGB panel which is a red, green and blue panels in Figs. 3, 4 and 5. The panel is used to check the intensity of the image. Then, we are merging all three images as one image. The merged image is considered as a boundary image. The boundary image will be showing the image of the affected portion as white and the non-affected portion as black. Then, skin binary image will remove the non-affected area accurately.

The masked image is the combination of the original skin image and skin binary image. It is displayed in Fig. 6. Finally, we will get the defective portion of the tumor. Then, we will get the result in our smartphone as abnormal in Fig. 7.

Now, here, the input image is uploaded as a non-defected image in Fig. 8. The above process will happen in Figs. 9, 10, 11 and 12 too. Finally, we will get the non-defected image and we will get the result as normal in our smartphone in Fig. 13.

Fig. 2 Original image and resize image of defective skin image

Fig. 3 Binary image and red panel of defective skin image



5 Conclusion and Future Direction

The proposed mobile medical care solution for melanoma detection is finished with the assistance of portable picture investigation. The most qualities of the proposed framework are a K-means segmentation plot reason for the asset obliged to stage a fresh out of the plastic new arrangement of elements which proficiently catch the shading variety and boundary unpredictable from the advanced cell image and a spic and span system for picking a com-settlement set of the chief discriminative elements. During this module, the image information is being saved in a cluster, and channel upsides of the images are being compared and put away in transitory exhibits. At last, the versatile neural organization is surveyed whether the given information picture is ordinary or unusual. As a part of future work, implementation of the same

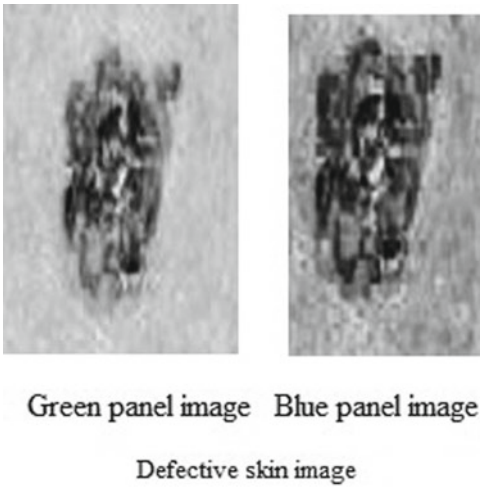


Fig. 4 Green panel and blue panel of defective skin image

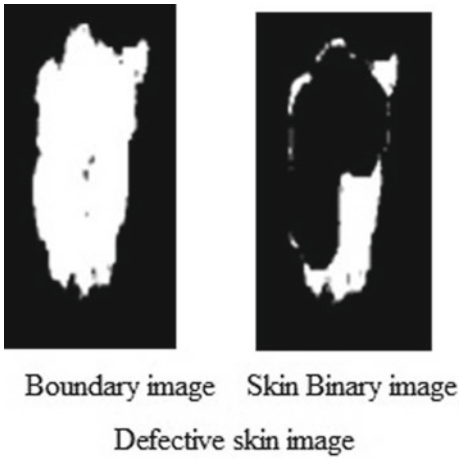


Fig. 5 Boundary image and skin binary image of defective skin image

system is idealized to be made work for other medical detections as well, along with the addition of AI perception incorporating for other fields and areas of investigation.

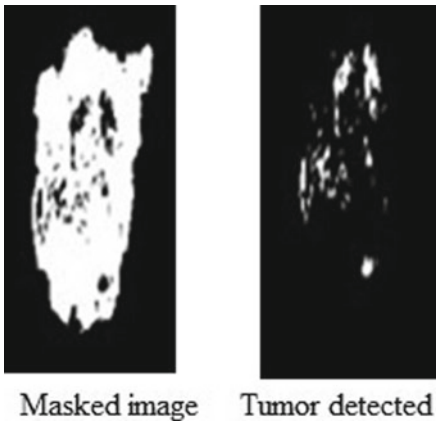


Fig. 6 Masked image and tumor detected

Fig. 7 Output image of defective skin image

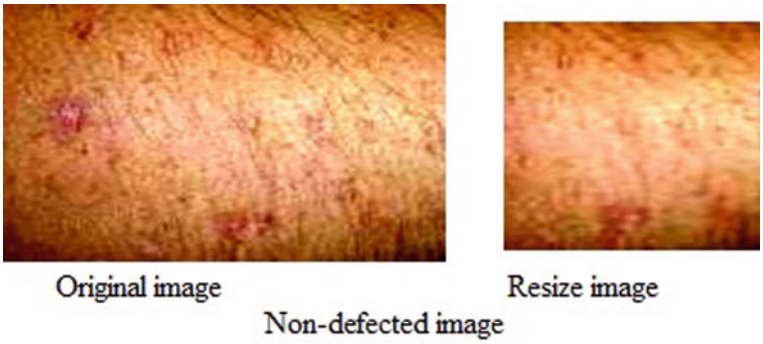


Fig. 8 Original image and resize image of non-defected image

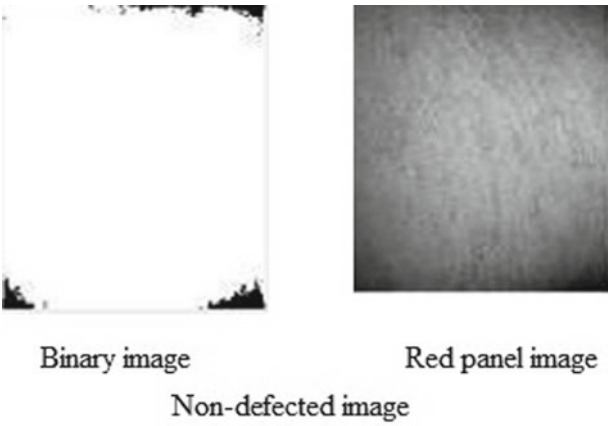


Fig. 9 Binary image and red panel of non-defected image

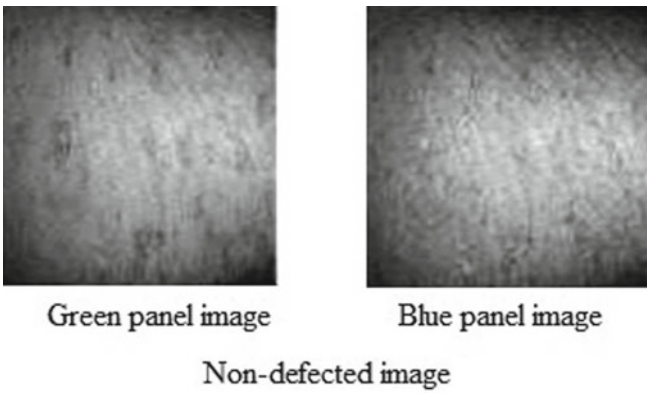


Fig. 10 Green panel and blue panelof non-defected image

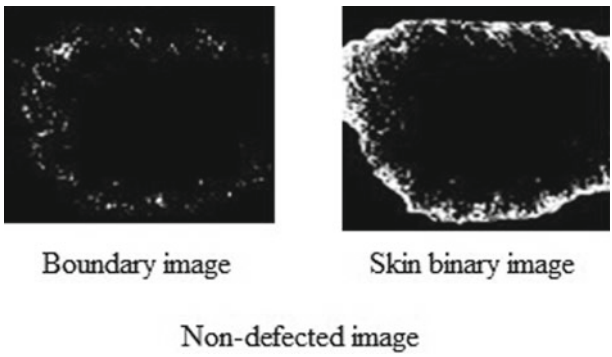


Fig. 11 Boundary image and skin binary imageof non-defected image

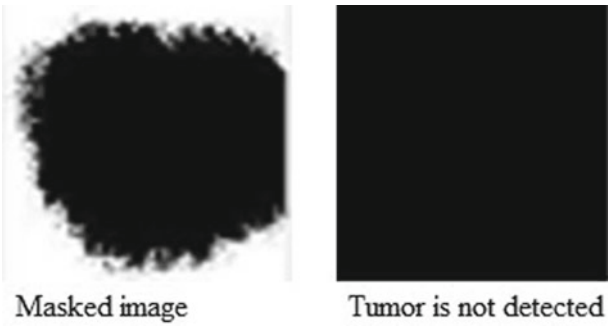


Fig. 12 Masked image and tumor is not detected

Fig. 13 Output imageof non-defected image

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Chapter 6
Minimization of Power in Home Automation by IOT-Based Interactive Home

Payal Bansal, Sandhya Sharma, and Pallavi Sapkale

1 Introduction

Today's modern and busy world has a great demand of technological advancement and its resulting comfort. And in these times, home automation is in great demand because of its comfort that it provides us when at home and security to our houses when we are not at home. And in this busy and running era, power saving and power efficiency are very important. But these rising technological advancement in the area of home automation or in any other field causes a lot of unnecessary utilization of power. So in order to reduce this power loss, we have come up with an IOT-based interactive home which have all the features of a basic home automation system and a lot more features that too at a reduced power consumption at a rate of approximately 40–50% [1] to other ordinary devices [2]. And to achieve this milestone, we have designed such a system in which only two energy efficient devices that are Arduino Uno [3] and ESP8266 [4] will be turned on all the time and rest of the devices will automatically turn on only when the user allots a specific task to the system which that devices can do, and after performing that task the devices shuts down automatically which in itself saves a lot of power as compared to all the devices turned on all the time unnecessarily. Further, it also gives a lot of comfort to the user as the switching system of all the appliances comes into their own smart phone [5].

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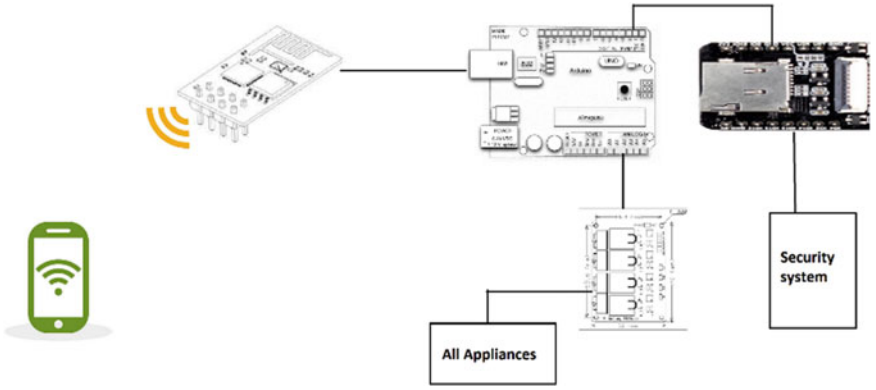

Fig. 1 Circuit diagram

2 Project Design

Project design is the most important aspect in our project, as the rightly planned design of our project significantly helped us in achieving our goal of implementing a power efficient [1, 6] home automating system. Our project consists of mainly five components, namely Arduino UNO, relay module, ESP32 CAM, ESP8266, and 12 V solenoid lock [4, 7–9].

This basic design of our project is as in Figs. 1, 2, 3 and 4.

For our ease of understanding, we have bifurcated our project design into two parts that are:

(1) Security system
(2) Appliance control.

3 Security System

As the name suggest this part is all about the security system of the place as mentioned under our project and contains all the basic circuitry design of this section which makes it functional (Fig. 5).

As seen in Fig. 2, ESP32 CAM is connected to the electric lock and the push button through the various circuitry, forms our basic unit of security system [7], further this system is connected to Arduino and ESP8266 and then, when any command is received by ESP8266, it transmits it to the Arduino and then if that command is related to the security system, then this part gets activated and then does the task given to it like, opening the door by the help of the electric lock feature, in cases, if any guests arrives while the owner is away, so that they can be comfortable inside, or be it the camera security by the help of ESP32 CAM so that the owner can anytime check the condition of its house or be alert in case of any intruder so that immediate actions could be taken.

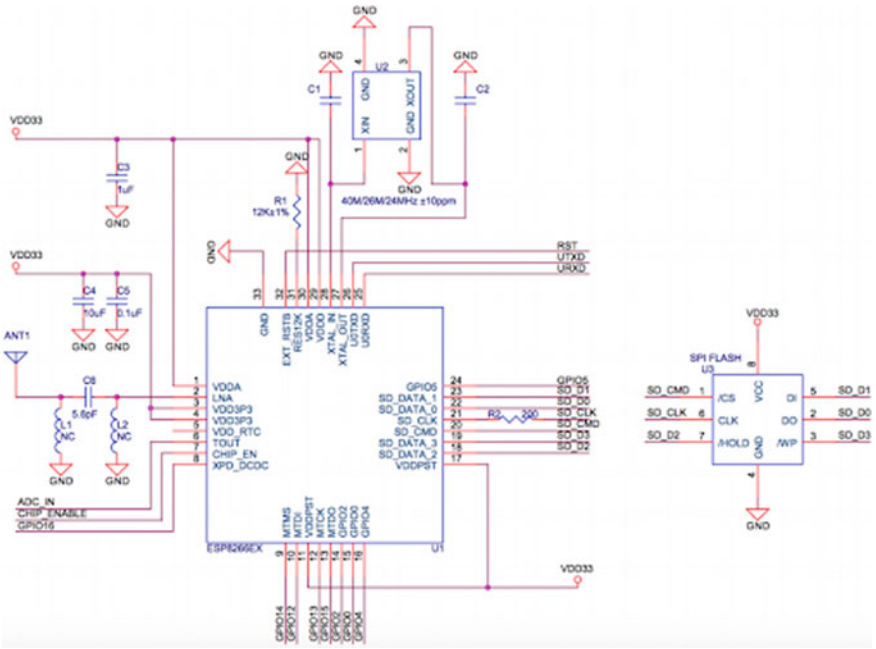

Fig. 2 ESP8266 Wi-Fi module pin diagram

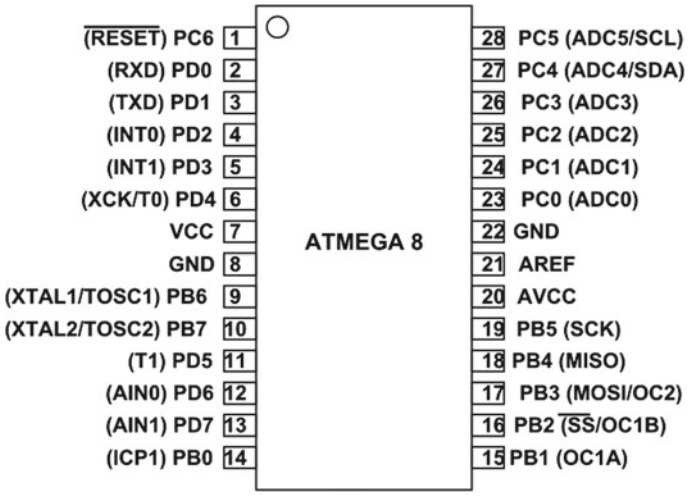

Fig. 3 ATMEGA 8 (Arduino) pin diagram

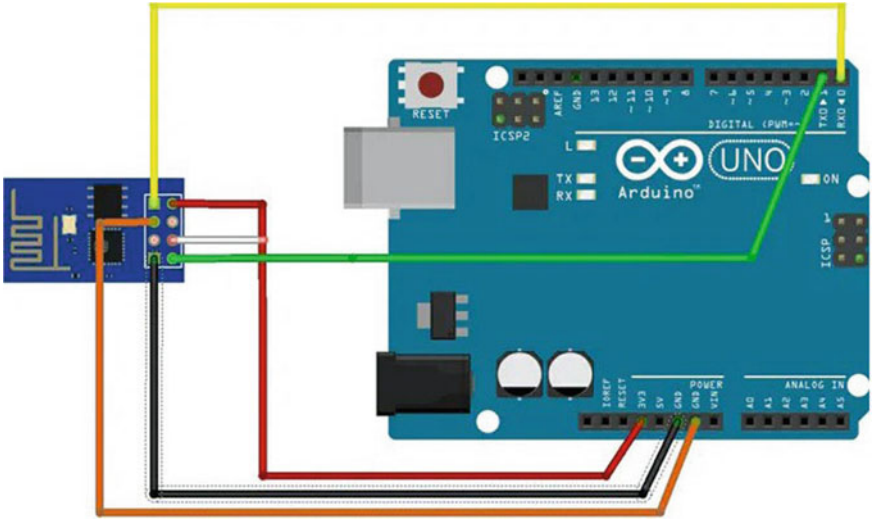

Fig. 4 Connection of ESP8266 with Arduino [3]

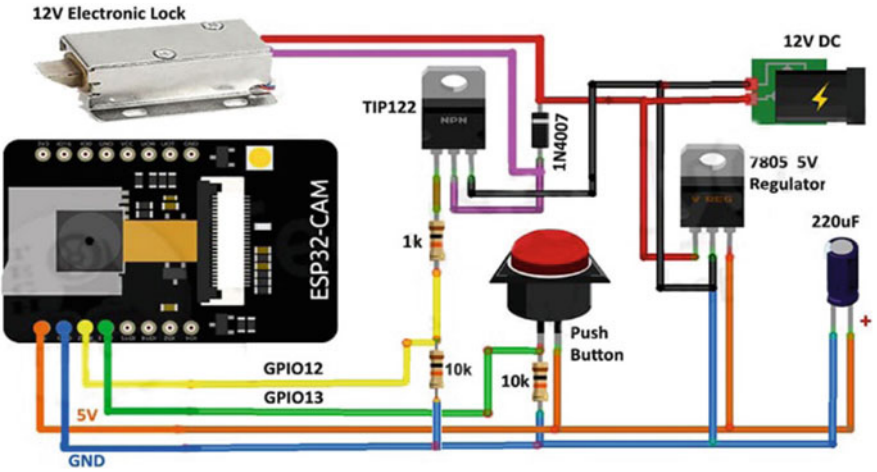

Fig. 5 Basic circuitry of security system [4]

4 Appliance Control

As the name suggest this part is all about the control of the appliances given to the user of their place as mentioned under our project and contains all the basic circuitry design of this section which makes it functional (Fig. 6).

As seen in Fig. 3, the relay module which is the main device in this section, is connected to Arduino and ESP8266 and then, when the users wishes it the device

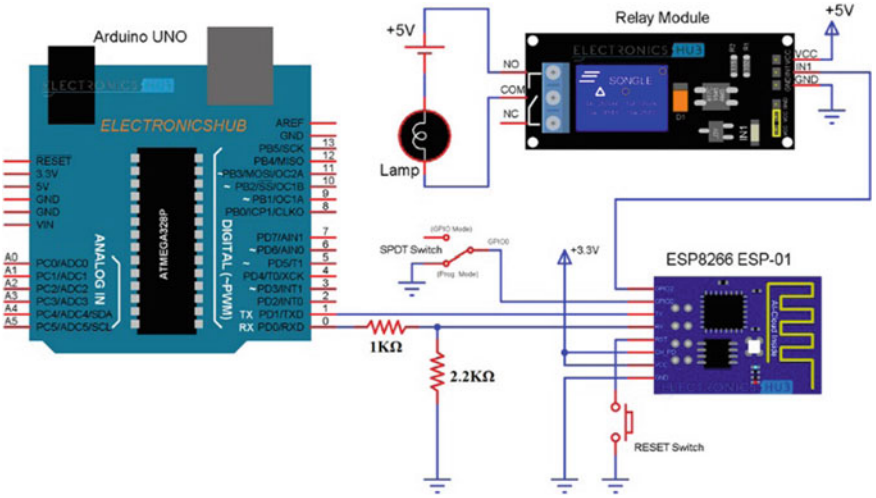

Fig. 6 Basic circuitry of appliances control

to perform any task for them, they simply gives the command to the ESP8266 by their smart phones, then the ESP8266 further processes the task and send it to the Arduino which analyse weather the task allotted is for the security system or the appliances control system, and if it is for the appliances control system, then the relay module gets the supply by the Arduino and it gets turned on and perform its task like switching on any device connected to it or switching it off or controlling its level of working, and it is able to do all such task only because of one device that is the relay module, to which all the appliances of the home will be connected and so it can control all of them [10].

4.1 Comparison in the Amount of Power Utilized

We firstly turned on all the devices included in our project and observed the amount of power it consumed for approximately five days, and later then, we turned off all the devices except ESP8266 and Arduino and allowed them to turn on itself when their part of the work comes, and observed it for five days, and we observed the difference in the power consumption in both the scenarios [1].

5 Observation

We observed the following results and formulated it in the form of graphs (Table 1).

In this graph, a comparison is show between the power consumption of various devices included in the project when they are in turn on mode and turn off mode (Fig. 7).

- Light sleep actual = turn off mode
- Light sleep pushed = sleep mode
- Deep sleep open = turn on mode.

Table 1 ESP8266 power consumption in various modes

Parameters	Min	Typical	Max	Unit
Tx 802.11b, CCK 11 Mbps, P OUT = +17 dBm		170		mA
Tx 802.11g, OFDM 54 Mbps, P OUT = +15 dBm		140		mA
Tx 802.11n, MCS7, P OUT = +17 dBm		120		mA
Rx 802.11b, 1024 bytes packet length, −80 dBm		50		mA
Rx 802.11g, 1024 bytes packet length, −70 dBm		56		mA
Rx 802.11n, 1024 bytes packet length, −65 dBm		56		mA
Modem-sleep ①		15		mA
Light-sleep ②		0.9		mA
Deep-sleep ③		10		uA
Power off		0.5		uA

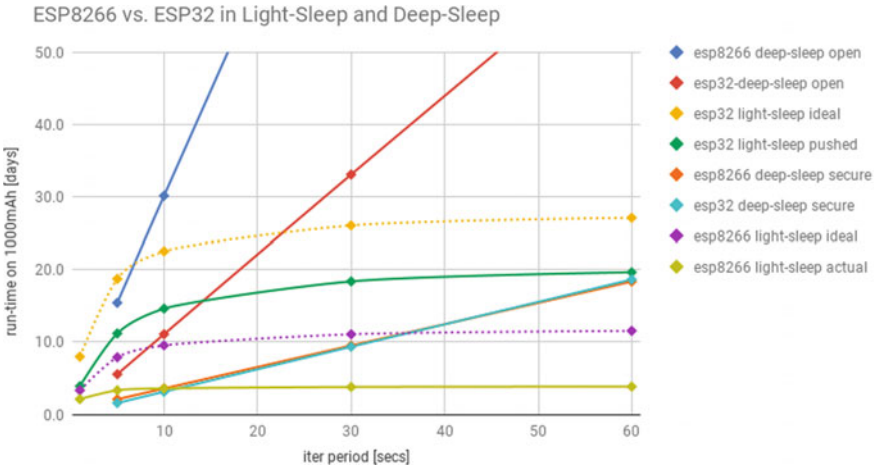

Fig. 7 Bar graph 1 of result [1]

The two charts compare the run-time in days between the ESP8266 and the ESP32 when running a test app that sends a simple packet to a server over TCP (Figs. 8 and 9). The first chart shows on time intervals of 1, 10 and 60 s while the second one shows final outcome time intervals of 60 and 20 s. This clearly shows that when the device is completely on and when its combination was applied, there was a measurable difference between both.

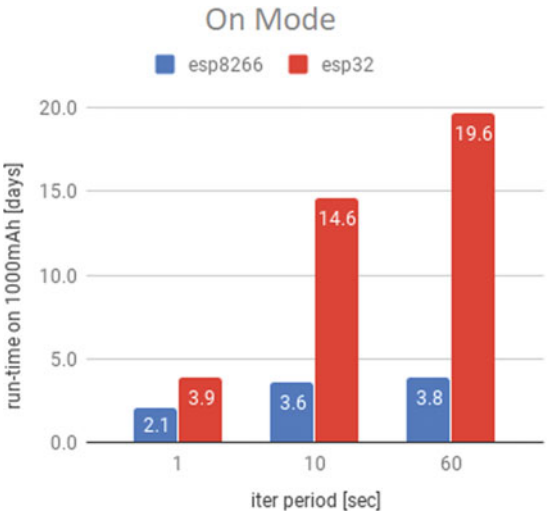

Fig. 8 Bar graph 2 of result [1]

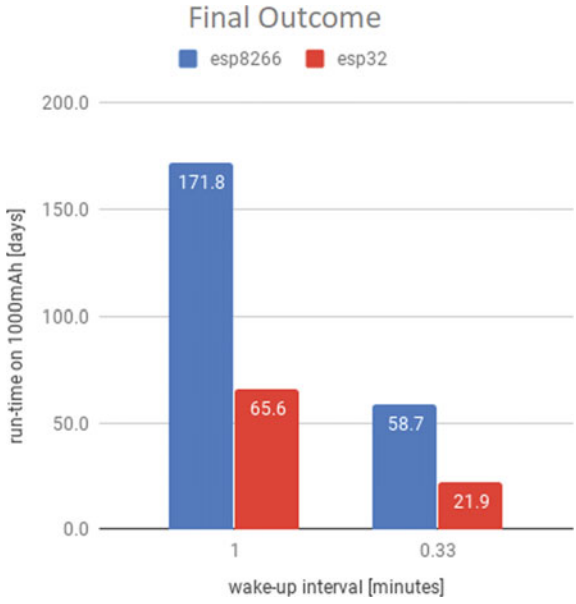

Fig. 9 Bar graph 2 of result [1]

6 Conclusion

In this paper, we are trying to build a device that will automate homes with the minimum power consumption and also be cost efficient with the minimum use of resources that to which are the most power efficient and are also trying to develop it in such a way that there will be the minimum turn on period of those devices of that power consumption would further minimize.

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Chapter 7
An Efficient Security Technique Using Steganography and Machine Learning

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1 Introduction

Social media now become a popular platform for sharing personal experiences, emotions, thoughts, and personal achievements. Due to the enormous use of social media by the common people, now it turned into one of the most venerable place, and thus, the security and integrity of information has become crucial issues. Steganography and machine learning are the two most favorable techniques used sensitive information by covering it with some other information in such a way that nobody can suspect the hidden information at first glance. The key aims of cryptography are integrity, authentication, and confidentiality. Steganography was derived first in Greek literature by combining the two words "stegnosis" that refer to "covered or secret" followed by "graphy" that represent "writing" [1–3]. In steganography, data are secretly hiding into some other unsuspected media file so that it is not visible to any other user. It can be only seen by the users who have valid decryption key. Nowadays, machine learning approaches in the steganography technique have been applied to enhance the quality, robustness, and security of information [1, 3–5].

Goldberg and Holland [6] have presented an important steganalysis based on machine learning approaches. Because the presentation of an embedding algorithm,

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investigated by them on the three facts: Payload capacity, visual quality, and indefectibility in the steganography. Using of different machine learning approaches with it can further enhance the robustness, security, and confidentiality in it [1, 7–10]. However, in practice, equal degree of embedding distortion has been caused. In this paper, a novel technique has been presented that basically work on the reduction of noise from hidden bits [11, 12].

The rest of the paper is structured as given below: Brief literature review has been presented in Sect. 2, research gap and research question elaborated in Sect. 3, followed by conclusion in Sect. 4.

2 Brief Literature Review

Steganography can be used to conceal almost any type of digital content, including text, image, video or audio content; the data to be hidden can be hidden inside almost any other type of digital content.

Steganography is different from cryptography; as in the cryptography, the communication medium and the secret data both are generally known by the protocols (i.e., HTTP protocol used by any site) [13–15]. In cryptography, there are two major steps which are encryption and decryption processes, in which sender and receiver have the encryption or decryption key for the transmission of any secret data [16, 17].

In the context of steganography, two domain theories have been widely used. The first one is spatial domain—which has been used in some simplest schemes in the terms of extraction complexity and embedding in the steganography. In the spatial domain technique, the message bit can be embedded using pixel gray levels along with their color values which are directly embedded in it. The techniques have some drawbacks such as it takes a large amount of additive noise in it which can increase the value of the creep value in any image, and this additive noise can directly affect the value of PSNR and some factors of any image [16]. The second one is *Transform Domain*—which helps to encrypt the message bits in the other domain such as transform domain of the image. It is widely used in the field of watermarking for enhancing the robustness of the image. It can also provide a large capacity for embedding in the field of steganography. It includes DFT, DCT, and DWT [16, 17], and these techniques can help in hiding data in the communication network for enhancing the robustness of the data and easily spread the image across the Internet for providing the better resistance against the signal processing. For example, as we know that some data are hidden in the transform domain "transform space," and peoples are sharing picture to each other mostly in the JPEG format because this format can compress the images when they are close. During compression, a JPEG will make itself lesser; hence it hides the information in transform domain [4]. The extraction complexity and embedding are high in the transform domain because the transform domain has robustness properties that are also applicable to the "watermarking" used in data hiding. We can also embedding data bits in this by the use of the discrete cosine transform coefficient and also help in rounding and

quantizing the data for their nearest data bits. In the signal, we use matrix encoding for reducing the embedding noise. And steganography provides various optimization techniques for getting the most efficient results. The well-known methods are particle swarm optimization, artificial bee colony, genetic algorithm, multistage protection using pixel selection technique for enhancing steganography, etc. [15, 16].

3 The Performance Measure of Steganography

The performance of steganography to be tested and evaluated depends upon various factors such as the secret message, cover file, and application of steganography. There are some factors which can be used to evaluate steganography, for example [14], "peak signal-to-noise ratio (PSNR), mean square error (MSE), weighted peak signal-to-noise ratio (w-PSNR), embedding rate, embedding efficiency, Jaccard similarity (JS), dice similarity coefficient (DSC), root mean square error (RMSE), accuracy, sensitivity, and specificity." For the sake of simplicity and readers prospects, we present here these concepts

(i) Mean-Squared Error (MSE): The MSE is the cumulative squared error technique between the cover file and the stego file. The MSE between two images $I1\ (M, N)$ and $I2\ (M, N)$ can be structured by the following mathematical representation [15].

$$\text{MSE} = \frac{\sum M, N[I1(M, N) - I2(M, N)]^2}{M * N} \tag{1}$$

where M and N stand for the number of rows and columns, respectively.

(ii) Peak Signal-to-Noise Ratio (PSNR): Is the measurement of the difference on some statistical data among the cover file and stego file. The PSNR value can be calculate by the following equation [16]

$$\text{PSNR} = 10 \log_{10} \frac{R^2}{\text{MSE}} \tag{2}$$

where the value of R is normally taken as 255.

From the above equation, it can be concluded that the PSNR value is high if the MSE value is low, and quality of the image is also high.

3.1 Limitations of Existing Methods and Proposed Model

There are several technologies that are related to image-based steganography as discussed in literature along with their formulations. It includes digital file like text

file, audio-file, video file, and network protocol which are also studied along with their techniques.

3.2 The Proposed Method

Now, we present our proposed method in this section. In the proposed work, an image has been first converted to the grayscale image, and the desired text is converted to the binary format. Image pixel value is also converted into binary form and traversed through each pixel of the image. Based on the LSB, pixel value information has been embedded after some comparison. The encoding is completed through the steps given below

Step 1: Convert the image to gray scale.
Step 2: If needed resize the image.
Step 3: Convert the text message to binary format.
Step 4: Convert the pixel value in unsigned binary form.
Step 5: Initialize output image equal to input image.
Step 6: Traverse through each pixel of the image and perform the following steps:

Step 6.1: Get the next message bit which need to embed.
Step 6.2: Get the least significant bit of pixel value by dividing pixel value by 2 and obtain remainder.
Step 6.3: If least bit is 0, add message bit to the binary pixel value.
Step 6.4: If least significant bit is 1, then subtract 1 from binary pixel element and embedded the message bit(s) to the present pixel value.

Step 7: Output image has been updated continuously until whole bits of the message are embedded.
Step 8: Write the input image and the output image to the local system.

The comparison Table 1 presented shows the resultant value for the two images after applying the proposed method (Figs. 1 and 2).

Table 1 Comparison of PSNR and MSE of Image 1 and Image 2

Number of least significant bits		LSB: 1	LSB: 2	LSB: 3	LSB: 4
PSNR	Image 1	51.0186	43.6011	36.8005	29.8799
	Image 2	51.8652	48.2832	43.5780	39.1113
MSE	Image 1	0.5143	2.8377	13.5841	66.8479
	Image 2	0.4232	0.9655	2.8529	7.9790

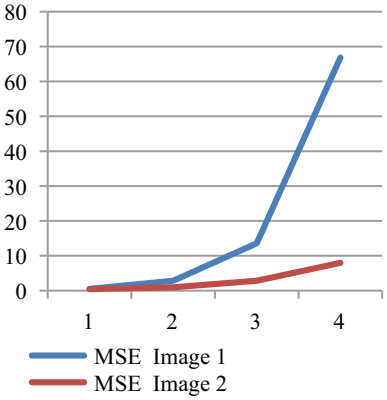

Fig. 1 MSE values of Image 1 and Image 2 on different number of LSB

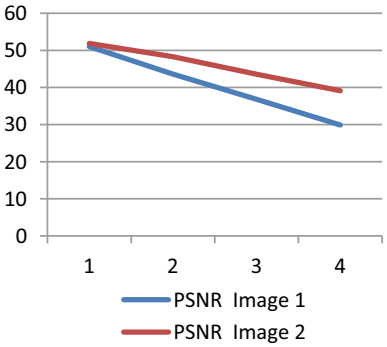

Fig. 2 PSNR values of Image 1 and Image 2 on different number of LSB

4 Conclusion and Future Work

In this paper, a novel framework has been presented to hide some information (in the form of images/text/hyperlinks) using LSB value in image. An image has been converted into the binary format and the desired information also converted into binary format which further has been compared with each LSB pixel value. Finally, the pixel value has been updated based on various factors. The proposed method has been simulated with MATLAB image tool, and the resultant vectors show the significance of the proposed work.

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Chapter 8
An Efficient Model for IoT Security Using Adopted RSA

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1 Introduction and Related Work

Internet of Things (IoT) is known by the billions of physical devices linked to the Internet through the globe which are used to accumulate and communicate the sensitive data. The IoT is a distributed system, a group of computational devices able to act independently to each other. It is used for dedicated IoT devices to validate quality of service (QoS) parameters, viz. packet forwarding rate (PFR) and resource routing (RR), should be optimized [1]. These services are distributed in fashion can be easily detained and negotiated. Therefore, it is crucial to offer security methods [2, 3] in any distributed system. Thus, security in IoT is a critical issue. Further, the resource routing could also be negotiated if security measures are not integrated into the IoT networking purposes. Therefore, the coordination among IoT devices is rather solicited. Though, due to its apparent properties and limited power of battery associated with IoT devices, malicious functionalities can also be done in this IoT network. Besides, the IoT organization might vary based on their several uses and applications [4, 5].

When the power of IoT device is taken as one of the utmost in such an environment, so there may be well chances that IoT devices may deny sharing their individual resources to save the power of battery or to get aids from other IoT devices [6, 7]. These participating IoT devices are called as misbehaving or selfish IoT devices and their functions are referred to as mischievousness or selfishness [8]. Previously,

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various techniques [9] in the literature have presented the study to detect and minimize the effect of such malicious activities of IoT devices in the IoT environment.

Among the various techniques, watchdog pathrater technique (WPT) and dynamic source routing technique (DSRT)-ACK2 [10, 11] are emphasized, which can considerably identify and decrease the effect of IoT network maliciousness, correspondingly. The wireless technologies and industries have practiced unexcelled development, from satellite broadcasts to a number of uncountable households to WPAN [12], vehicular ad hoc network (VANET) [13], wireless sensor network (WSN) [14], etc.

The IoT can maximize its QoS parameters, e.g., output, packet delivery fraction (PDF), etc., through intermediate IoT devices[15, 16] available and after that furthering packet. Though, the IoT device can consequently show bad behavior by rejecting the providers or delivers the packets in the public due to the bad activities [17, 18].

The study in year 2020 [11] described the improper response in IoT and recommended DSR-ACK2 to identify and minimize the effect of selfish IoT devices in routing. Another technique like DSRT-ACK2 is worked on the basis of a general 2-hop-ack packet that is reverted back to the next-hop connected receiver. It runs an alternate routing technique to detect improper functioning and reduce its unusual effects [19]. After this introduction and related work section, the efficient digital signature using RSA techniques is discussed in Sect. 2. Section 3 discussed a secure model for the IoT environment. In Sect. 4, the performance analysis of the proposed model has been done with the help of experimental evaluation. Finally, Sect. 5 summarizes the paper with future scope.

2 Efficient Digital Signature Using RSA Techniques

In the ordinary signature technique [20, 21], a hand-written signature is personified with the documents that specify a particular user is liable for it. The prominence of a signature may be seen in normal situations [22]. Nowadays, the most identified and authentic technique is the improved digital signature. In this technique, the sign message is being kept in digital form and sent to the receiver. It permits the sender to generate a code for the message which behaves as a signature.

3 Proposed Model: RSA Enhanced Digital Signature Algorithm (RSAEDSA)

For any secure and efficient IoT communication network, it is quite difficult to manage the IoT network. Moreover, among other functions of the IoT network, the secure routing has highest importance. In IoT layered architecture, numerous

security attacks and vulnerabilities, viz. wormhole attack, denial of service (DoS), jamming attack, Sybil attack, distributed DoS (DDoS), eavesdropping attack, etc., are propelled by attackers during the secure routing. Therefore, by using digital signature and fast RSA, a technique is proposed. The digital signature uses hashing technique [22] which demonstrates that the data should not be altered during transmission which is performed by using digital signature techniques.

The steps to generate a digital signature [22] are given below.

1. The message digest (MD) is generated by applying hash-function over the message (M) and then message digest (MD) is encrypted using private key (PK) to generate digital signature (DS).
2. The digital signature (DS) is then sent with the message. Then receiver decrypts the DS using the public key (PK).
3. The receiver can calculate the message digest (MD) from the message. The message is computed by receiver and the message digest (MD).

The proposed RSAEDSA uses fast RSA and the digital signature (DS) technique to reduce packets falsification. The RSAEDSA consists of explicitly four key functions: secure ACK, IoT device authentication, packet authentication, and non-repudiation using digital signature technique. It uses the benefit of a DSRT-ACK2 technique which earlier supportive to overcome pitfalls with WPT using faster RSA. Further, in the DSRT [23–25], seven bits are reserved in the DSRT header. One of the extensively used complex problems due to its simple description is the IoT secure routing problem which is NP-hard [26–29]. This problem involves optimizing the QoS parameters such as PDF, routing overhead, cumulative delay, etc. To solve this problem, the exact techniques indicate exponential time-complexity. Moreover, these techniques can only try for limited size problems. But this problem needs an efficient solution, which motivated the authors to develop a novel algorithm referred to as a digitally signed secure acknowledgment technique (RSAEDSA) using fast RSA [22, 30] to improve the performance of the existing system.

4 Experimental Evaluation and Performance Analysis

Performance analysis of the proposed technique RSAEDSA along with existing ones such as DSRT, WPT, and DSRT-ACK2 is carried out in this section. To assess the performance of RSAEDSA with different types of attacks, two case scenarios is planned to simulate the various types of attacks by seeding proportionate misbehavior in the IoT devices in our simulation terrain setup.

The NS3 simulation environment with i7 CPU, 16-GB RAM, 1 TB HDD has been taken as a simulation resource and implemented by writing C++ functions.

The considered performance metrics are packet delivery fraction (PDF) and resource routing overhead (RRO). The PDF is defined as follows [22, 30]:

$$\text{PDF} = (\text{Data Packets Received})/(\text{Data Packets Sent})$$

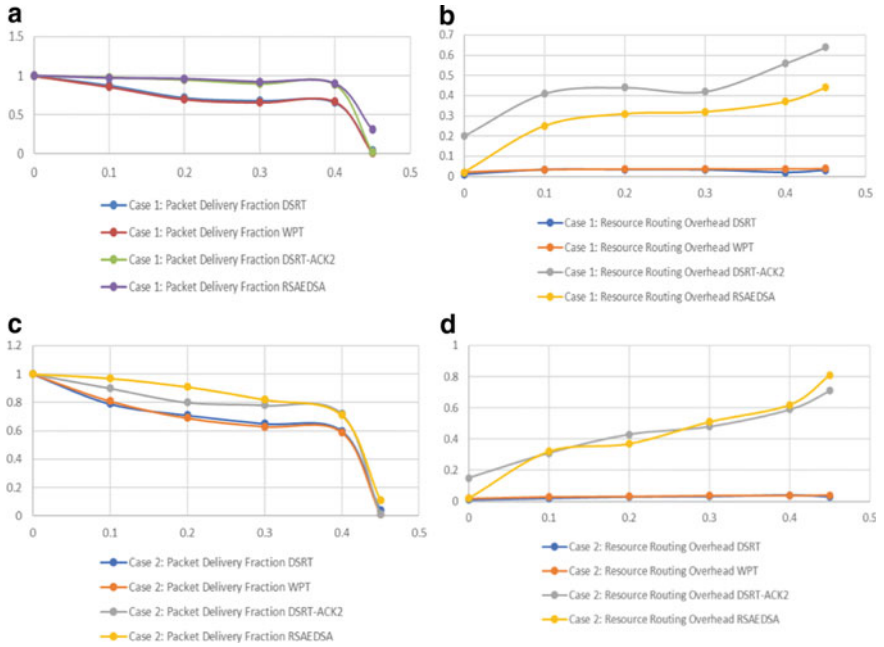

Fig. 1 Performance evaluation **a** packet delivery fraction Case 1, **b** resource routing overhead Case 1, **c** packet delivery fraction Case 2, and **d** resource routing overhead Case 2

RRO [22, 30] is defined as the data routing over the network that is acquired through an application by using a fraction of the bandwidth needed. This supplementary data is referred as the routing overhead.

Figure 1a, c depicts that if virus-infected IoT devices fraction increases, then PDF decreases and tends to zero when it reaches to 0.5. These figures also depict that for both cases, PDF is higher than the other three states-of-the-art techniques.

Figure 1b, d shows that if virus-infected IoT devices fraction increases, then resource routing overhead increases. These figures also depict that for both cases, resource routing overhead is lower than the other three states-of-the-art techniques. Further for the improvement of the digital signature technique, an open source library referred as Botan [25, 31] is used. For RSA techniques, a 512 bits RSA key for every IoT device in this network is considered. For every IoT-device, it is presumed that private and public keys were made and already distributed. The size of key file of 512 bits is 256 and 512 bits, respectively. Size of key file is 120 bits is 256 and 512 bits, respectively. RSA file size is 120 bits.

5 Conclusion and Future Scope

This paper suggested and simulated the Efficient Improved Digital Signature Technique (RSAEDSA) in an IoT network environment and compared it with present techniques under various security attacks setups. The obtained IoT framework simulation results show that our proposed model performed better in comparison with the state-of-the-art in the different security attacks setups. Further, the WPT and DSRT-ACK2 do not guarantee to work well in case of the false mischievousness acknowledgment and excessive collisions situations will increase and reduce the QoS parameters which is handled by this RSAEDSA IoT framework. Though in limited situations, it generates more overhead and upsurges the network's effectiveness with regard to the fraction of packet transmission. In the future, machine learning models will be used to make intelligent techniques to improve QoS parameters under this scenario.

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Chapter 9
Robotic Process Automation in IT SOX Compliance

K. Murugappan and T. Sree Kala

1 Introduction

RPA is a software program that imitates human actions while interacting with a computer and helps to automate repetitive processes. This is called a software robot or bot. It can further utilize machine learning and artificial intelligence to make it more productive. This RPA can be used in information technology area to ensure the compliance of various government laws and regulatory requirements. This paper helps to study and explore the use case of RPA in Sarbanes-Oxley Act-related (SOX) IT compliance requirement.

2 Problem Identification

In the current situation, most of the organizations are spending significant amount of their work time in ensuring the SOX compliance. Some organizations might have implemented the automation in SOX compliance partially or fully; however, most of them are still performing these activities in a traditional manual methodology. Moreover, these automation solutions were not targeted or not capable enough to replace the human interactions. There are many reasons for it, for example, lack of established process for implementing RPA in SOX compliance, lack of skillset, and no time for solution development. In this paper, all these were explored and proposed a standard lifecycle process to establish RPA in IT SOX compliance.

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3 Solution Proposed

For an effective utilization of RPA in IT SOX compliance, it must consider various elements like technical, process, and people [1]. It shall follow the life cycle approach as mentioned in Fig. 1.

3.1 Life Cycle

This is aligned as per the entity's need [2].

IT SOX Objective: The objective is set to ensure accurate and reliable financial reporting. This has three folds into it. First one is to ensure the manual processes

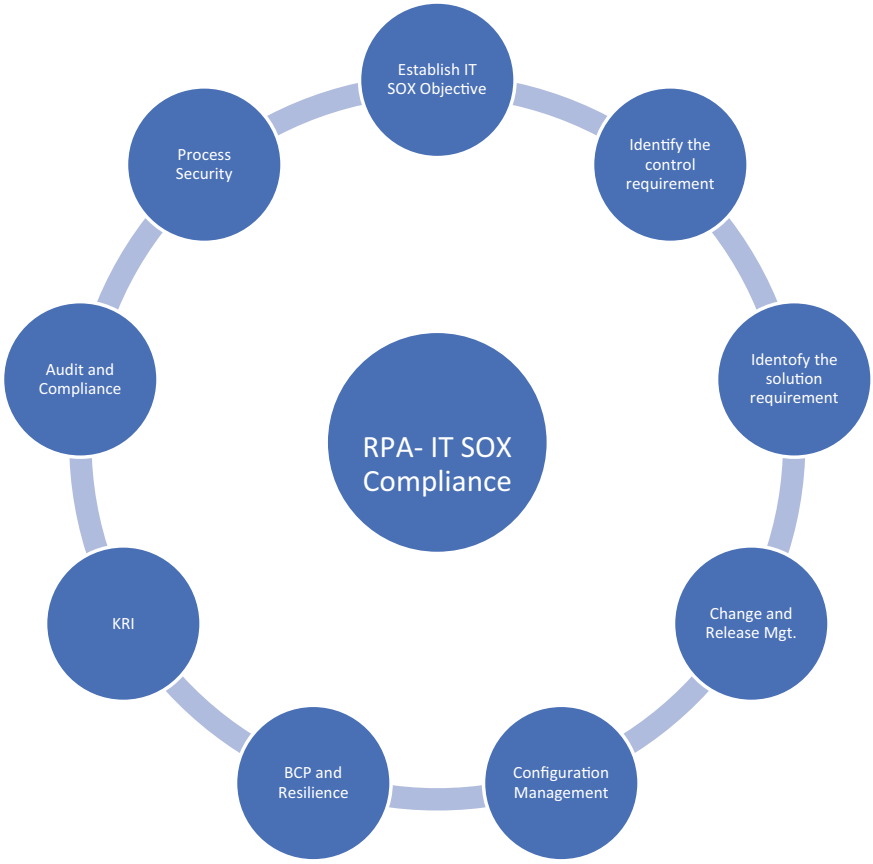

Fig. 1 RPA-IT SOX life cycle framework

surrounding the financial business is designed and effective controlled. Second one is to ensure the application controls, and third one is to ensure the IT general controls pertaining to the infrastructure that supports the finance systems.

Control Requirement: Control is the action that you take to ensure the compliance of IT SOX objective. The control types can be preventive, detective, and corrective.

Solution Requirement: Based on the IT SOX objective, controls are derived, and these controls shall be automated using RPA solution. Detailed solution process flow is provided in Sect. 3.2.

Change and Release Management: Changes and releases are implemented in an authorized way to ensure the stability and security.

Configuration Management: All devices and application configurations are maintained online and offline to ensure the availability and security.

Business Continuity Planning (BCP) and Resilience: This can ensure the minimum level of accepted service during disaster and resumption of service to the normalcy.

Key Risk Indicators (KRI): This can help to identify the risks in RPA and proactive mitigation.

Audit and Compliance: This is to ensure that the bots are compliant to all legal, regulatory, and company requirements.

3.2 Process Flow for Bot Establishment

A person can initialize a request, and it is validated by the respective business subject matter expert for a business alignment. This can lead to the resource planning and the required resources allocated to the project.

In the build phase, bot package is created, and then, it moves into testing phase. Test plans are developed and tested. If the test results meet the expectation, the final package would be moved into the production. Management phase ensures the operational activities and minor bug fixes or enhancements. Termination can be done once the business objective is achieved and no more a requirement for business. This process flow life cycle is provided in Fig. 2.

4 RPA in IT General Controls (ITGCs)

In Sect. 3, bot establishment is explained, and the same need to be followed when implementing a solution for each IT SOX control requirement. The ITGC and its relevant design and effectiveness approach is provided in Table 1.

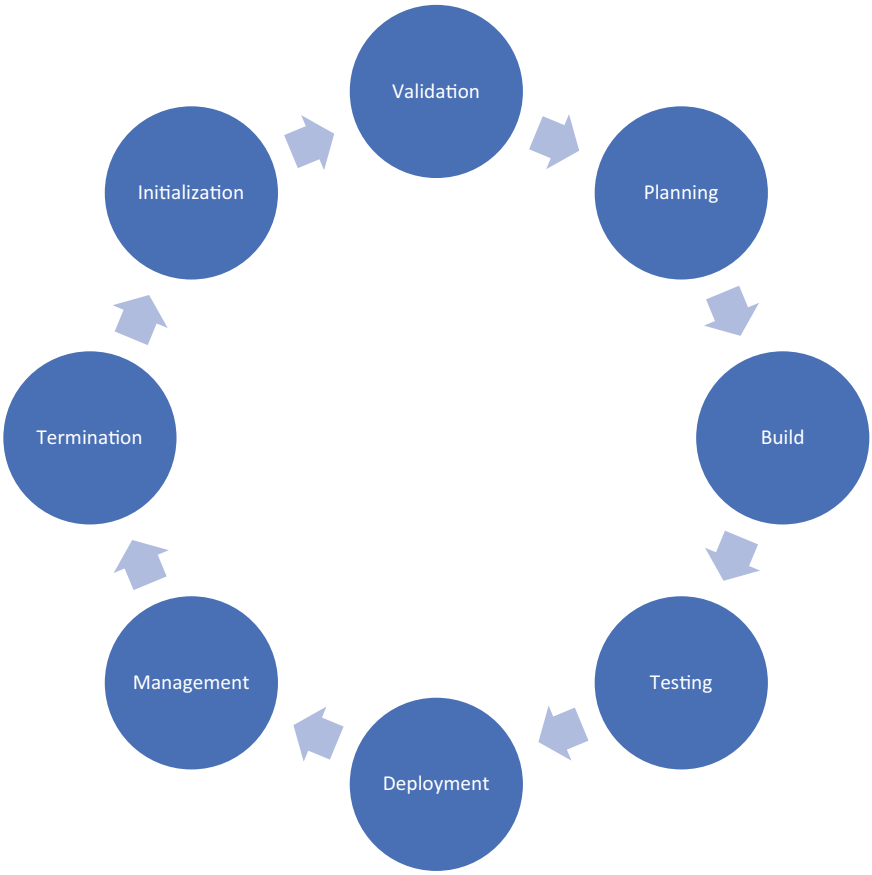

Fig. 2 Process flow diagram

5 Comparative Analysis

Below are the few examples of analysis and research performed in RPA however in practical organizations are still evolving in RPA technology and trying to follow their own way of implementing it. This leads to inconsistency in the operation.

Author Moffitt and Rozario [3] mentioned about the significance of robotic process automation and how it will help in improving the auditing process. RPA in audit helps big time in every aspect like security of data, handing of invoice, purchase records, and many more repetitive tasks can be done very easily by RPA [4]. Authors Lacity and Willcocks mainly concentrate on integrating the use of automation along with manpower so that the companies can deliver better services at a lower cost [5]. Risk and cost-benefit analysis have to be performed before considering the robotic process automation solution [6]. While establishing the RPA, agile methodology

Table 1 ITGC controls—RPA design and effectiveness

IT general controls	RPA design and effectiveness approach
• Batch monitoring	• Design: Enable the monitoring of key application interfaces and batch jobs. A bot can be configured to monitor the jobs and any failure to be notified to the respective administrator • Effectiveness: Auditor/compliance personnel can run a separate bot to parse through the log history and identify any job failure. If any job failure that should be matched with any job rerun/action performed
• User account provisioning	• Design: Set up a bot to pull out a joiners list from the organization HR system and match it with current user list available in the organizations centralized authentication system. Bot should raise a red flag to compliance/audit personnel if there is a mismatch • Effectiveness: Bot can be set up to check whether number of tickets created for user account provisioning match with the joiners list for the particular duration
• User account de-provisioning	• Design: Set up a bot to pull out a Leavers list from the organization HR system and match it with current user list available in the organizations centralized authentication system. Bot should raise a red flag to compliance/audit personnel if terminated users present in the current system • Effectiveness: Bot can be set up to check whether number of tickets created for user account de-provisioning match with the Leavers list for the particular duration
• Privileged access review (PAR)	• Design: Business can set up a bot to pull out a privileged user list screen shot from SOX in-scope system and send it over an email to the respective reviewer and approver. If any unauthorized users found, then appropriate actions to be performed • Effectiveness: Auditor/compliance personnel can validate the current user list from the SOX in-scope system for its appropriateness. If any deviation identified, then it means business is not effectively following the PAR
• Change management	• Design: Implement a bot to monitor the SOX in-scope systems' sensitive configuration parameters, if any change in the parameter, then it has to alert the respective business owner and record it • Effectiveness: Auditor/compliance personnel can have a bot to pull out the change request tickets from the centralized ticketing management tool. Then, this list can be matched with the actual changes implemented directly in the system. If any deviation found, then it has to be raised as a red flag to the management
• Backup and recovery	• Design: A bot can be configured to execute lot of backup jobs for SOX in-scope systems, and any failure jobs can be flagged and moved to the pending pipeline for rerun • Effectiveness: Auditor/compliance personnel can run a separate bot to parse through the backup log history and identify any job failure. If any, then it should be matched with the job rerun/action performed

(continued)

Table 1 (continued)

IT general controls	RPA design and effectiveness approach
• System migration	• Design: A bot can be configured to validate the following before and after migration at both source and destination – count of files and folders matching – file and folders size matching – content match – format conversion, etc. • Effectiveness: Auditor/compliance personnel has to check any discrepancy in the above matching process; if any, then those need to be reported as a red flag to the management

should become the norm to ensure the quick and effective delivery [7]. Adaptive culture to be established for RPA and any failure in the way has to be taken as a leaning [8].

Moreover, [9] in the current industry, there are many organizations performing the SOX compliance activities and have a dedicated compliance and/or internal audit team to provide a reasonable assurance on these tasks. Nearly, around 70% of their work efforts been spent for this; hence, in this paper, we explored the various possibilities to reduce these efforts with the help of software bots. The use case is implemented in one of the largest manufacturing industries, and results are fruitful. Now, we can explore the possibilities to extend the RPA to other regulatory frameworks as well.

6 Conclusion

RPA is being considered as one of the emerging technologies in the industry, and there is a feel among employees that RPA can completely replace the human workforce, and they go jobless. However, the RPA should be considered as a tool to utilize the resources in an optimized manner [10]. Hence, employees can concentrate on the core business development without worrying about performing the repetitive, monotonous, and tiring jobs. Based on the study and fieldwork conducted, ITGC controls compliance using RPA will be a thought-provoking and efficient way to manage the controls. Stakeholder can get benefited by the design and effectiveness methods used in this paper and save the cost, resources, and avoid regulatory penalties by ensuring the automated compliance process. This can be further enhanced by using an intelligent process automation (IPA) which is a combination of artificial intelligence (AI) and robotic process automation.

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Chapter 10
Analyzing the Impact of Nationwide Lockdown on Air Pollution Levels in Indian Cities—And What We Can Learn from It

Sanayya, Ahraz Ahmad Arfi, and Sherin Zafar

1 Introduction

India consistently ranks among one of the worst nations in terms of air quality. According to IQair 2019, 21 of the 30 cities with the worst PM2.5 concentrations globally were in India. Delhi has on numerous occasions held the top spot in that list. India fares poorly at the country level also, being the fifth most polluted nation in the world after Bangladesh, Pakistan, Mongolia, and Afghanistan.

Data from government and unofficial monitoring networks, global models, and satellite observations show that India's air quality has deteriorated during the previous two decades [1]. In 2018, 40% of districts did not reach the national ambient limit (40 $\mu g/m^3$) on an annual basis, while 98% of districts did not meet the World Health Organization recommendation (10 $\mu g/m^3$) [2]. The resulting health impacts have been severe with an estimated 680,000 premature deaths that were attributed to ambient PM2.5 pollution [2]. According to the World Economic Forum, India currently has six of the world's ten most polluted cities, and Delhi tops the list [3].

The unprecedented nationwide lockdown brought the nation to an abrupt halt with almost all industrial and vehicular activities coming to a standstill. This led to a dramatic decrease of about 20–60% for various air pollutant species in almost all cities [2]. It should also be noted that geographical and meteorological conditions also play a role apart from industrial pollution; for instance, agricultural fires in the neighboring states of Delhi are one of the main contributors of air pollution in Delhi.

In this paper, we use data gathering, and data cleaning techniques to analyze and visualize the levels of the main six species of air pollution—PM2.5, PM10, O_3,

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NO_2, SO_2, and CO. PM2.5 (particulate matter with an aerodynamic diameter shorter than 2.5 μm) is the most harmful and dangerous contaminant in air pollution [4–7]. We compare the levels of the above mentioned species for the duration of the first nationwide lockdown, i.e., the months of March, April, and May in 2020 vis-à-vis their corresponding levels in the same months in the years 2016, 2017, 2018, and 2019. The paper is organized as follows. Section 2 gives a background and literature review of related work and how this research builds on it. Section 3 discusses the methodology—data gathering, data cleaning, methods, data visualization techniques. Section 4 discusses the results obtained using data visualization. This section also tries to explore the causes of the result obtained. In the end, Sect. 5 talks about the conclusion and future scope, the key takeaways from this analysis, and how it can be used to achieve clean air and tackle the problem of air pollution.

2 Literature Review

There have been studies related to the impact of COVID-19 on the environment and air pollution and the other way around. The COVID-19 outbreak has resulted in a massive influx of new papers, with over 120,000 available at the time of writing, and over 100,000 of them have open access. In China, Zhu et al. discovered a link between air pollution and COVID-19 infection. Kerimray et al. [8] studied COVID-19's impact in Kazakhstan's major cities. They discovered that while the lockdown did not directly reduce pollution levels in time due to favorable weather conditions, the lockdown did reduce pollution levels spatially. Non-traffic sources like coal-fired power plants also polluted heavily. Dantas et al. [9] studied the COVID-19 partial shutdown's impact on air quality in Rio de Janeiro. Carbon dioxide levels fell the most during the partial lockdown, while nitrogen oxide levels fell less due to industrial and diesel input. The PM10 concentration improves only during the first week of partial lockout. For their research, Bao and Zhang [10] looked at 44 Chinese cities' pollution levels. The scientists discovered that the lockdowns reduced human mobility by 69.85% in 44 cities, causing the drop in the air quality index.

Researchers have found a link between rising COVID-19 infections and climate change. Tosepu et al. [11] studied the relationship between weather and the COVID-19 pandemic in Jakarta, Indonesia. Scientists say only the average temperature was linked to the COVID-19 pandemic. Ma et al. [12] published a study in Wuhan, China, on temperature and humidity effects on COVID-19 mortality. On the other hand, the authors used a generalized additive model to examine the impact of temperature, humidity, and diurnal temperature range on COVID-19 daily death counts, as well as meteorological and air pollution data.

Our analysis of the current COVID-19 air pollution statistics found several significant flaws. There is limited overlap between studies of COVID-19 and its impact on air quality. Pollutants are frequently examined combined rather than separately and then explored to find their underlying correlation and dependence on each other. We

provide data from recent air pollution research and its relation to COVID-19 to help fill in these gaps.

3 Methodology

The air quality of a particular place is affected by the concentration of all the contaminants present in the atmosphere. We needed data for the major contaminants present in the air such as PM2.5, PM10, ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), Carbon monoxide (CO) of various cities in India. India observed a total of four lockdowns between March and May 2020, with almost all activities barring a few essential services coming to a halt. For the purpose of this study, we analyze the pollution levels and the impact of COVID-19 on it only till 22nd May 2020. We also compare the air pollutant levels during the lockdown period with the corresponding months, i.e., March, April, and May in the preceding four years—2019, 2018, 2017, and 2016.

To maintain reliability of the analysis, we use only one monitoring station for a particular city as simply taking averages of all the monitoring stations is not a scientifically sound approach as even two different areas in one city can have significant variations in pollution levels. This is due to the fact that some monitoring stations might be in a more polluted part of the city.

Figure 1 presents the framework followed to analyze the impact of COVID-19 on air pollution. There was not a single dataset available according to our needs, so we gathered data from different sources and then cleaned it, and performed joining and blending to make a single dataset for visualization in Tableau. We gathered data for individual monitoring stations for all the cities from the World Air Quality Project [13] which gathers data from CPCB, DPCC, SAFAR [14–16]. We considered a total of six parameters for our study. The final dataset consists of daily concentration levels of different parameters of air pollution. There were many states in which the data were not consistent—missing data for a particular contaminant at one monitoring station and missing data for some other contaminant at another station. As PM2.5 is the most harmful contaminant and to maintain reliability and consistency in data, we decided to choose the monitoring station which had the most consistent data for PM2.5.

Fig. 1 Framework diagram for selected monitoring stations and pollutant species showing the data gathering and processing, data blending and joining, and analysis and visualization using Tableau

Based on this filtering criteria, we singled out monitoring stations for the cities and selected them for further analysis and visualization. After gathering data from all the various monitoring stations for all the cities, we used the Pandas library from Python to clean our data and remove any null values. There were some cities such as Kolkata which only has two monitoring stations and recorded only PM2.5 levels. So, we had no option but to not include Kolkata in the analysis of any other contaminants. We then joined different columns from the datasets of individual monitoring stations to create a common dataset for doing the analysis and visualization in Tableau.

4 Result

We analyzed the main six species of air pollution—PM2.5, PM10, O_3, NO_2, SO_2, CO. Nationwide lockdown in India due to COVID-19 started on 24th March 2020; our analysis compared the levels of the abovementioned species for the months of March, April, and May in 2020 vis-à-vis their corresponding levels in 2016, 2017, 2018, and 2019. Figure 2 presents PM2.5 values of monitoring stations of six Indian cities, namely Delhi, Hyderabad, Kolkata, Lucknow, Mumbai, Patna, and Pune from January 2020 to 22nd May 2020. We see a significant drop of about 20–60% in PM2.5 levels during the months of total nationwide lockdown. The months of April and early May in India have cleaner air as compared to the rest of the months as this period is marked with good wind conditions which disperses most of the emissions to farther regions. These emissions then get scavenged via dry and wet deposition or chemical transformation in the atmosphere [2]. Such significant drop in air quality cannot be attributed only to the suspension of activities but also to seasonal effects. An AOD

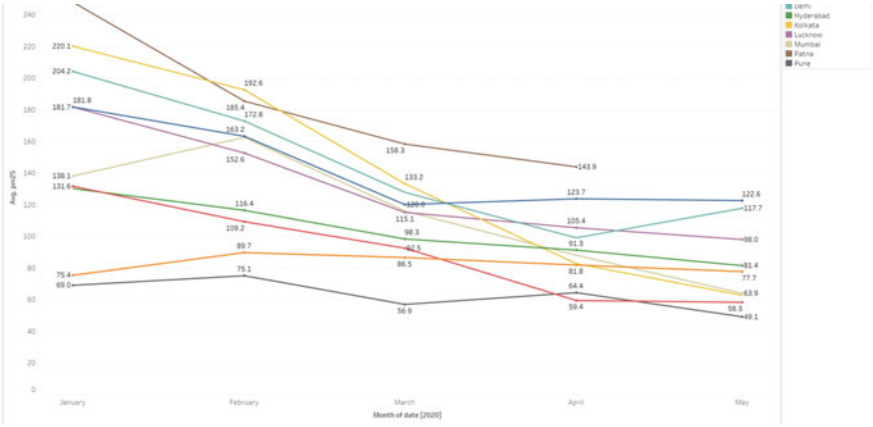

Fig. 2 PM2.5 concentrations from January 2020 to 22nd May 2020 in Delhi, Hyderabad, Kolkata, Lucknow, Mumbai, Patna, Pune

	2016			2017			2018			2019			2020		
city	March	April	May	March	April	May	March	April	May	March	April	May	March	April	May
Agra	168.4	205.0	184.5	179.5	162.8	158.6	164.4	153.4	157.9	151.3	147.1	143.3	120.0	123.7	122.6
Bengaluru	143.4	139.5	128.7	102.1	115.6	80.7	99.2	137.0	106.6	129.3	143.5	129.0	86.5	81.8	77.7
Chennai	171.2	171.6	160.8	142.8	169.8	161.3	151.9	107.6	94.8	137.7	85.0	139.4	92.5	59.4	58.3
Delhi	138.6	146.7	126.2	150.8	157.7	168.2	154.3	158.0	164.3	144.0	145.1	158.5	127.8	99.0	117.7
Hyderabad	136.0	121.0	89.7	136.5	147.2	115.3	137.3	107.0		141.5	134.1	144.4	130.1	118.2	134.5
Kolkata	153.7	110.3	98.7	150.2	122.7	112.3	161.3	113.7	96.3	141.0	97.8	94.9	133.2	82.7	62.7
Lucknow	171.8	175.3	171.0	184.2	186.3	173.7	154.1	156.5	138.3	174.4	157.3	142.8	115.1	105.4	98.0
Mumbai	102.7	80.1	79.8	123.4	104.2	81.0	127.1	97.0		88.5	67.8	54.9	73.1	67.8	104.4
Patna	184.1	159.5	160.0	190.4	183.0	144.6	198.6	174.2	154.5	160.6	133.6	134.6	158.3	143.9	
Pune	116.1	93.4	70.3	63.1	104.3	72.6	108.5	89.8	77.7	74.1	58.6	56.1	56.9	64.4	49.1

Fig. 3 Concentration of PM2.5 for the months of March, April, and May from 2016 to 2019

	2016			2017			2018			2019			2020		
	Q1	Q2		Q1	Q2		Q1	Q2		Q1	Q2		Q1	Q2	
city	March	April	May	March	April	May	March	April	May	March	April	May	March	April	May
Delhi	104.2	154.1	133.9	114.0	158.6	152.6	120.5	153.1	133.4	113.4	148.6	175.9	73.5	68.3	81.4
Hyderabad	70.8	70.2	56.7	90.9	103.8	80.0	81.7	67.9		83.1	75.4	91.5	69.9	58.3	66.9
Mumbai	75.5	58.0	52.9	89.2	72.9	50.1	83.5	62.7		81.6	60.2	51.9	54.9	44.8	48.9
Pune	101.7	89.3	66.8	64.8	98.7	72.4	103.7	95.2	84.3	72.3	58.5	52.7	64.5	69.0	51.2

Fig. 4 Concentration of PM10 for the months of March, April, and May from 2016 to 2019

climatological analysis projected a 50% reduction at the start of the lockdowns, with levels decreasing to decadal norms by the fourth lockdown [17].

As seen in Fig. 2 as well as Fig. 3, PM2.5 levels saw a decline of about 20–60% across India. Delhi saw 31% less and 25% less PM2.5 emissions in April and May 2020 compared to April and May 2019. Similarly, Bengaluru saw a decline of 42% in PM2.5 emissions for the same period. PM2.5 pollution mainly comes from motor vehicles, wood burning heaters, and industry. All of these activities were restricted during the lockdown resulting in such a significant decline. Figure 4 compares the concentration of PM10 in four cities—Delhi, Hyderabad, Mumbai, Pune. PM10 comes from motor vehicles and also includes dust from construction sites, landfills, and industrial sources. Due to restriction on construction activities, less road dust, restricted non-essential vehicular activity, and suspension of industrial activities, Delhi saw a decline of 54 and 53% in PM10 emissions in April and May 2020 compared to April and May 2019, whereas Hyderabad saw a decline of 22 and 27% in PM10 emissions for the same period. Figure 5 shows the concentrations of ozone during lockdown and in the previous years. Delhi saw a sharp increase of 102% in O_3 concentration in the month of May 2020 compared to May 2019. Agra also witnessed an average increase of 60% in April and May 2020 compared to the

	2016			2017			2018			2019			2020		
city	March	April	May	March	April	May	March	April	May	March	April	May	March	April	May
Agra	6.3	6.6	30.7	36.8	45.0	35.2	10.5	14.1	15.5	5.0	5.0	24.2	3.6	17.9	36.1
Bengaluru	35.5	86.0	20.6	37.0	30.5	22.7	26.7			33.8	20.5	24.5	20.1	19.7	16.8
Delhi	17.2	27.6	27.8	24.8	32.9	32.1	21.8	22.5	25.2	14.5	13.7	14.0	6.2	8.0	28.4
Hyderabad	32.0	27.9	20.9	54.0	60.9	54.8	22.5	21.2		19.3	20.0	33.7	14.6	10.7	8.8
Lucknow	42.1	47.4	41.9	48.3	70.4	21.2	29.7	29.4	21.6	15.6	23.6	8.8	16.0	4.9	14.2
Mumbai	12.2	6.7	7.3	24.4	16.3	22.8	46.3	35.8		33.5	16.3	9.9	18.5	5.0	3.6
Pune	99.8	77.2	63.5	63.5	66.5	53.3	105.0	68.8	48.3	116.2	99.3	74.4	89.4	78.7	69.4

Fig. 5 Concentration of O_3 for the months of March, April, and May from 2016 to 2019

	2016			2017			2018			2019			2020		
city	March	April	May	March	April	May	March	April	May	March	April	May	March	April	May
Agra	18.59	15.18	12.81	21.90	21.73	20.70	39.97	36.60	32.71	13.23	15.17	16.10	21.35	19.10	12.76
Bengaluru	6.35	8.41	10.10	10.29	10.45	8.50	14.48	12.25	15.13	10.71	10.47	13.03	11.74	8.00	9.57
Chennai	5.67	4.93	7.29	10.62	11.03	13.10	8.29	6.80	15.53	18.35	8.77	10.40	5.07	4.20	3.52
Delhi	22.07	28.09	22.16	23.42	29.07	31.83	23.52	27.47	27.28	21.69	23.13	25.71	18.08	9.00	9.40
Hyderabad	1.00	18.89	19.79	14.10	20.43	13.66	26.39	22.53		29.27	22.80	19.14	14.77	21.00	21.50
Lucknow	9.62	22.25	23.88	11.97	10.00	7.04	24.26	20.57	19.97	20.73	2.00	6.26	9.83	4.70	5.42
Mumbai	2.74	4.07	3.10	12.35	8.87	8.06	13.65	12.17		6.13	10.00	5.81	18.62	1.52	3.60
Pune	15.47	12.70	13.87	31.61	22.00	16.71	19.85	19.89	19.30	41.81	31.63	18.97	15.35	10.70	10.41

Fig. 6 Concentration of NO_2 for the months of March, April, and May from 2016 to 2019

previous year. A portion of the increase in O_3 concentrations that occurs from winter to spring is attributable to seasonality, while another component can be attributed to chemistry because NO_x and hydrocarbon emissions aren't present [2]. All other cities demonstrated very less or no drop in O_3 concentrations. Figure 6 shows that NO_2 concentrations dropped significantly in almost all cities as vehicle exhaust is the main source of NO_2 emissions, and all non-essential vehicular activities were restricted during lockdown. Since 81% of Delhi's NO_x comes from the transport sector (as per TERI Emission Inventory, 2018), Delhi saw a decline of 61 and 63% in NO_2 emissions in April and May 2020 compared to April and May 2019. Chennai saw a decline of 52 and 66% in NO_2 emissions for the same period. Mumbai too saw a sharp decline of 80% in NO_2 emissions for the month of April 2020 compared to April 2019. From Fig. 7, it is evident that SO_2 emissions did not witness any significant drop like the other contaminants. SO_2 emissions in Delhi did not change much compared to previous years mainly because of the fact that 70% of SO_2 emissions in Delhi originates from power plants located around Delhi (as per TERI Emission Inventory, 2018) which were operational during the lockdown as well as some biomass/refuse burning. In Chennai, there is a decline of 68 and 71% in SO_2 emissions in April and May 2020 compared to April and May 2019. In Mumbai, SO_2 emissions increased, which was unusual and intriguing. With no vehicular traffic and minimal industrial activity, this result is surprising. Some big and small ships hovering off the coast of Mumbai may have caused the lockdown, according to Guttikunda and Nishadh [2]. Figure 8 shows that due to reduced vehicular and industrial activity, CO emissions in Mumbai fell by 51% and 57% in April and May 2020, respectively, while CO emissions in Bengaluru fell by 39%. This drop can be attributed to the migration of low-income groups to their hometowns.

	2016			2017			2018			2019			2020		
	Q1	Q2		Q1	Q2		Q1	Q2		Q1	Q2		Q1	Q2	
city	March	April	May	March	April	May	March	April	May	March	April	May	March	April	May
Agra	9.48	3.36	8.93	7.10	7.07	5.55	8.68	10.30	14.45	6.48	5.73	9.06	13.32	13.07	12.81
Bengaluru	1.11	1.14	1.00	7.16	3.30	2.43	2.17	2.63	2.71	1.80	1.00	1.59	2.50	2.60	2.88
Chennai	3.82	2.07	2.13	7.07	5.43	3.94	7.97	5.37	3.83	8.23	4.57	4.68	5.13	1.43	1.33
Delhi	10.71	16.32	8.19	5.84	8.83	8.60	9.90	10.57	7.00	4.23	4.93	5.00	6.68	10.00	9.50
Hyderabad	3.77	3.97	3.96	11.71	13.57	10.76	3.10	3.32		1.05	1.06	1.20	3.06	1.05	1.05
Lucknow	3.41	4.04	6.06	2.74	3.19	1.65	2.13	1.29	1.10	1.97	1.59	2.19	2.26	3.63	3.35
Mumbai	1.77	3.37	2.80	7.81	6.27	5.00	11.90	12.00		5.33	11.00	8.94	8.83	16.30	27.24

Fig. 7 Concentration of SO_2 for the months of March, April, and May from 2016 to 2019

	2016			2017			2018			2019			2020		
	Q1	Q2		Q1	Q2		Q1	Q2		Q1	Q2		Q1	Q2	
city	March	April	May	March	April	May	March	April	May	March	April	May	March	April	May
Bengaluru	9.31	5.30	7.87	3.87	6.10	7.15	7.52	5.44	4.58	9.61	12.10	8.58	8.39	7.30	7.76
Chennai	10.72	6.80	11.83	3.97	5.53	5.67	6.52	8.67	8.03	6.97	9.60	10.24	6.90	5.20	7.81
Delhi	7.82	6.15	7.52	11.47	13.53	12.77	7.46	7.90	8.83	8.06	8.70	8.19	8.64	6.90	7.85
Hyderabad	8.68	7.74	6.35	7.71	9.87	8.14	10.00	12.68		5.83	5.96	5.68	5.97	4.14	4.77
Lucknow	7.48	7.21	6.31	11.10	9.67	8.32	9.55	7.93	6.19	8.27	12.03	13.97	9.06	7.53	7.30
Mumbai	6.06	4.27	5.35	7.39	5.73	4.71	13.90	11.78		15.40	16.03	14.52	12.41	7.83	6.19

Fig. 8 Concentration of CO for the months of March, April, and May from 2016 to 2019

5 Conclusion and Future Scope

With the cessation of anthropogenic (human made) activities, this analysis has shown everyone a proof of concept (POC) that clean air can be achieved. The main sources of NO_x, PM2.5, and PM10 are vehicular combustion and traffic, especially NO_x. Lockdown stopped all non-essential vehicular activity, reducing traffic and reducing road dust (PM10). Along with the decrease in air pollutants, there has also been a significant decrease in aerosol optical depth (AOD) and lightning activities in many urban regions [18, 19]. We can learn from this. People in cities like Delhi had forgotten what it was like to have clear blue skies and clean air, and now, they are concerned about it and raising awareness. If coronavirus taught us anything, it is that strict measures are required to solve a problem, but first, we must accept that there is a problem. India still lacks a mass demand for clean air. Our analysis shows that this clean air phase will be fleeting. Granted, cleaner air has been a boon for some, but the way we got there is not sustainable, and it comes at a high cost to the economy and societal well-being. Our analyses show that emissions will gradually return to pre-lockdown levels. After the restrictions are lifted, several environmental protections may be relaxed to help the economy recover, causing a drastic increase in emissions, making current levels difficult to maintain. Because air pollution kills over a million people per year in India, it must be addressed head-on, just as the coronavirus pandemic is. The drop in emissions should serve as a wake-up call, forcing more debates, and stronger policy actions to clean up India's air. The analyses clearly demonstrate that only a city-centric approach is not enough to tackle this issue, instead an airshed approach needs to be adopted where the reductions in air pollution in a particular area are complemented by the reduction in the neighboring areas also. This approach becomes extremely important and necessary for cities like Delhi where a large contribution of air pollution is from neighboring states.

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Chapter 11
A Comparative Study of Time Series Models for Blood Glucose Prediction

Sofia Goel and Sudhansh Sharma

1 Introduction

Diabetes is a serious chronological problem that happens when the human body produces insulin but not get utilized effectively. People are called insulin resistant in that case. The pancreas produces insulin which helps glucose to enter in cells of the body and controls in the normal range [1]. When the amount of glucose produced is not utilized effectively, it results in fluctuation of blood sugar level either too low or too high. This results in either hypoglycaemia or hyperglycaemia. After a diagnosis of T2DM, it is generally observed that most of the significant damage has already been done in the body. This is a serious concern of research as the disease is a lifelong metabolic disorder that can only be controlled but not cured. Type 2 diabetes is not only a metabolic disorder but also a distressing disease that requires the management of glucose and insulin [2]. To accomplish this, it requires recording a series of observations in chronological order, e.g. blood glucose level, electrocardiogram (ECG) etc. Glucose and insulin dynamics are very complicated to record because of its non-stationary and nonlinear behaviour. It also differs from person to person. To help protrusion of diabetic problems, we examined real-time glucose forecasting-based models on time series algorithms [3]. Specifically, the model is based on Bi-LSTM and is being compared with other time series models like LSTM, ARMA and ARIMA. Our prediction model is supposed to be of immense potential for diabetes self-management. At the moment, the entire responsibility of maintaining blood glucose levels to prevent or maintain diabetes falls on the patient, which affects the patients' health in all four dimensions: physically, mentally, economically and

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socially [4]. The patient is additionally stressed to maintain insulin portions dependent on what they eat, their active work, blood glucose levels and different factors all of which require steady consideration. Indeed, even with fastidious consideration regarding the subtleties, this methodology can just inexact the constant blood glucose control that comes from having an ordinary pancreas and leaves the patient in danger for entanglements, among them diabetic kidney illness, diabetic eye infection (retinopathy), diabetic nerve sickness (neuropathy), cardiovascular failure and blocking of arteries [5]. Moreover, insulin treatment makes perilously low blood glucose levels (hypoglycaemia) which can cause unconsciousness or even death in extreme cases.

Thus, to circumvent the issues raised by the prevalence of the disease, deep learning approach is required to design the model for accurate prediction of blood glucose level which helps the patient to reduce the number of insulin doses and make him more secure both mentally and physically.

Time series data from a study of patients suffering from Type 2 diabetes has been utilized in this paper. We have researched on in silico data. In silico data is obtained openly for research UVA/Padova T1DM data. This data is of patients suffering from diabetes for 15 days and conducted monitoring of blood glucose levels at different time intervals like breakfast, lunch and dinner. Also, performed the rating of sugar consecutively for three days on one parameter such as three days only after breakfast and three days after lunch and dinner.

There are numerous time series models available to forecast the data like RNN, ARIMA and ARMA along with the most prevalent model LSTM [6]. In this paper standard, LSTM models have been explored for forecasting disease. In addition, a comparative study of different time series models is done. Traditional models were less often significant due to the prediction of one factor over another in the loop based on the previous outcomes and forecast the latter [7, 8].

We provide a model using Bi-LSTM overcoming the shortcomings of existing approaches to forecast efficiently. Performance evaluation metrics used for comparative analysis based on R^2, MSE, RMSE and MAE. This model not only implements time series real data but also correlated the factors required for predicting the disease. The proposed model is the best suited simple model to for prediction of diabetes by considering the simplest neural network architecture.

2 Related Works

It has been a constant effort of researchers to design a model for the prediction of blood glucose to monitor diabetes. Researchers contributed to this field by developing various models and algorithms using machine learning, ANN and deep learning for the prediction and analysis of blood glucose levels.

Recently, there are several approaches and techniques which are proposed in the review using time series to model the medical data. Analysis of time series data is accomplished through pattern recognition of history of data in the context of

detection of the types of sequences occurred and how frequently it occurred. This aids in forecasting future values of blood glucose levels based on historical pattern. [9]. There are several time series forecasting models known to the literature, such as ARIMA models, neural networks, RNN and LSTM.

In this literature, we aim to showcase the state-of-art all-time series models beginning from autoregressive integrated moving average (ARIMA) to deep learning. The following are time series model-based reviews applied for forecasting and prediction purposes especially in the context of diabetes. Yang et al. [7] developed an ARIMA model for predicting blood glucose on non-stationary and time-varying CGM data. Interestingly Shanthi and Kumar et al. [8] worked on the prediction of ARIMA model by optimizing parameters with differential evolution. Thus, ARIMA models proven to be happening for time series data and opened the way to research more on the same.

But time series data remained a challenging task due to its size, nature, complexity, high dimensionality and continuous updation. Thus, researchers explored deep learning techniques to improve the performance achieved from classical approaches.

Researchers in [6] adopted an advanced level of sequential pattern analysis techniques to classify diabetes. Data of 40 patients was continuously monitored for blood glucose and medicine intake. Linear regression and ARIMA were used to detect blood glucose level of the patient. Authors Swapna et al. [10] performed analysis on input HRV signals of 20 people including diabetic and non-diabetic to perform detection of diabetes. In this research, feature extraction was done using deep learning neural network as a hybrid of CNN and LSTM along with SVM for classification.

Contributing in the same direction, Martinsson et al. [4] also developed a model to forecast of blood glucose using RNN and LSTM. As compared to other researchers, they believed that, it is easier to predict blood glucose with glucose as input alone. Mirshekarian et al. [11] performed their research on synthetic data by developing neural attention modules that were specifically designed for time series prediction of glucose monitoring. Authors worked significantly to overcome the vanishing gradient problem of RNN using LSTM. Another researcher Gadaleta et al. [12] applied classification algorithms for the detection of hyper and hypoglycaemia based on CGM signals.

In retrospect of predicting blood glucose, most of the researches performed prediction patient by patient, while Mhaskar et al. [13] considered the data for the number of patients and trained the model so that the machine need not recalibrate for the new patient. Authors like Sparacino et al. [2] also tested time series data of glucose values in every min and quantified these results using mean square errors. But these methods were limited to handle gaps in input data.

3 Methodology

Time series data is collected from real-life things of interest. The data is collected at regular intervals and analysed using a computer to give numerical output. This output

is further used for forecasting the causes of the disease. Time series is expressed mathematical estimations taken at similarly separated timespans. It very well may be week after week, month to month or every year. Time series investigation expects that some patterns repeats over the long run, i.e. the resultant value will be predicted by sequential pattern along with some interference of random effects [3]. As time series data is non-deterministic, it is difficult to forecast the data with certainty, but this becomes easy, if data in time series is taken stationary [14]. There are many models which are used to decompose stationary time series data such as ARMA, ARIMA, LSTM and Bi-LSTM.

3.1 Autoregressive Moving Average Model (ARMA)

Autoregressive moving average model consists of both AR component and MA component. Thus, it is a combination of intercept and several lag terms of AR series and error terms. Hence, it exhibits property of AR model, where the Y_t value depends only on its past values and MA, where Y_t depends on error values which follow a white noise process Thus, mathematically, it is represented as ARMA **(*p*, *q*) model**:

The equation is given by:

$$X_t = c + \in_t \sum_{i=1}^{p} \emptyset X_{t-i} + \sum_{i=1}^{q} \theta i \varepsilon_{t-i} \tag{1}$$

where p and q are order of AR and MA polynomial, respectively.

φ is the parameter of AR model, θ is the MA parameter, c is a constant and ε is error terms (white noise).

3.2 Autoregressive Integrated Moving Average Model (ARIMA)

In autoregressive integrated moving average model, the "*I*" stands for integrated which is added in ARMA model discussed earlier. This integrated meant to make the data stationary by taking a series of differences. It is used to capture autocorrelation in a series by modelling it directly. [7]. The key concepts are its order and differencing. This differencing is applied to remove trend or seasonality.

The equation for forecasting is constructed in the following manner. First, let y denote the dth difference of Y, which means.

$$\text{If } d = 0: \quad y_t = Y_t, \text{ If } d = 1 \quad y_t = Y_t - Y_{t-1} \text{ and so on}$$

The difference of Y is the discrete analogue of a second derivative. In terms of y, the general forecasting equation is:

$$\hat{y}_t = \mu + \phi_1 y_{t-1} + \cdots + \phi_p y_{t-p} - \theta_q e_{t-1} - \cdots - \theta_q e_{t-p} \tag{2}$$

where θs are the moving average parameters with their negative signs in the equation.

It is the order of differencing (d) which is needed to be determined to make the series stationary and remove the seasonality in the sequence.

3.3 Long Short Term Memory Network (LSTM)

LSTM is a special kind of recurrent neural network which is able to learn long-term dependencies [15]. Thus able to handle the vanishing gradient problem occurred in RNN. Unlike other neural networks, LSTM structure is in the form of chain comprises of four layers which interacts in a very special manner to make the architecture suitable for persistent memory. The key to LSTMs is that it works in three stages, first, it selects the information from the input which is to be remembered and whatever is irrelevant to be ignored. In second stage, it learns the new information and in third stage passes the updated information. Moreover, LSTM does not require setting such parameters (p, q, d) like in the case of ARIMA which must be calculated based on data. However, there are some hyperparameters we need to tune for LSTM.

We implement LSTM in our research work because of two reasons: one it supports nonlinear data another is it works well with less time for training signals with high accuracy [16]. Traditional neural networks do not support analysis of the reasoning of the cause based on previous ones and utilize that information for later ones. LSTM addresses this issue [17]. They are neural networks having loop structure, which allows allowing information to persist and peep to forecast. The basic model of LSTM suffers from the problem of gradient vanishing which is overcome by bidirectional LSTM. The LSTM architecture consists mainly of four gates:

Forget Gate: In LSTM network, forget gate decides whether to remember the information coming from the previous timestamp or simply forget it. The equation for forget gate is

$$f_t = \sigma\left(X_t * U_f + H_{t-1} * W_f\right) \tag{3}$$

where X_t is input, U_f: weight of input, H_{t-1}: the hidden state and W_f: it is the weight matrix

Input Gate: It selects what all information is carried as input to the cell. The equation of the input gate is as follows:

$$i_t = \sigma\left(X_t * U_i + H_{t-1} * W_i\right) \tag{4}$$

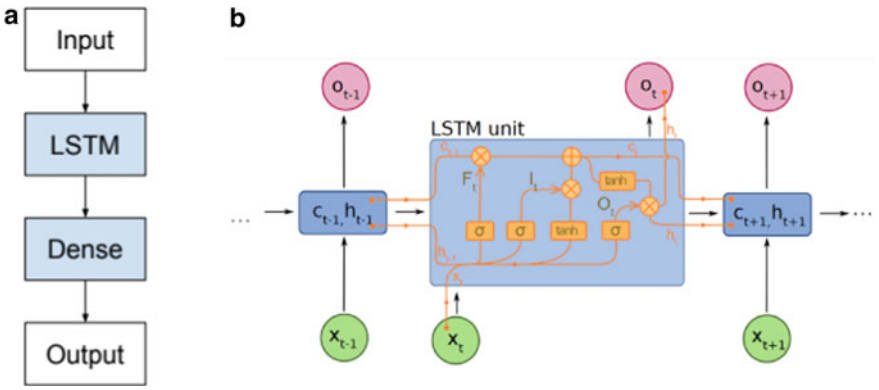

Fig. 1 **a** Block diagram of LSTM, **b** LSTM cell architecture

where U_i: weight matrix of input and W_i: weight matrix of input of hidden state.

Output gate: The output gate is meant for generating the output and updating the hidden vector h_{t-1}.

$$O_t = \sigma(X_t * U_o + H_{t-1} * W_o) \tag{5}$$

In all the above equations, σ is the sigmoid activation function (Fig. 1).

3.4 Bidirectional LSTM

To improve further accuracy in output, researchers tried to use the input data in both directions rather than one direction. In bidirectional LSTMs, input time series data is processed in both the forward and backward directions. Duplication of the first recurrent layer occurs resulting in two LSTM units one in the forward direction and the other in a backward direction which goes side by side [18]. Thus, two layers are working simultaneously one providing input sequence in forward direction and the second providing reverse of the same as shown in Fig. 2. This approach overcomes the limitations that exist in old architectures by providing information of past as well as future as whole sequence [19]. This is required in testing especially when inputs are in form of vectors and was successfully applied for speech recognition, but now, it is the widely accepted approach for lifting model performance.

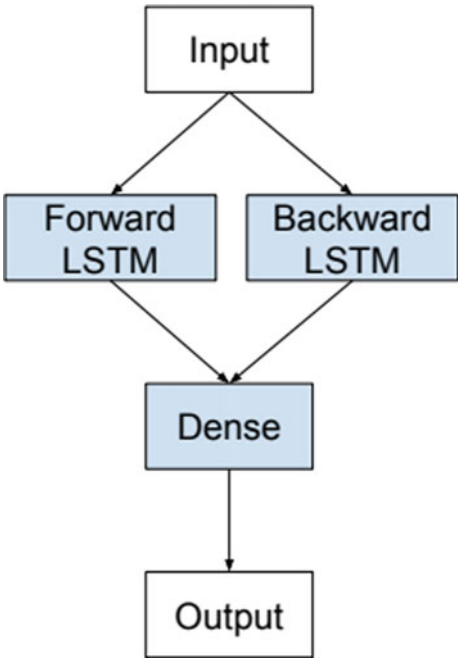

Fig.2 Block diagram of bidirectional LSTM

4 Data Collection

In this research work, UVA/Padova simulator dataset is used for blood glucose prediction. It is FDA-accepted T1D simulator and generates 30 days of blood glucose readings in silico trials for 10 virtual subjects (10 adults, 10 adolescents and 10 children). Here, CGM is generated every three minutes, and 20 samples are taken for testing in an hour. Entire data is in.csv format, where every 15 min of data is used for predicting the next 5 min of data by passing it in a deep learning model. Table 1 shows the overview of the dataset used.

Table 1 Parameters and values used in UVA/Padova dataset

Parameters	Value
Simulation time	360 h
Scenario	Custom
Meals	Breakfast, lunch and dinner
Subjects	Adults, adolescents, children
CGM sensors	Dexcom, Guardian RT and navigator (basal bolus controller was used for keeping these blood glucose levels under control)
Insulin pump	Cozmo and insulet

Table 2 Results of different time series models for blood glucose prediction

Ph = 15 min					
Approaches	MSE	RMSE	MAE	MAPE	*R*_Square
Bi-LSTM	166.6681	**12.9115**	8.7787	4.3997	0.5389
LSTM	180.5260	13.4362	9.1025	5.6337	0.6878
ARIMA	214.8276	14.6571	9.4652	5.3680	0.6996
ARMA	217.6510	14.7531	9.6675	5.5507	0.7125
Ph = 30 min					
Approaches	MSE	RMSE	MAE	MAPE	*R*_Square
Bi-LSTM	253.17636	15.9112	10.9707	6.6997	0.8389
LSTM	276.6566	16.6333	11.2035	7.0337	0.9878
ARIMA	297.7695	17.2562	11.5682	7.2660	0.9996
ARMA	304.7468	17.4571	11.8655	7.3507	1.0322

5 Experiment

LSTM due to its recurrent network can handle long-term dependencies of the input signals. This distinguished feature of the deep learning model of LSTMs helps to remember the essential portions of the sequence. This makes the forecasting model capable of learning parameters more proficiently, making it constructive for prediction in times series data. In this experiment, two models are trained using the UVA/Padova dataset one with LSTM and the second with bidirectional LSTM. Both the models were grained on 3 min interval data, where 50 min of data is input as the sequence for predicting the level of blood glucose in next 10 min.

The Bi-LSTM model was built using the tensor flow in Python. The model is made up of 128 LSTM units in bidirectional, multiple dense layers, dropout layers and an output layer with single unit (for prediction). We used ReLU activation function and Adam optimizer. Performance evaluation was done using MSE and RMSE to calculate loss. The size of epochs used for training the model was 200 along with a batch size of 256 and 64 filters with kernel size [3, 6, 14]. Cross-validation (70, 30%) was used for training and testing data. The results of the model for each architecture are provided in Table 2.

6 Evaluation Criteria

- Mean squared error represents the average of the squared difference between the original and predicted values in the dataset. It measures the variance of the residuals.

$$\text{MSE} = \frac{1}{N}\sum_{i=1}^{n}\left(y_i - y^{\wedge}\right)^2 \tag{6}$$

where $y^{\wedge}$ is the predicted value.

- Root mean squared error is the square root of mean squared error. It measures the standard deviation of residuals.

$$\text{RMSE} = \sqrt{\text{MSE}} = \sqrt{\frac{1}{N}\sum_{i=1}^{n}(y_i - y^{\wedge})^2} \tag{7}$$

- The mean absolute error represents the average of the absolute difference between the actual and predicted values in the dataset. It measures the average of the residuals in the dataset.

$$\frac{1}{N}\sum_{i=0}^{n}|y_i - y^{\wedge}| \tag{8}$$

- The **mean absolute percentage error (MAPE)** is one of the most commonly used determination metrics to measure forecast accuracy. MAPE is the average of the absolute difference between the actual and predicted values in the dataset. It gives average of the percentage errors.

$$M = \frac{1}{N}\sum_{t=1}^{n}\left|\frac{A_t - F_t}{A_t}\right| \tag{9}$$

where M is mean absolute percentage error, N is number of times the summation occurred, A_t=Actual value and F_t=forecast value

- R squared error is the ratio of the variation in the prediction of dependent variable from the independent variable (s).

$$R^2 = \frac{\text{SSR}}{\text{SST}} = \frac{\sum\left(\hat{y}_{\text{i}} - \overline{y}\right)^2}{\sum\left(y_{\text{i}} - \overline{y}\right)^2} \tag{10}$$

where SSR is sum of squares of residuals and SST is total sum of squares.

7 Results and Discussion

Bi-LSTM, LSTM, ARIMA and ARMA methods were used for blood glucose predictions. The prediction horizons (PH) considered were 15 and 30 min. Table 2 shows the results of prediction for 15 and 30 min, respectively. The model is evaluated on

performance measures like RMSE, MSE and MAE, MAPE and *R* squared error. The Bi-LSTM method outperforms the existing methods in all the cases under all criteria of performance evaluation. Its low error rate in all the cases shows that ARIMA, ARMA, LSTM and the Bi-LSTM outperformed all other methods in diabetes prediction. In the case of Ph = 15 min, the minimum value of RMSE found was 12.9115 which was the least among all other methods. Similarly, in case of Ph = 30, the value obtained by Bi-LSTM for RMSE is 15.911 which is the least value error among all.

8 Conclusion

In the present research work, a bidirectional LSTM network is used to predict level of blood glucose along with LSTM, ARMA and ARIMA models. All models were trained and tested on in silico data of 30 patients with each dataset containing 15 days of CGM data. The model was tested on 200 epochs and kernel size as vectors of [3, 6, 14]. Based on the performance evaluation, the Bi-LSTM model outperformed the existing methods ARIMA and ARMA and also shown a low error rate as compared to LSTM. As compared to other models and all prediction criteria, the Bi-LSTM network results show reduce values of loss in terms of RMSE and MSE. So from this experimental study, we can conclude that for blood glucose prediction, recurrent neural networks play a vital role and prediction rate could be improved further with more experiments on deep learning models.

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Chapter 12
Machine Learning Approaches in Mobile Data Forensic: An Overview

Preeti Dudhe and S. R. Gupta

1 Introduction

Mobile forensic data analysis (MFDA) is a relatively new and underdeveloped subdiscipline within the field of mobile forensics (MF). As M. K. Rogers notes, digital forensic research has "fallen into the trap of concentrating nearly entirely on data collection and paying little attention to the inspection and analysis stages". The need to implement intelligent solutions that alleviate the strain of manual investigations has been emphasized by a significant number of research articles across the literature—in addition to a questionnaire-based study on current problems conducted by [1].

The challenges confronting forensic practitioners indicate that 85% of respondents identified the "need to develop methods for identifying and extracting important evidence via techniques such as criminal profiling" [1] as a critical problem.

Since mobile device usage grows in popularity, so does the importance of mobile device forensics, as mobile devices are often discovered at crime scenes. Forensics is utilized in various circumstances, ranging from internal company audits to law enforcement's more typical criminal investigation cases. Numerous crimes and other wrongdoings underscore the critical role of forensics in improving the world. Digital forensics is becoming more essential as society becomes increasingly reliant on computers, communications tools, and technology. Mobile device forensics is a subset of digital forensics attempts to recover or collect data and suggestions from

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mobile phones and analogous gadgets used in everyday life. Mobile device forensics enables researchers to investigate specific topics using mobile device-based messages. It is constructed on established methodical methods and standards for gathering data about an item, event, or artifact within a particular time to evaluate if it was what it claims to be or is claimed to be. Mobile device forensic experts have faced many obstacles that impede their work throughout these forensic investigations.

As we all know, mobile gadgets are rapidly becoming the primary portable computation power source due to their constant upgrades, changes, and new additions; this has resulted in the absence of existing forensic apparatuses for data recovery that are well-suited with today's proliferation of novel model gadgets. The primary distinction between mobile device forensics and processor forensics is that one must contend with various hardware and software standards with mobile device forensics, making the development of a universal standard tool almost tricky. Because embedded software is more specialized than PCs, data collection methods are non-standardized, necessitating the development of huge solutions. With the introduction of new phones at an exponential pace and the entry of new businesses employing a unique mix of registered software, the issue has become even more exacerbated with time. The embedded software platform for malware analysis is shown in (Fig. 1).

A mobile gadget forensic tool's objective is to extract information from a mobile gadget without altering the data. The instrument should deliver essential updates on a timely basis to keep up with the fast evolution of mobile gadget computer hardware and software. The devices may be forensic or non-forensic, each posing a unique set of problems and allowing for various possible solutions. While forensic tools are mainly meant to unearth information from mobile gadgets, non-forensic apparatuses are not planned to do so but may be used. Two distinct methods have been tried to solve this condition: either shorten the time between the launch of the cell phone and the availability of the mobile gadget forensic package for that cell phone or establish a baseline for evaluating the efficacy of an instrument on a specific gadget.

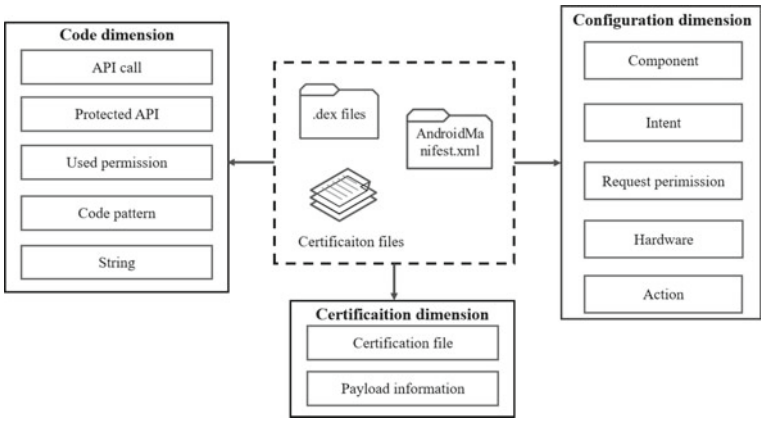

Fig. 1 Integrated software platform for malware analysis of mobile terminals

The first approach shortens the time between when a mobile device is released and when it becomes available. The tools are made available mainly via the addition of a new coat called phone manager procedure filtering, which is seated between the programming boundary and the library at a higher abstraction level, thus providing a degree of program information independence. The circumstance enhances this technique's usefulness that the majority of mobile managers run on Windows.

The main goal of this technique is to acquire a mobile manager and alter it so that hazardous "write" instructions cannot be given; i.e., forensic researchers will not inadvertently put information onto an uncertain phone, thus compromising or jeopardizing a case. A software called a filter does this change to the phone manager. This filter will prevent hazardous write instructions from being executed, intercept information from the target cell phone in binary form, and then transmit it to the cell phone management for more decoding. The second approach is to offer benchmark or test data for forensic tools evaluation. The user then populates the phone with the desired data and recovers it using a forensic instrument. Thus, the reference line is the information that was initially agreed upon over the phone. Identity module programming often establishes the basis (IMP).

The remaining sections of the paper are structured as follows. Section 2 does a literature review, while Sect. 3 discusses digital forensics' challenges and ends the article.

2 Related Work

Given the short release cycles of mobile phone models and the wide variety of operating systems and hardware variants, this is not a simple criterion to meet. The difference in hardware and software, combined with the connection to a live network, introduces additional complications. One issue is a power outage, which may result in the reactivation of security procedures. Another issue is remote data wipes. Due to these difficulties, investigators are constrained by training and time constraints while investigating a mobile phone or gadget connected to a live network.

Numerous research articles use intelligent computing approaches to automate criminal profiling via behavioral evidence analysis (BEA) methodologies. The overwhelming majority of them move to inference based on demographic data and qualitative data. Additionally, their primary objective is the establishment of a validating knowledge base. One of the earliest efforts in this approach was the NNPCP project, which resulted in a neural network capable of criminal profiling across various crime types. Its data source was the Italian police department's official criminal records. Despite the reasonably remarkable description for the time covered in the article, the NN architecture and capabilities explanation is relatively abstract, with no further information on the generated outcomes. Ferrari et al. examined the results of Bayesian and feedforward neural networks used to "predict criminal behavior using post-mortem datasets of single-victim murders" [1]. The systems categorized

additional criminal acts according to various psychological variables relating to the perpetrators' character and how each crime was committed.

Recent paintings are more refined and solid in their presentation. Additionally, they include a more significant number of experiments and outcomes, which provides more reliable evidence. Finally, the writers do not shy away from combining several methodologies and incorporating interdisciplinary concepts to obtain the best results. A drawback of these technologies is that they are either profiling or detection tools. Andro AutoPsy is the only exception, and it is likewise more focused on machine behavior. The present article employs an approach that combines established profiling methods with a newly proposed suspicious pattern identification tool based on NNs and ANFIS. The following section details the technique used.

2.1 Present Technological Used in Crime Detection and Prediction

The term "crime forecasting" denotes the fundamental procedure of anticipating crimes. Predicting a crime in advance requires the use of tools. Currently, police utilize technologies to help them do particular duties, such as hearing in on an accused's phone conversation or recording odd criminal behavior using a body cam. The following is a collection of such tools to help you better grasp their potential with technical aid.

The "stakeout" is a widely used technique that has been in use since the beginning of surveillance. Stakeouts are the most commonly used surveillance method by police personnel and collect information on all kinds of suspects. The authors of [1] explain the significance of a stakeout by saying that police officers see many incidents for which they must make reports. Such illegal activities are seen during stakeouts or patrols, guns, narcotics, and other suggestions discovered during home explorations. Descriptions of their conduct and that of the uncertain are provided after an arrest. Stakeouts are very beneficial and regarded as 100% trustworthy since they include the police monitoring noteworthy events. Are they, however, absolutely accurate? Every officer is a human being, and all people experience tiredness. Stakeouts are primarily used to keep an eye out for criminal activity.

Additionally, surveillance techniques like facial recognition, license plate recognition, and body cameras are used. The authors of ref. They are stated that face recognition may acquire suspect profiles and compare them against other databases to elicit further information. Likewise, a license plate scanner may be used to get information on a vehicle that may have been engaged in a crime. They may even employ body cameras to get beyond the range of the humanoid eye, implying that the person who reads watches and records whatever a police officer sees and records. Generally, when one is familiar with an item, they are unable to recall its complete picture. The effect of body cameras on officer misbehavior and domestic violence during arrests was examined in ref. in [2].

2.2 ML Techniques Used in Crime Prediction

In [1], they explored machine learning-based crime prediction. Predictions were made using crime statistics from the past 15 years in Vancouver, Canada. This machine learning-based criminal investigation technique includes data collection, categorization, pattern recognition, prediction, and visualization. Additionally, the crime dataset was analyzed using K-nearest neighbor (KNN) and boosted decision tree methods. The researchers examined a total of 560,000 crime records from 2003 to 2018 and found that using machine learning algorithms, and they could predict crimes with an accuracy of between 39 and 44%. As a prediction model, the accuracy was inferior. Nonetheless, the authors found that accuracy might be enhanced or enhanced by fine-tuning the procedures and the crime information for detailed applications.

Tabedzki et al. [3] describe a machine learning method for forecasting crime data in Philadelphia, Pennsylvania, United States. The issue was split into three sections: assessing if the crime occurred, committing the crime, and maximum probable crime. The datasets were trained using logistic regression, KNN, ordinal regression, and tree techniques to generate more precise quantitative crime predictions with a higher degree of relevance. Additionally, they provided a crime prediction map depicting several crime classes in various regions of Philadelphia during a specific time, with different colors representing a particular kind of crime. Other crimes, ranging from attacks to cyber scams, were added to reflect the overall crime design in Philadelphia during a given time. Their system predicted the likelihood of a crime occurring with an astounding 69% accuracy and the number of crimes occurring between 1 and 32 with a 47% accuracy.

Prithi et al. [2] describe a machine learning method for forecasting crime rates through a graphical user interface. The primary objective of this research was to identify the most accurate machine learning-based strategies for forecasting crime rates and to examine their relevance to the dataset in particular. The dataset was analyzed using supervised machine learning methods to verify the data, clean it up, and display it. To anticipate the outcomes, we compared the outputs of several supervised machine learning systems.

Kang and Kang [4] propose a technique of feature-level information fusion built on a deep neural network (DNN) for correctly predicting crime existence by efficiently fusing multi-modal information from many domains with ecological context data. The collection includes an online record of Chicago's crime data, demographic and climatic data, and pictures. Numerous machine learning approaches, such as regression analysis, kernel density estimation (KDE), and support vector machines (SVM), are used in crime prediction systems. Their methodology was primarily composed of three phases: data gathering, statistical investigation of the connection between crime events and acquired information, and, finally, actual crime occurrences. Spatial structures, temporal structures, and ecological context are all included in the DNN model.

The SVM and KDE models achieved 67.01 and 66.33% accuracy, correspondingly, while the suggested DNN model achieved 84.25% accuracy. The experimental findings indicated that the proposed DNN model was more precise than the other prediction models in predicting crime occurrences.

The writers of [5] concentrated on studying and developing machine learning procedures to decrease crime in India. Machine learning methods were used to infer pattern relationships between a vast collections of data. The study mainly focused on forecasting future crime based on historical crime areas. Analyses and interpretations of the data were carried out using Bayesian neural networks, the Levenberg-Marquard procedure, and a scaled procedure. In contrast to the other two methods, the mounted process performed the superlative. A statistical study using correlation, analysis of variance, and graphs has shown that the crime rate could be decreased by 78% with the assistance of the scaled algorithm, indicating a 0.78 accuracy.

2.3 Comparative Study of Different Forecasting Methods

The authors of [6] predicted crime in 2014 and 2013 using the KNNs algorithm in [6] that a better crime estimate accuracy could be achieved by integrating gray correlation investigation with the KNN classification method. They were using the suggested method, which resulted in a precision of about 67%. In comparison, Shojaee et al. [6] split crime information into crucial and non-critical categories and used a basic KNN algorithm to classify them. They attained an astounding 87% accuracy.

Obuandike et al. and Iqbal et al. [7] predict crime for the years 2015 and 2013 using a decision tree algorithm. Obuandike et al. attempted to obtain more than 60% accuracy in their research by combining the Xero algorithm and a decision tree. Additionally, using a decision tree method, Iqbal et al. obtained an astounding 84% accuracy. In both instances, however, a slight alteration in the information may significantly alter the structure.

In [8, 9], a new method for crime estimate and analysis termed naive Bayes was developed. Jangra and Kalsi [8] obtained an astonishing 87% accuracy in crime prediction but could not apply their method to datasets with many variables. In comparison, Wibowo and Osman [9] predicted crimes with an accuracy of just 66% and ignored computing speed, robustness, and scalability.

The following section summarizes the above comparison and adds additional models to demonstrate the comparative study's validity and the correctness of specific commonly used models (Table 1).

The research focused on three key issues. To begin, the writers raise concerns about the effectiveness of computer visualization algorithms. They claimed that prediction correctness is 90% for less complex datasets and 60% for more intricate ones. Another area of emphasis is cost reduction in terms of storage and computing. Second, there is the issue of its suitability for law enforcement. They determined that detecting different activities is complicated. They identified a critical component; the public safety graphic analytics workstation comprises numerous capabilities ranging

from object recognition and localization in photographic camera feeds to labeling movements and events related to training information and enabling query-based examinations for specific actions in videos. They want to treat each occurrence as a

Table 1 Performance analysis of forecasting methods

S. No.	Forecasting method	Accuracy	Limitations	Observation	References
1	Decision tree (J48)	59.15%	The model took 0.76 s longer to construct than the other models, which took 0.09 s	We compared the J48 naive Bayesian and Xero models using tests	[10]
2	KNN ($K = 10$)	87.03%	The naive Bayesian model is somewhat more accurate	It evaluated five classification algorithms, namely naive Bayesian, neural networks, and KNN, to see which predicted better than the SVM and decision tree	[6]
3	Naïve Bayes classifier	87.00%	It cannot be used with a high number of characteristics in the dataset	The new criminal detection naive Bayes technique was used to predict and analyze crimes	[8]
4	Decision tree	83.9519%	Due to its instability, even a slight change in data may result in a noticeable alteration in the structure	With the same crime dataset and WEKA, the decision tree fared better than the naive Bayesian	[7]
5	Naïve Bayes	65.59%	There was no consideration made for computational speed, reliability, scalability, or interpretability	It provides a comparative study of the predictive correctness of KNN, naive Bayes, and decision tree procedures for crimes and criminal acts	[9]

(continued)

Table 1 (continued)

S. No.	Forecasting method	Accuracy	Limitations	Observation	References
6	Autoregressive	0.0867 ± 0.0293	According to them, this model is very complicated in comparison to others	For auto-prediction, ARIMA makes use of auto-correlation parameters	[11]

proficient, documented, and tagged computer vision occasion. Finally, they inquire if computer visualization affects the criminal evenhandedness system. Their reply is very positive, to place it mildly, even if they need to use computer visualization alone, which they think will be inadequate.

3 Challenges of Digital Forensics

Along with concerns of forensic examination purity, examiners must contend with highly technical challenges, beginning with determining a particular phone's manufacturer and operating system. This is a significant issue because of the wide diversity of contemporary telephones. When selecting the software for the investigations, it is essential to be completely informed of the data extracted from the device and how much can be obtained and processed by the particular program. The following are the primary difficulties that mobile forensics specialists encounter throughout the investigative process.

3.1 Advantages and Disadvantages

The benefits of utilizing forensic tools during a computer investigation include the capacity to rapidly search through large quantities of data and search in many languages (which is critical given the internet's lack of borders). Once-deleted data may now be recovered using forensic techniques.

- The trading of data is occurring regularly preposterous. Although this might be advantageous for us, it can likewise act as a chance for hackers or cybercriminals.
- Phishing, corporate fraud, protected property debates, online theft, breach of agreement, and resource recovery are cases wherein digital forensics can be utilized.
- Aside from the technical angle, lawful issues are additionally included. Digital forensics experts make their examination to make the digital proof or evidence which will be permissible in court.

- Important information that has been deleted or destroyed by hackers may be retrieved, providing substantial evidence in court. Legal experts may present previously unthinkable facts in court.

There are certain drawbacks, such as the fact that computer forensic techniques may potentially alter current data. Consequently, the forensic expert must record everything done, including which software was used and modified, and inadequate documentation may result in inadmissible evidence. Additionally, engaging a forensic expert to examine all of the data may be very expensive.

4 Conclusion

This article discusses how machine learning methods may be used to automate repetitive tasks in digital forensics. These diverse approaches demonstrate what to anticipate in the future from machine learning-based digital forensics applications. Finally, we examined the areas of digital forensics that need our attention to protect our work in all aspects.

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Chapter 13
Generating an Extract Summary from a Document

Fatima Boumahdi, Ayoub Zeroual, Ibtissam Boulghiti, and Hamza Hentabli

1 Introduction

The summary is a condensed version of the document's content. The automated text summary, on the other hand, is a reduced form of a written document obtained through computer technology. Automatic text summary may take one of two methods. The extractive approach attempts to locate and extract the most relevant text parts in order to create a summary. And, the abstractive method is primarily influenced by artificial intelligence research, with the goal of producing summaries of similar linguistic quality to those generated by people. Recently, a novel approach called semi-extraction was introduced that makes use of compression, fusion, and sentence segmentation methods. In terms of automated summarising techniques, there are many approaches for extracting important phrases. The majority of these approaches are based on the computation of a score for each phrase in order to evaluate its significance in the text. Figure 1 illustrates some of these techniques [1].

The remaining document is structured: Sect. 2 provides an overview of the state-of-the-art extraction summary methods. The proposed system architecture is described in Sect. 3. Section 4 deals with the assessment of performance. Section 5 concludes the paper.

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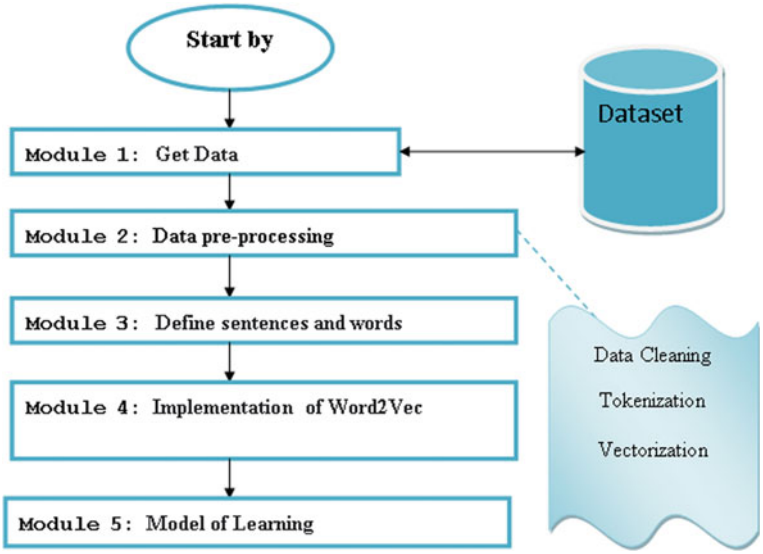


Fig. 1 Proposed architecture

2 Related works

Abstraction-based and extraction-based summarising methods were utilised in several research. Extracting important sentences and pasting them into a summary is how the extraction-based method produced a summary. A grading system called "features" was used to evaluate all of these sentences, and each phrase received a distinct score. Sentences that rated the highest were then chosen to be candidate summary sentences. This method summarised texts by adding or subtracting text units (phrases or sentences) as well as segmenting and paraphrasing certain portions of the text units in order to provide a concise summary. Because of its complexity, this method is more difficult than the extraction-based approach [1].

It is possible to use the "indicative summary" or the "informative summary" for the target text summary. What is in the main document, which concentrates on a particular topic? That is what the indicative summary tells you. Approximately 5–10% of the original content is compressed in order to produce the summary. The instructive summary, on the other hand, evaluates a majority of the issues in the main text. This kind of produced summary contains between 20 and 30% of the original. Additionally, ATS researchers have examined two types of document input sizes, namely one document and multi-document summarisation.

All summarisation methods have been classified into three ways, surface, entity, and discourse [2, 3], based on the document's processing level. To extract the important phrases from the document and include them in a text summary, a surface-level approach uses a shallow feature set to extract them. The entity-level procedure extracts the entities from the text content, determines their connection, and

models their extraction. Some of the most effective methods for detecting the essential connection between entities include the usage of a vector space model and graph-based representations. On the other hand, a discourse-level method relies on the modelling of the global text structure and its correlations, such as the rhetorical text structure (e.g. narrative and argumentation structure) and the different themes threads (as and when they get exposed in a text).

Surface-level (i.e. feature scoring) methods were some of the earliest strategies suggested for summarising texts [4, 5]. To assist, summarisers discover important sentences in text documents [4] and [6] suggested new terms-frequency processes for emphasising term-importance in context. After studying two processes for ten years, [5] identified pragmatic terms (such as "important", "key").

According to [7], document-level similarity may predict more complicated interpretations than sentence-level similarity. Then, [8] proposed an ATS system based on a reinforcement learning algorithm and a recurrent neural network (RNN) sequence model of encoder-extractor network architecture for single-document summarisation.

3 The Proposed Architecture

Our system is a fully automated English text summarising system that makes extensive use of abstraction methods. The suggested architecture makes use of machine and deep learning principles. The following graphic depicts the proposal's flowchart, which goes through many stages to arrive at a summary.

3.1 Module 1: Get Data and Pre-processing

The first step is for the Amazon Food Reviews dataset to be downloaded which has 10 columns in this dataset and 500,000 rows; we obtain a CSV file from this data columns, text column on rows, summary row column. The following picture shows an example of data cleaning (removing the term empty, transforming words from uppercase into lowercase, etc.).

3.2 Module 2: Define Sentences and Words

We break each paragraph down into phrases and each sentence and summary into words. Then, each summary is repeated according to the number of sentences in each text, until each phrase in each text corresponds to the text summary, as shown in the accompanying picture.

3.3 Module 3: Implementation of Word2Vec

In this module, we go downloading glove-twitter-50 and we complete the following procedures. We are converted to a Word2Vec vector.

Conversion of Word to Vector
The Word2Vec tool reads a text corpus and outputs word vectors. It generates a vocabulary from the training text input and then learns the words' vector representations. As a result of running Word2Vec, we obtained a vector containing 50 segments for each word in our dataset. The following is an example of a sentence after it has been processed by Word2Vec (see Fig. 1).

Conversion of Sentence to Matrix
We convert the longest sentence in our dataset (we count the number of words in each sentence and take the sentence containing the maximum) into a matrix of (max; 50) as shown in an example in the following figure.

After counting the number of words in each sentence and getting the maximum number, say 50, we then convert all the text and summary sentence matrices into matrices of dimensions (50, 50) and fill in the space with zeros; e.g. if we have a matrix of dimensions (23, 50), we will fill the matrix with zeros up to (50, 50).

We transformed our dataset into a three-dimensional vector: number of sentences, number of words (fixed 50), vector of 50 segments.

On the other hand, we repeat each summary according to the number of sentences in each text, to finally get each sentence from each text corresponding to the summary of each text, but without dividing the sentences into words.

In the end, we get text sentence matrix, summary matrix, text sentence, summary.

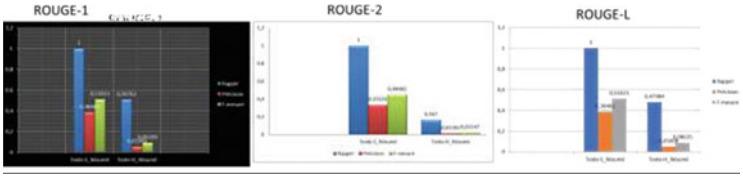
3.4 Module 5: Model of Learning

In this step, we will apply two models: auto-encoder and multi-layer perceptron, and we take the text matrices as inputs and the summary matrices as outputs. In order to train to produce summaries, we go through the following steps:

Step: 1 For each document, we compute latent convolution between the matrix of each sentence in the text and the text summary matrix, and it is made by model auto-encoder.

Step: 2 In this step, we take the texts as inputs and their summaries as outputs; to know the percentage of similarity of the sentences for each document, we calculate BLUE score that is the similarity between the sentences of text and the summary. By obtaining for each similarity a vector of 1 segment which contains the value of similarity.

Step: 3 After finishing the computation of BLEU score, we move to the second model multi-layer perceptron between latent convolution of each sentence as input and BLEU1 score of each sentence as output.



	ROUGE-1			ROUGE-2			ROUGE-L		
	Recall	**Precision**	**F-measure**	**Recall**	**Precision**	**F- measure**	**Recall**	**Precision**	**F- measure**
Text S_ Summary	1,0	0,38482	0,51021	1,0	0,33531	0,44965	1,0	0,38482	0,51021
Text H_ Summary	0,50762	0,05343	0,09209	0,16700	0,01342	0,02247	0,47984	0,05008	0,08635
S_ Summary H_ Summary	0,35667	0,12491	0,17044	0,11138	0,03343	0,04605	0,33591	0,11733	0,16018

Fig. 2 Comparison of single extractive document summarisation using ROUGE-1, ROUGE-2, and ROUGE-*L* result

4 Results

When it comes to text summarising, a "good" summary should include as much relevant information from the source document as feasible while remaining within acceptable length constraints. Numerous techniques for assessing human performance have been suggested to address this need [9–11].

In this study, the researchers suggested CNN-ATS. An extractive summarisation method based on a new methodology may be used to a single document. CNN-ATS is a convolutional neural network (CNN) with a novel text matrix representation (text matrix representation). Automated text summarisation is another use of this technology. In addition, it is a deep learning system that combines information about the words and their meanings with the idea of those words. As a result, the suggested CNN-ATS method was compared to five different benchmark summaries.

Using five benchmark summarisers: Copernic summariser, Microsoft Word 2007 summariser, DUC's best automatic summarisation system, the average of human model summaries (models), and ROUGE-1, ROUGE-2, and ROUGE-worst *L*'s automatic summarisers, Fig. 2 shows the average precision and recall, as well as the average *F*-measure for the proposed method.

5 Conclusion

Due to the continuous growth in the quantity of accessible data and the requirement for relevant information in a fast and clear manner, automatic text summarising has become more essential in many areas, including research. We used three current technologies, namely Word2Vec, auto-encoder, and multi-layer, to develop a software for automated text summarisation using novel methods, which we trained on the

Amazon Fine Food Review dataset. Our project's outcomes were very positive. In this study, the results of the suggested summariser were compared to those of other summarisers, including Copernic summariser, summariser, poorest system, and best system. The system summaries were then assessed at 95% confidence intervals using the ROUGE tool set. The average recall, precision, and *F*-measure from ROUGE-1, 2, and *L*, respectively, were used to derive the findings. Because it is a balance of accuracy and recall for the system's outputs, the *F*-measure was used as a selection criteria. Our suggested approach generates the best average accuracy, recall, and *F*-measure, according to the findings.

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Chapter 14
Obtrusion Detection Using Hybrid Cloud Models

Siddarth Chaturvedi, Swati Jadon, and Ankush Sharma

1 Introduction

Cloud computing is a scheme of estimation in exacting situations under convinced conditions, does not have right to use to the Internet source. Cloud is the fundamental hardware information assemblage. For the sustain machinist, it will be potential to attain the expertise and sculpt the position outcomes. Cloud computing is a representation of supplementary operational that assimilate existing innovation measures in a different manner. The cloud computing proposal must be at least double the sum of storage space that we want to accumulate. In cloud computing, preservation of information turns out to be the major concern only because of their sensitivity. The sensitive data uploaded into cloud is susceptible to safety hazard such as reliability, discretion and accessibility of those trades. Cloud computing recommend an immense impending to develop efficiency and decrease expenses, but simultaneously it possesses a lot of latest security risks. Obtrusion detection systems (ODS) have been utilized extensively to identify malevolent activities in system communication and hosts.

The conventional obtrusion detection system is not lithe as long as protected in cloud computing because of the disseminated arrangement of cloud computing. Cloud computing is defined as a "*network of networks*" in the presence of the Internet, consequently probability of obtrusion is more with the sophistication of interloper attacks. Cloud computing is disseminated in architecture; hence the probability of obtrusion is higher.

Protection of the cloud computing scheme is confidential and is classify into two extents for instance physical security and cyber security. Physical security distresses the physical chattels of structure for instance incombustibility, continual

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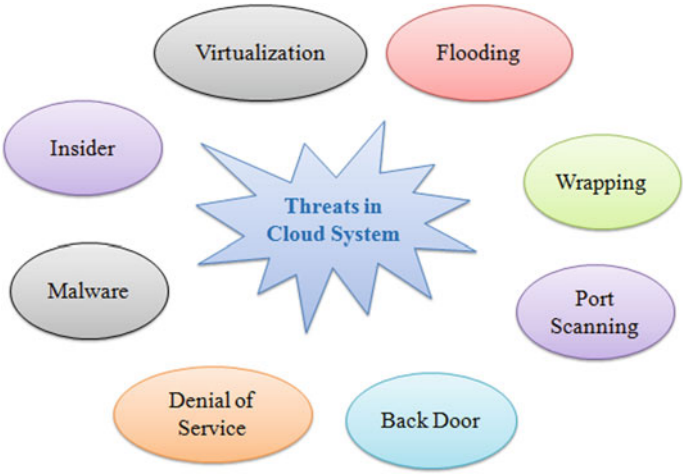

Fig. 1 Various attacks in cloud system

power supply, principles of the cloud mechanism and safeguard for normal catastrophes. Alternatively, cyber security identifies the anticipation of structure from cyber attacks. There is a threat of cyber security attacks on overhaul of cloud computing scheme which exploited the enormous amount of data of cloud customers.

2 Security Issues in Cloud

Cloud computing make use of three liberation mock-ups by which special kind of services can be conveyed to the end consumers. The three liberation mock-ups are the SaaS, PaaS and IaaS which offer communications possessions, submission proposal and software as overhaul to the end users. IaaS is the basis of all cloud services (Fig. 1).

3 Obtrusion Detection Schemes

It is described as a Computer network arrangement to accumulate database on an amount of input points, and investigate this dataset to observe whether there are contravention of arrangement in security performance (Fig. 2).

It is a mechanism or software submission that observes arrangement or scheme behavior for malevolent actions or strategy contravention and constructs reports to an administration location.

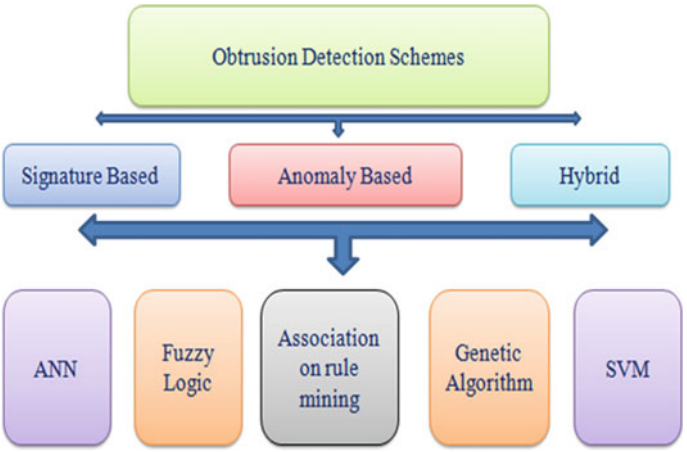

Fig. 2 Obtrusion detection schemes

4 Methodology

Operational procedure of obtrusion detection scheme consists of:

Data Accumulation
It engrosses accumulating network traffic by mean of meticulous software and get dataset about the traffic like packets, hosts and protocols.

Attribute Choice
Need to select attribute vectors that includes simply required information. In obtrusion detection, it can be IP header for source and destination IP address, packet types, protocol types and various flags.

Analysis
The accumulated dataset is analyzed to verify that whether database is inconsistent or not.

Action
ODS unease the structure administrator that an attack has taken place and inform about the character of that attack. ODS also play an important role in controlling the attacks.

5 Cloud Model

There are different clouds models available for obtrusion detection. Among them one model works only for the private use of the associations which is managed by a third

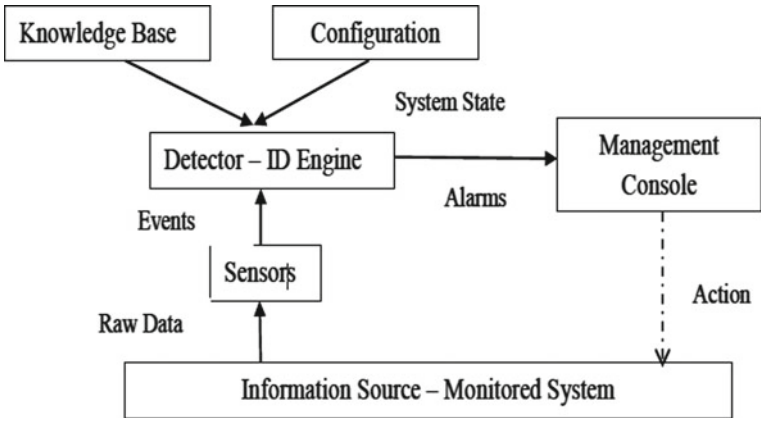

Fig. 3 Private cloud-based obtrusion detection

party or by the association itself. If it appears similar to a private–public cloud, then cloud is additionally elite and protected. In Public clouds there is bandwidth limitation, requirement of supplementary safety policies, and some legal requirements. Eucalyptus systems is a widely used example of private cloud (Fig. 3).

On the other hand in hybrid cloud, the positioning prototypes of two or more clouds congregate by the shift of information between them are accomplished. These hybrid clouds are shaped by corporations while the managerial errands are mutual between corporation and cloud suppliers. The intention of the company's overhaul requirements can be evidently tacit. Services for instance payment of users, staff processing by staff has been done by use of hybrid cloud (Fig. 4).

To offer information and portability of its submission throughout cloud configuration, private clouds, hybrid clouds are integrated by regular techniques. Amazon web services are the example of hybrid cloud. It includes following processes (Table 1).

5.1 Performance Metrics

F-Score

F-Score is the accuracy measure based on precision value and recall value of the obtrusion detection system.

$$F - \text{score} = \left[\left(1 + \beta^2\right) * \text{ recall} * \text{precision}\right] / \beta^2 * (\text{recall } + \text{ precision})$$

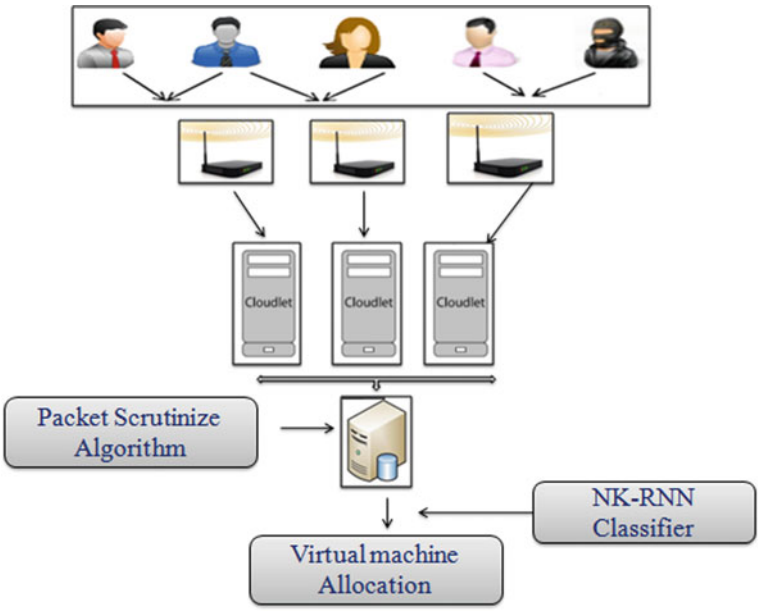

Fig. 4 Hybrid cloud-based obtrusion detection

Table 1 Key features of hybrid cloud-based obtrusion detection

Hybrid obtrusion detection model is intended to identify the attacks in the cloud background
The cloud user packets are accumulated by cloudlets via router
Each cloudlet is associated to the Cloudlet Controller (CC) that monitors the behavior of packets
CC is accountable to roam the packets from heavy traffic cloudlet to idle cloudlet
Then packets are moved to virtual machine manger that classifies the packets into normal and intruder packets by using NK-RNN classifier model

False negative alarm rate (*F*)

The false alarm rate is the ratio between the numbers of false alert to the total number of traces in validation data.

$$F = \mathrm{FP}/(\mathrm{FP} + \mathrm{TN})$$

Detection rate (*D*)

The detection rate (D) is the percentage of correctly detected attack records of the obtrusion detection system.

$$D = \mathrm{TP}/(\mathrm{TP} + \mathrm{FN})$$

Table 2 Data collection

Traffic Sample	Total number of samples	True samples detected	False samples detected
Normal	13,450	13,365	85

Throughput

Throughput is defined as the rate that packet finishes successful processing of packets (Table 2).

6 Conclusion

The obtrusion detection method involved cloudlets, cloudlet controller and virtual machine allocator. Cloudlet controller used to reduces the network traffic in the system. It is used to detect the probing and flooding attacks at early stage. The proposed model used MATLAB for simulation by using normal parameters, i.e. total number of samples taken are 13,450, number of true detected samples are 13,365 and number of false detection samples are 85. It is efficient to detect obtrusion in the system by mean of *F*-Score, false alarm rate, detection rate and throughput. This model simulated 97% of false alarm rate, better performance of 88% throughput, 98% of detection rate.

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Chapter 15
Comparative Analysis of Speech Enhancement Techniques in Perceptive of Hearing Aid Design

Hrishikesh B. Vanjari and Mahesh T. Kolte

1 Introduction

The most prevalent and complicated defect in human life today is hearing loss. Recent WHO study found that about 450 million people globally face the issue of hearing loss and hearing disability. The approximate incidence of deafness is increasing with alarming rate [1]. Hearing aids are a big relief to hearing-impaired people. They are effective for conductive and sensor neural hearing loss. The methods used for improving speech intelligibility like frequency-dependent elevation of the hearing levels, frequency selective amplification works well in ideal hearing conditions. However, in non-ideal situation like noisy environment, there is severe problem in speech intelligibility. In the last two decades, systematic trials have been carried out to find effective solution to this problem. Many wireless hearing aids include frequency selective amplification, compression of the dynamic spectrum, and tone suppression capabilities. However, in the presence of noises of varying forms and intensities, the output of these instruments deteriorates, as they do not compensate for spectral temporal masking and wideband non-stationary noises. Due to resource constraint in hearing aid systems, use of sophisticated signal processing algorithms is limited. Therefore, there is need for speech enhancement algorithm with low computation complexity and low latency. Compressive sensing-based speech enhancement addresses the two issues for hearing disabled: improving the speech quality by suppressing the noise and the increase the intelligibility of speech. CS permits efficient and optimal resource use. Usage of compressive sensing for speech enhancement facilitates reconstruction of speech signals for hearing impaired.

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2 Related Work

The prime purpose of speech enhancement is to improve the speech perspicuity. It is used in various applications like voice amplification, automated speech synthesis, biomedical applications, digital hearing aids, speech coding, radio communications, teleconferencing networks, and defense equipment's communications, etc. Speech enhancement methods can be for single [2] or multi-channel [3]. To leverage spatial diversity, multi-channel techniques required two or more microphones to differentiate the original signal from noise. The single channel techniques are more computationally effective than multi-channel techniques since only one microphone is required [4, 5]. The spectral subtraction method is used to enhance speech in a single channel, which is a popular strategy nowadays.

The Boll's spectral subtraction [6] is a well-known single channel speech enhancement technique. It has gained widespread appeal because of its simplicity [7, 8]. Using the original signal as a starting point, it subtracts the noisy spectral measurements from noisy signal to recover the original signal. There is a requirement for a reliable noise spectral part calculation. For calculation of noise statistics, the voice activity detector (VAD) is employed. The presence of speech and (Silence) non-speaking phases is determined by this method.

The Wiener filtering method obtain original speech signals by reducing the estimates of error [9, 10]. Donoho firstly presented the wavelet denoising [11]. In this noise is represented by DWT coefficients of low amplitude. Speech enhancement is achieved by using statistical methods to improve various statistical parameters [12–14]. Methods like maximum likelihood (ML), statistical modeling techniques have good noise suppression capability for non-stationary noises.

Compressive sensing has gained popularity recently in various speech-processing applications. CS is based on sparsity of signals. Since, the large number of real-world signals are showing the sparsity. The Systematic and optimal resource utilization are made possible by CS. When it comes to research domains, compressed sensing (CS) has garnered a lot of attention and interest [15, 16]. It has been used in medical imaging to process an MRI database [17] and audio signal processing [18, 19], among other things. In the field of voice and audio signals, only a few investigations have been conducted. A large proportion of the most recent applications [18] is devoted to voice recovery at sub-Nyquist rates.

The implementation of a CS-based approach for speech augmentation in hearing aids has not yet been investigated. Because speech signals are sparse in certain bases, the addition and compression is applied for speech enhancement along with CS. CS for speech enhancement does not need VAD or prior noise estimate. Here in this paper, an algorithm for hearing aid application, for speech enhancement using Compressive Sensing is presented. The results are compared to existing noise reduction methods for enhancement of speech that are spectral subtraction, Wiener filtering. The performance is compared with speech quality measurement metrics segmental signal to noise ratio (SNRseg), perceptual evaluation of speech quality (PESQ), Mean Opinion Score (MOS), and processing time.

3 Speech Enhancement Theory

Noise in the speech signal causes an annoying distortion that is difficult to ignore. As a result, before any additional processing takes place, noisy speech must be improved. For simplicity, consider the following example: the speech signal s produces the noisy signal x, which is corrupted by the noise n. Noise n is assumed to be additive noise, and as a result

$$x[u] = s[u] + n[u] \tag{1}$$

here $u =$ time.

The Speech enhancement method used to find speech signal(s) from noisy signal(x).

3.1 Spectral Subtraction

The spectrum subtraction (SS) technique is one of the oldest algorithms for speech enhancement and it is still in use today. It is easy to develop and has a low level of complexity for single channel speech optimization. It is possible to create the improved expression from the spectrum produced by spectral subtraction by deducting the noise spectrum from its spectrum data and combining the results. It is necessary to determine the amplitude of the noise spectrum from only one noisy speech signal. This is a tough problem given the limited amount of available noisy speech data accessible. The stationarity of the expression are crucial principles in this methodology [20]. The segmentation into twenty–thirty millisecond frames of speech signal, the short-time Fourier transform (STFT) is used to enhance the quality of the signal.

$$X_k[u] = S_k[u] + N_k[u] \tag{2}$$

where

k is the segment key,

u is the frequency index,

and $X_k[u]$, $S_k[u]$, and $N_k[u]$ are the spectra magnitudes of signals in Eq. (1)

The spectrum of enhanced speech is obtained by

$$S_k[u] = X_k[u] - N_k[u] \tag{3}$$

It is necessary to estimate the spectrum of noise between gaps to detect the presence or absence of speech and silence. Voice activity detection (VAD) is required for

this purpose. There are varieties of spectral subtraction techniques that can be used to improve the quality of speech. The subtraction methods developed by Berouti [21] and Boll [6] serve as the foundation for many spectral subtraction methods. The use the spectral subtraction method in the modulation domain [4].The partition of the spectrum into frequency bands, followed by the application of nonlinear rules in each band are examples of spectrum division. The machine learning optimization for speech signal reconstruction that uses a binary sensing matrix.[22] The application of a psycho acoustical paradigm to silence residual noise is discussed in [23].When it comes to calculating the spectrum magnitude of the voice signal, spectral subtraction is effective. However, because the phase of the original signal is not retained, the result is a clearly audible distortion known as 'musical noise'.

3.2 Wiener Filtering

When using the Wiener filter, the short-time Fourier transform (STFT) MMSE estimate is obtained [24]. The frequency response of the Wiener filter is given as

$$H[u] = P_s[u]P_x[u] = P_x[u]/P_n[u]P_x[u] \tag{4}$$

here.

$P_s[u]$, $P_n[u]$, and $P_x[u]$ are the clean signal, noise, and noisy signal power spectrum, respectively. The clean signal is obtained as in [20].

3.3 CS-Based Speech Enhancement Algorithm for Hearing Aid

In speech signal 's' contaminated by noise 'n', the result is a non-sparse noisy speech x. The recovered speech signal of 's' from the observation vector 'y' is made possible through use of Compressive Sensing. The following are the steps in the Speech enhancement algorithm using Compressive Sensing:

1. Prediction of the wavelet basis (x) and hard thresholding (using the universal threshold) are performed to remove non-significant coefficients and increase sparsity, respectively.
2. Acquisition: The random acquisition is obtained by the product of random Gaussian matrix is multiplied and sparse vector.
3. Inverse wavelets are transformed using $L1$ minimization in the reconstruction process.

4 Results and Discussion

The effectiveness of the Compressive Sensing-based speech enhancement is compared against spectral subtraction and Weiner filtering for various noisy speech from noisy speech corpus (NOIZEUS) [23]. Following parameters were used for performance comparison.

1. Perceptual Evaluation of Speech Quality (PESQ)
2. Mean Opinion Score for 20 listeners in a five-point scale of Excellent (5), Good (4), Fair (3), Poor (2), Bad (1)
3. Segmental SNR (seqSNR) calculated as

$$\text{seqSNR} = \frac{1}{M}\sum_{m=1}^{M} 10log\left[\frac{\sum_{n=R(m-1)+1}^{Rm} x^2(n,m)}{\sum_{n=R(m-1)+1}^{\text{Rm}} (x(n.m)-y(n.m))^2}\right]$$

where M is the number of frames and x is noised signal and y is the output of the proposed solution. $x(n, m)$ is the nth sample of the mth frame.

4.1 Impact on PESQ

The PESQ was measured for different input SNR (0, 5, 10 dB) with different noise types and the result is given in Table 1. PESQ in Compressive sensing-based approach higher than Wiener filtering and Spectral subtraction. Even at low SNR of 0 dB, where noise is more, the PESQ is above 3 in the Compressive sensing-based approach.

4.2 Impact on SEG SNR

The results on segmental SNR for different noise types at different input SNR is given in Table 2. The segmental SNR increases as the input SNR increases uniformly across all noise types. The segmental SNR is higher for compressive sensing method.

4.3 Impact on MOS Score

MOS score is computed in 3 different noise types (street, car, and restaurant) for 20 participants. The mean of the subjective rating from the 20 participants for three noise types is given Fig. 1.

The MOS score in the Compressive Sensing is 40% higher than Spectral Subtraction and 19% higher than Wiener Filter.

Table 1 Comparison of PESQ

Noise t ype	Solution	0 dB	5 dB	10 dB
Airport	Compressive sensing	3.12	3.32	4.19
	Spectral subtraction	2.0	2.17	2.34
	Wiener filter	2.12	2.54	2.87
Babble	Compressive sensing	3.5	3.67	4.21
	Spectral subtraction	2.65	2.73	2.88
	Wiener filter	2.73	2.86	2.94
Car	Compressive sensing	3.67	3.87	4.43
	Spectral subtraction	2.43	2.68	3.1
	Wiener filter	2.56	2.83	3.2
Restaurant	Compressive sensing	3.89	4.1	4.32
	Spectral subtraction	2.54	2.67	2.94
	Wiener filter	2.63	2.87	2.95
Station	Compressive sensing	3.12	3.57	3.89
	Spectral subtraction	2.56	2.64	2.84
	Wiener filter	2.62	2.84	2.96
Street	Compressive sensing	3.31	3.56	3.83
	Spectral subtraction	2.17	2.67	2.87
	Wiener filter	2.22	2.71	2.93

Table 2 Comparison of SEQ SNR

Noise type	Solution	0 dB	5 dB	10 dB
Airport	Compressive sensing	4.12	5.23	6.15
	Spectral subtraction	3.34	3.87	4.45
	Wiener filter	3.67	4.13	4.67
Babble	Compressive sensing	4.32	5.34	6.26
	Spectral subtraction	3.36	3.91	4.41
	Wiener filter	3.71	4.21	4.81
Car	Compressive sensing	4.43	5.51	6.35
	Spectral subtraction	3.47	4	4.47
	Wiener filter	3.8	4.34	4.68
Restaurant	Compressive sensing	4.32	5.24	6.14
	Spectral subtraction	3.67	3.89	4.12
	Wiener filter	3.91	4.21	4.43
Station	Compressive sensing	4.45	5.12	5.97
	Spectral subtraction	3.63	3.92	4.31

(continued)

Table 2 (continued)

Noise type	Solution	0 dB	5 dB	10 dB
	Wiener filter	3.68	3.96	4.41
Street	Compressive sensing	4.82	5.12	5.57
	Spectral subtraction	3.31	3.98	4.14
	Wiener filter	3.42	4.24	4.35

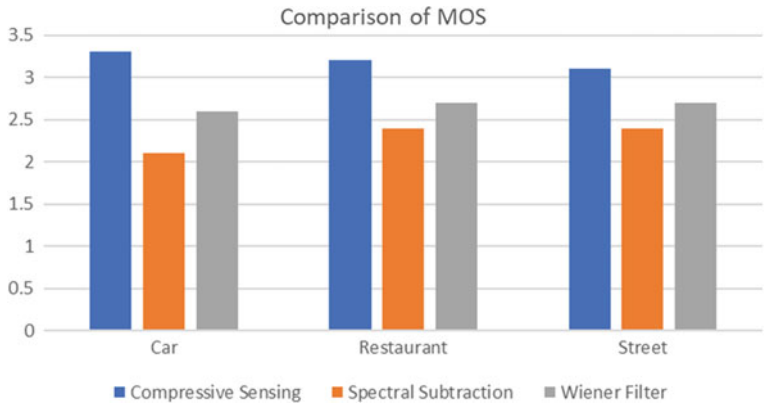

Fig. 1 Comparison of MOS

5 Conclusion

A speech enhancement method for hearing impaired users using three different techniques is compared. Followed by it an adaptive Compressive Sensing is done. The performance results showed Compressive Sensing-based speech enhancement method can achieve higher PESQ compared to noise estimation and other Compressive Sensing-based speech enhancement methods.

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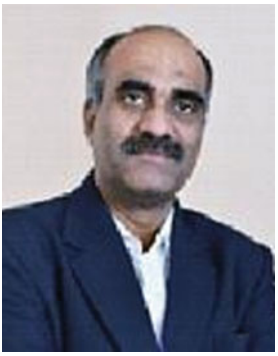

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Chapter 16
Smart Walking Stick: An Aid to Visually Impaired

Kritika Singh, Heemal Yadav, Kunal Aggarwal, and Garima Sharma

1 Introduction

Visually impaired people face many issues communicating and understanding their surroundings. Physical development tests outwardly weakened people since it can wind up dubious about recognizing where he should be at present or where he seeks to move to get to a place. To explore new places, he will always need to bring a companion for help. A study shows that a large percentage of visually impaired individuals are unemployed. Since obliged on the sorts of livelihoods, they can manage. They rely upon their families for basic conveniences and monetary help. Their movability negates them from socializing with people in public places. In the past, many different systems were built without a solid perception of the non-visual. Most of these Sticks are built only for indoor courses and have no method to utilize these sticks in the outside territory. Specialists have been trying to build an assistive tool to alert visually impaired persons from obstacles and provide them with their surrounding knowledge. Researchers in recent decades have been driven toward creating new devices which structure an average and robust system for visually impaired individuals to recognize snags at spots close to them. There are a few frameworks that have small insufficiencies. A decent arrangement will be a compact gadget that can caution the client of obstructions in their way when the client is strolling. With the true objective of this endeavor, we streamlined the issue portrayed above to help visually impaired individuals with getting around outside.

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An endeavor like this will inspire all the more intelligent electronic devices to assist visually impaired individuals with getting around. We imply that the gadget can give a heads up to unvisited areas while guaranteeing a safe route by quicker witted. Also, the gadget is not proposed to supplant the utilization of intelligent stick, nor will it provide any emotional assistance to the person.

This prototype of the smart walking stick is exceptionally designed to enhance the ability of the visually impaired to move around freely. The sound messages will keep the person alert throughout his journey. This framework displays an idea to provide an electronic guide/help to visually impaired individuals, both in private and public places.

The proposed system contains ultrasonic and LDR sensors with an SOS button and an android application. The proposed system works on the principle of detection using the sensors; the ultrasonic sensor measures the distances between the object and the person. When any objects/obstacle come in the sensing range of an ultrasonic sensor, the headphone alerts the person that the obstacle is in front, left or right of the individual.

The smart walking stick is a simple electronic gadget to recognize the obstructions in the surrounding. This framework is light weighted and compact. It acts as the best companion to the individual who needs assistance. The visually impaired individual can move from one place to the next without being assisted by another person.

This paper proposes planning and building a compact unit (stick) for easy use and route in open spots. This study utilizes ultrasonic sensors, which give out ultrasonic waves to recognize the obstacles in their path. Once an obstacle is detected, the information is transferred to the microcontroller. The microcontroller uses this information to identify the proximity of the obstacle. In case if the object is not nearby, the stick does nothing. In case when the object is near, the microcontroller sends a prerecorded sound as a signal to indicate the person about the obstacle.

The feature of this proposed design is that it enables the user to know light or darkness in the room. The primary goal is to assist visually impaired individuals in navigating with ease and utilizing development innovation. The proposed system enables visually impaired individuals to perform daily routine functions efficiently and increases their autonomy.

2 Related Works

A structure of an intelligent stick for outwardly impeded people is proposed in [1], which consists of infrared sensors for obstacle detection. After carefully analyzing the obstacles, the stick vibrates. These vibrations help the person to be alert that there is an obstacle in the path they are strolling. The shrewd stick is just for snag identification and not for helping in crisis purposes required by the subject. Furthermore, the IR sensors are insufficient because they can recognize just the closest hindrance in short separation.

In a similar study [2], a smart walking stick is proposed, joining GPS innovation, informal communication, and ultrasonic sensors to assist outwardly impeded individuals with navigating. The GPS identifies the area of the obstruction, but the ultrasonic sensors that identify the object and caution the person affected to maintain a safe distance.

The university students [3] presented an electronic stick for outwardly weakened people, which provides the necessary information about the surroundings around the customer. The stick utilizes the RFID chips inserted into street signs, retail exteriors, and relative regions to transfer the information to the subject. The device incorporates an ultrasound sensor to detect obstacles.

A splendid stick that uses a laser [4] recognizes obstructions in the path. The user is given a signal in a high-pitched beep via an intensifier. The structure of the laser stick is familiar. However, the stick cannot give emotional and mental help but effectively detect the hindrances.

An intelligent stick model [5] for the visually impaired works by tending to the worldwide route for managing the client to some fate and neighborhood route for arranging ways, walkways, and passageways, even with evasion of static and moving deterrents.

A system for ostensibly weakened individuals uses a smart stick that incorporates ultrasonic sensors and a sound yield system. Particular territories are stored in a secure digital memory card [6], which individuals can voice recognitions to enter the designated territory and provide a high-speed processing system. The system proposed in this paper assists visually impaired people to navigate effortlessly utilizing development innovation.

In [7], the authors arranged an assistive development contraption called the electronic long stick to convey ability help for visually impaired and ostensibly crippled people. An ergonomic structure that is embedded inside the handle of a long stick is proposed in the system. Haptic sensors are used for recognizing obstacles above the waist. In case of detection, it vibrates or makes a beep sound.

Dambhara and Sakhara [8] an artificial vision is developed with real-time assistance via GPS. This stick will help the visually impaired in accessing a device that is reasonably at a low cost. The navigation provided by the GPS will help the person move around without any relative's help.

In [9], it is suggested to use the latest technology like cameras, GPS, GSM modules for visually impaired people. There are places where GPS cannot function to its best. We can use the camera embedded with an algorithm to identify the obstacles. Also, this paper aims to develop an SOS alert.

In [10], an electronic navigation system is used to detect obstacles. Concurrently, the sensor collects the signal reflected from the obstacles and sends it to the Arduino board. It processes the signal, and based on the result, appropriate action is taken.

Table 1 Prototype design requirements

S. No.	Design requirements	
1	Overall functions	The stick alarms the client of the objects that causes hindrances while he/she is strolling Coordinates clients in utilizing the SOS application in the requirement for help
2	Performance	It takes not more than 2 min to start up from a complete shutdown to fully operational mode
		Cautions client when snag is at a separation of somewhere around 3 feet
		It works when the client is strolling a limit of 3 ft per second
		It finds a GPS signal within 1 min of initialization of the SOS Button
3	Aesthetics	The stick weighs less than 2 kg The main system is within a 12 × 6 × 4 in dimension
4	User-system interface	The framework can incorporate vibration modules appraised at 1.5 V/10 mA
		Framework issues a discernable or potentially haptic cautioning when the hindrance is inside 3 feet Framework issues admonitions to signify status of the framework (inert/seized/stacking)
5	Power	Works for 5 h of nonstop use
		Can charge completely in 3 h
		On standby mode battery should last for at least 20 h

2.1 Purpose and Motivation

It often happens that the best of our competencies and strengths are frequently brought to action when we willingly accept challenges. The life of a visually impaired is accompanied by many challenges, experiences, and tough times beyond one's imagination. While living such an extraordinary life, a little outside help can make a considerable difference. With this thought, this project aims toward developing an advanced walking stick device that could act as a counterfeit vision to the visually impaired. Though few but less capable alternatives were present in the market an improved yet economical prototype was developed to add value to the consumer after much research and brainstorming (Table 1).

3 The System Architecture

This section discusses the architecture of the proposed visually impaired stick, as shown in Fig. 1. The hardware components deployed in the system are presented in Sect. 3.1.

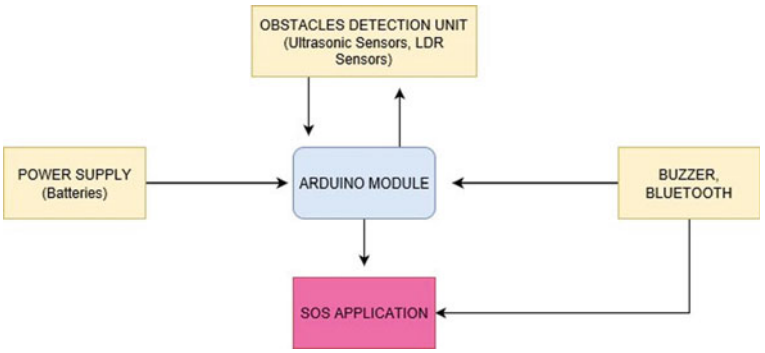

Fig. 1 Architecture of the proposed stick

3.1 Hardware Components

The hardware components used in the development of the proposed sticks are as follows:

(a) **Arduino Module—(Made using I.C., Resistors)**
This platform enables the user to control many devices in the physical world compared to the workstation. It relies on an essential microcontroller board and a headway circumstance for creating programming for the board. A gear board is arranged with an 8- or 32-bit Atmel AVR microcontroller. These models utilize a USB interface, six analog information pins, and 14 electronic *I/O* pins to associate distinctive extension sheets.

(b) **Bluetooth Module**
The Bluetooth module serves as a secure medium for transmitting information over short distances using radio wavelengths. A recurrence bouncing spread range separates the data sent and transmits it in packets up to 79 gatherings. Bluetooth offers a safe method to trade data between electronic gadgets like cell phones, computer systems, printers, advanced cameras, computer game consoles.

(c) **Ultrasonic Sensors**
Ultrasonic sensors (generally called handsets when they both send and get) interpret sound waves signals. These sensors estimate the time taken by the signal sent and the signal received back to calculate the distance from an obstacle. In this study, the sensors are installed on the three sides of the stick. They are used to calculate the obstacle's distance concerning the stick from the left, right, and front faces.

(d) **LDR Sensors**
Light-dependent resistor or photoresistor, a latent electronic segment, is a resistor with an obstruction that changes depending on the light force. Depending on the amount and recurrence of the assimilated photons, the electrons gain enough amount of energy to excite into the conduction band,

resulting in a vast number of charge transporters. These signals are sent to the buzzer, cautioning the client.

(e) **Buzzer**
It converts audio signals into sound signals. The buzzer consists of a transducer that changes from electrical energy into mechanical energy. This investigation uses the flag to alert the visually Impaired individual against an object by making sounds relating to separate from hindrance.

(f) **Resistors**
It is a device that resists the flow of electric current. It has two terminals, and they either limit the flow or regulate the flow of current in the circuit to safeguard the circuit and control the amount of voltage.

$$V = I.R. \text{ (OHM}'\text{s Law)}$$

3.2 Mathematical Calculations

After striking with an object, the signal to the receiver. The formula can compute the distance of the object from the sensor

$$\text{Distance} = (\text{time} \times \text{speed})/2.$$

We divide the computed distance by two because the total time is twice as the signal first hits the object and then travels back to the device.

3.3 Sensing Obstacles

Sensing the obstacle is the central part of the stick. The prototype is integrated with three ultrasonic sensors on the stick's front, right, and left. Once the stick is switched on, it waits till the object comes in its vicinity. The stick recognizes the time taken by the ultrasonic wave to reflect after hitting the object. The sensors are connected to the pins of the Arduino Uno processor. The Arduino IDE is programmed to sense the signal and generate a response accordingly (Fig. 2).

3.4 Circuit Diagram

The circuit diagram consists of the following connections.

- Three ultrasonic sensors connected to Arduino via 14th–19th pins, i.e., (A0–A5).
- A Bluetooth module connected to pins 2nd, 3rd, i.e. (PD2, PD3).

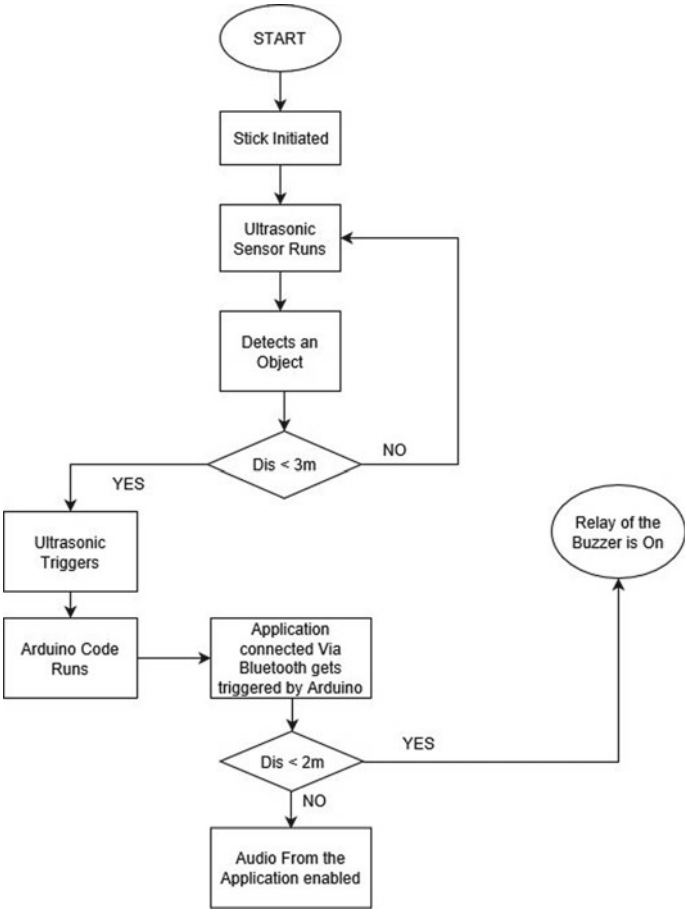

Fig. 2 Working of the stick

- A buzzer is connected to the 9th Pin of the I.C. is PB1.
- LDR is not connected to the Arduino module. It separately provided a voltage of 5 V (Fig. 3).

3.5 Working of Hardware (Stick)

- ADC is used to provide the system a constant power of 5 V.
- ATMEGA328, an 8-bit programmable system chip, is used that can be flashed.
- An ultrasonic sensor emits the radio waves and checks if the waves are reflected.
- If the distance is less than the minimum, it will transfer a signal 1/2/3 based on the ultrasonic device that sensed the object via Bluetooth to the android application.

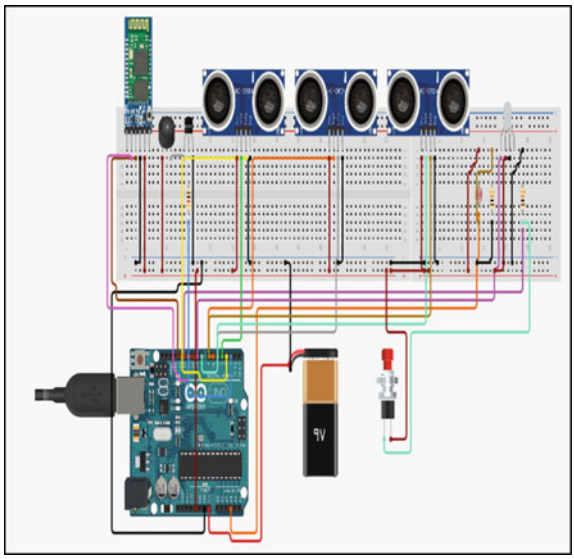

Fig. 3 Circuit diagram

- The hardware also consists of the LDR or the light detector resistor that is used to detect the light.
- The basic idea behind using the LDR sensor was to enable the person to commute during any hour, including at night. The LDR sensor could be highly efficient in detecting the approaching vehicle, triggering the buzzer, and alerting the blind person about the upcoming vehicle. A separate button is provided to control the power of the LDR sensor to avoid bogus responses.
- The device will also have another button that is the SOS button. This SOS button is an emergency button that the person might use if he/she detects and danger.
- On pressing the button, a signal will be sent via Bluetooth that will initiate a process that will extract the person's current location(coordinates) and immediately share it to the saved contact in the form of a link. This link could be directly opened in google maps (Fig. 4).

3.6 Software Implementation

Android Studio is used to make an application to provide the user with functionalities such as.

- Connectivity the stick to the android phone via Bluetooth,
- The center part of the Stick is a panic button. It sends an SOS to the presaved contacts with their current location in case of any danger.

Stick, on the other hand, will be embedded with the components such as a U.V. sensor to detect objects in its vicinity and notify the user with the help of Bluetooth

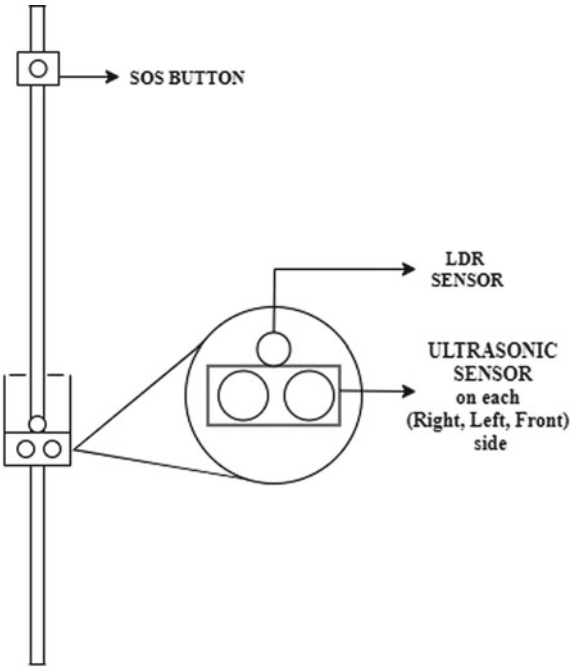

Fig. 4 Proposed prototype of the stick

HC-06, which in the master mod is capable of sending the data in serial format to the phone.

Moreover, a button is provided on the Stick and the Application in the phone, which can be used to notify the saved contacts in case of emergency or danger.

Panic Button

Android application is built using android studio in Java and XML. The application interface shows the panic button, an emergency button via which the visually blind person can inform his/her loved ones if he is in danger.

This application will get the information from the backend of the app where the data is stored. Then send the message and the current location while using the GPS system of the phone.

This is the interface of the application (Fig. 5).

3.6.1 Working on the Android Application

- A mobile application is built to connect the stick via Bluetooth. This application will not work until connected to a working Bluetooth device (the Stick).
- The application provides a talkback feature that uses the alarm setting configuration, so that mode of the device does not affect the applicability.

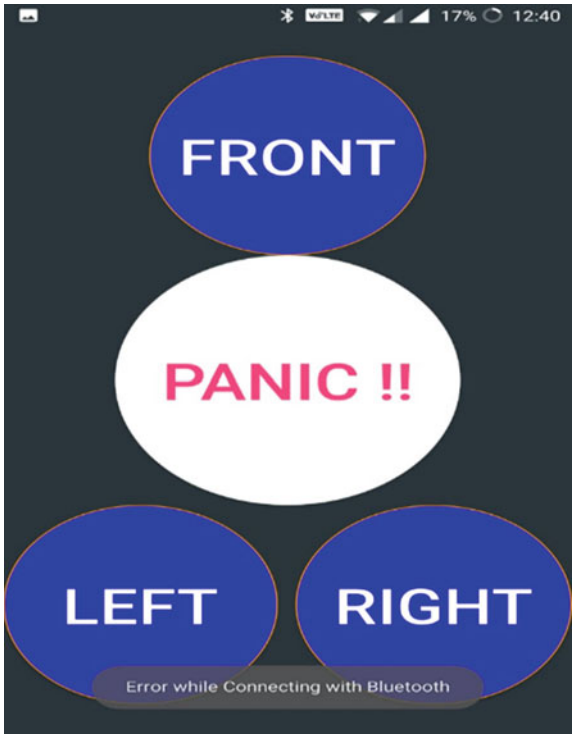

Fig. 5 User interface of the application

- As soon as the mobile receives the signal from the device, it detects the signal and then identifies which hardware has triggered the signal, either the U.V. sensor incorporated on the left, right, and front face or the LDR.
- After detecting the device, the application will play the associated media file (mp3) to inform the device's person regarding the object's direction.
- If in case of a possibility of failure in working of the button (hardware), the application will help.
- U.I. of the application is designed in a way that a large part of the middle area of the phone screen (nearly 33%) acts as a touch button that can also trigger the SOS function and share the details as discussed above.
- On triggering the SOS button, an audio file will be played.
- Post this when the message is sent, another audio file will be played indicating the message has been successfully sent or failed. Similarly, different audio will be played whenever any action is performed.

4 Overviews of the Proposed Model

4.1 Problems Encountered

1. When the buzzer was connected directly to the output pins of the PIC, this resulted in a weak sound that was barely audible. Therefore, the buzzer was separated from the output pin and then connected to the 5 V battery.
2. Hardware Issues: We utilized three primary classifications of segments; sensors, actuators, and microcontrollers—each shown some rate of disappointment. A few sensors did not work or carried on whimsically, and a few actuators comparatively did not work. Also, the microcontrollers displayed defective conduct, and some started to break after continued reconstructing. These issues were effectively taken care of, in any case, with due foreknowledge and gathering of reinforcement segments.
3. Software Issues: While the last code was moderately straightforward, a few techniques were attempted to get the planning ideal. The end goal was to catch the beat width of the sensor yield effectively and adjust the distinctive sensors appropriately.
4. Final Performance: In genuine utilization, the gadget's execution utilizing every one of the four sensors as one while strolling about was more terrible than wanted. The code, microcontroller, or equipment issues may have been at fault, such as broken segments or impedance and cross-talk between the sensors.

4.1.1 Possible Design/Device Improvements

One potential beneficial enhancement to the structure of our gadget would be variable power yield on the actuators to recognize the relative separation of obstacles. For instance, the actuator demonstrating an obstacle one meter away would vibrate more strongly than the one showing an impediment two meters away. This could be proficient by utilizing a further developed microcontroller, as our own was not fit for variable yield, or by executing outside advanced simple converters. Another technique to accomplish comparative outcomes would require an extra microcontroller(*s*) to solely deal with the constant obligation cycle to reproduce variable yield on the actuators. One approach to enhance our gadget is to supplant our SRF04 ultrasonic sensors with higher quality sensors with longer ranges and more solid yield. Longer ranges and more dependable input, particularly in the more drawn-out range, would bear the cost of a superior goal and a superior by an extensive nature of "vision".

Additionally, it would enable us to adjust and align our gadgets all the more precisely. In a similar vein of enhancing the input, further developed handling systems could be created to dispose of commotion found in the criticism because of development when utilizing the gadget. For example, individual false positives could be sifted through when seen among long stretches of negatives. Likewise, unique sensors could be actualized instead of depending entirely on ultrasound and extended sensors'

situation. One of the upsides of our structure is its position of safety, in any case, so remote correspondence and printed circuit boards to lessen the size and overhead of extra parts would likewise be attractive in such a case.

5 Results

5.1 Results

The showed structure is arranged and intended for viable usage. The framework can deal with seven expresses that the visually impaired people may confront. The framework will take actions according to the program coded and in the Arduino microcontroller. All the test which had been audited demonstrates that there are various systems for making an ultrasonic visually impaired walking stick. The positive points of the framework lie in how it can be an answer for many visually impaired individuals worldwide. The smart walking stick is essentially an achievable item.

- Whenever the ultrasonic sensor detects an obstruction in its surrounding, the microcontroller sends the message to the individual with the help of a prerecorded sound through the earphone.
- The light sensor is used in detecting the presence or absence of light; the buzzer will be on; if there is no light, the buzzer will remain silent. If there is an approaching light of high intensity, the buzzer will make a sound to alert the person warning through the sound of the buzzer and voice message through the earphone.

A simple, cheap, and configurable framework is proposed to give visually impaired people valuable right hand and support. This framework is tried and confirmed. It can look at directions left, right, and front. The ultrasonic sensor has been ultimately used to propel the versatility of the visually impaired in sheltered and autonomous ways. The light sensors are utilized for the discovery of the quality of light during the evening. This structure similarly settles restrictions that are related to, by far, most of the advancement issues that may affect the outwardly impeded people in their condition.

The analyses were led to assess the execution of the smart walking stick. The outcomes displayed here imprint the start of our endeavors to manufacturing a reduced voyaging help that permits the outwardly debilitated to arrange common conditions. As recently referenced, the sensor gives data about its surroundings. The circuit that has been intended for the item discovery has given precision to around 3 feet. The discovery run for different articles in cm is recorded in the underneath table (Table 2):

- These tests were conducted on various objects at a different locations.
- A mean range of about 3 feet that is 90–100 cm was observed.

Table 2 Measurement of the response of stick to various objects (cm)

Obstacles	Trial 1	Trial 2	Trial 3	Trial 4
Wall	110	125	95	100
Human body	87	80	100	85
Cardboard	110	115	128	117
Plastic	79	62	68	70

- Some objects were detected at different distances because ultrasonic sensors get affected by temperature. As the temperature rises, the speed increases for the waves to travel, whereas the waves travel slowly if the temperature decreases.

The above experiment observed that the ultrasonic waves detect the objects faster, reflecting the waves thoroughly and quickly like for concrete walls, wooden boxes. For plastic, the waves do not get reflected ultimately; they penetrate themselves from the object.

5.2 Future Works

The framework can be improved with GPS to find the shortest path to a destination. A.I. cans also are used to utilize the device to its fullest. The sensors will detect the obstructions path from the source to the destination. Synchronization with different route programming applications accessible on the web so new, un-customized goals can likewise be picked.

It can be upgraded by the inclusion of the VLSI innovation to plan the PCB unit. It makes the framework smaller. We can install a vibrator to some degree, nearly deaf person. Voice control using speech recognition can be installed to enable the person to instill commands of a location he wants to visit. Other sensors like water detection, smoke detection, and flame detection can be installed to the smart walking stick.

6 Conclusion

We could identify that the proposed model detects obstacles and alarms the individual with the help of speech output from the above discussion. The proposed prototype can be used in both indoor and outdoor surroundings. Even an individual's location can be requested whenever required, which guarantees extra security for the person. This framework can be used for applications like oncoming vehicle discovery. The actual objective of this proposed model is to make life a little better for the visually impaired person; this model cannot act as emotional support to them. It can only

identify if there are any objects in the person's path so that he may walk around freely and with no fear of being alone. This product gives a sense of independence to the person who tends to depend on the other and gives a sense of belonging. Their movability will not negate them from being a part of social and cultural gatherings.

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Chapter 17
Hydroponic Farming as a Contemporary, Dependable, and Efficient Agricultural System: Overview

Hari Mohan Rai, M. K. Singh, A. N. Mishra, and Aman Solanki

1 Introduction

The current world population is estimated to be about 7.3 billion people, with India accounting for 1.39 billion of them. The world's population is expected to exceed ten billion people by 2050, with India accounting for 1.67 billion people [1, 2]. According to the United Nations' Sustainable Development Goal 2 (UN 2017), about 66% of the world's population is expected to reside in urban areas, implying that their food requirements must be fulfilled [1]. To meet the world's food need for the constantly growing population, agricultural production must also rise. As a consequence, the food needs of the extra 2–3 billion people must be fulfilled, or to put it another way, food output must increase by approximately 50% (FAO 2017) by 2050 to feed the extra 2–3 billion people. As a consequence, we may consider increasing the output of agricultural goods utilizing conventional manufacturing techniques. Traditional agricultural techniques, on the other hand, have a number of drawbacks, including environmental conditions, soil quality, temperatures, water needs, and a range of other variables. Agriculture relies on the availability of grazing pastures, groundwater, electricity, and fertilizers, and the current use or degradation of these resources on a worldwide scale exceeds their global regeneration [3, 4]. The soilless

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agricultural technique is not new; it was first utilized commercially in 1967 [5, 6] when it was originally described and was used to improve food output and efficiency.

2 Related Works

The hydroponic system has grown in popularity in recent years, especially in urban areas, and much research is being conducted to improve it and make it even more efficient. Yang et al. [7] presented their research on hydroponic agricultural nutrition and lettuce growth, as well as the impacts of ozone-treated home sewing. Mupambwa et al. [8] used a deep water culture technique to show the ineffectiveness of biogas digestates nutrient solution for a hydroponically grown tomato plant. Its study focused on the effects of biogas digestates on agricultural toxicants as well as their nutrient fertilizing capability in hydroponic tomato production.

Magwaza et al. [9] conducted a thorough investigation on the effect of nitrogen absorption on hydroponically grown tomatoes plants fed partially treated household wastewater as a nutrient source. Sipos et al. [10] conducted research using a hydroponic system in an indoor environment with LED lighting to find the best method to grow basil plants. Also included is an overview of LED light use, light intensity and duration, light treatment on vegetative metrics and nutrient content, and sensor features. Salazar et al. [11] used Nordic microalgae to study nutrient removal from hydroponic sludge. Because of the severe winters in the Nordic countries, the bulk of the population relies on greenhouses to guarantee continuous agricultural production throughout the year. In order to create an automated harvesting system, Wang et al. [12] studied the mechanical and physical properties of lettuce grown hydroponically. Based on the Internet of Things, Ezzahoui et al. [13] provided a comparative study of the Aquaponic and Hydroponic agricultural systems (IoT). Hydroponic and aquaponic farming are two of the most innovative agricultural methods.

3 Materials and Methods

3.1 Hydroponic Farming

Because of its great efficiency and ease of setup without the need for professional help, the hydroponics system is one of the most popular and extensively utilized soilless agricultural systems. The phrase “soilless cultivation” is used in the area of horticultural agriculture to describe any structure that allows plants to grow in soilless settings by supplying water and nutrients via solution culture, both with and without the use of a developing medium [14, 15].

3.2 Advantage of Hydroponics

Hydroponic is a low-cost and highly lucrative method for food production [16]. It is possible to measure the advantages of a hydroponic system more accurately than the benefits of conventional farming on six different criteria. These parameters are land and labor; climate; fertilizer; water; consistency; and consistency [17].

4 Types of Hydroponic

There are many kinds of hydroponics available in the Indian market, some of which are economically viable, while others are more of a passion endeavor. So when we talk about the many sorts of hydroponic farming techniques, there are essentially six different kinds of hydroponic farming methods [18].

4.1 Wick System

The wick system, which is made of a synthetic fiber such as nylon, feeds plants and crops via capillary action. It is considered suitable for indoor cultivation and the development of a single plant [19]. Hydroponic wick systems are composed of four fundamental components: a growing container, a reservoir for the nutrient solution, a growing medium, and wicks. The wick method is inefficient for hydroponic gardening. The main disadvantage of this method is that huge plants may eat up the fertilizer solution quicker than the wicks can replenish it [19].

4.2 Water Culture Method

Water culture (also known as deep water culture (DWC)) is a method of growing plants in water. A large container filled with the nutrient solution is placed in the water and a raft is placed on top of the container. Deep water cultivation in a hydroponic system may be a viable choice in areas where water is not a problem, and where there are no problems with electric dependence or energy [18, 20].

4.3 EBB and Flow Method

The flood and drain (F and D) system is another name for the ebb and flow system. Thus, that is, how it works: By briefly flooding the growing tray with nutritional

solutions and then draining the solution back into the reservoir. Flood and drain (F and D) action is typically performed using a submersible pump controlled by a timer. Ebb and flow systems need a significant initial investment of money; therefore, for commercial purposes, you can expect to incur significant capital expenditures.

4.4 Drip System (Recovery and Non-recovery)

In a drip system, the timer controls the pump's ON and OFF intervals, and the nutrient solution is dripped into the roots of each plant via a tiny drip line at the base of each plant. In a recovery drip system, the surplus nutrient solution from runoff is collected and returned to the reservoir for re-use of the nutrients. In a non-recovery system, the runoff is not collected and returned to the environment [18].

4.5 Nutrient Film Technique (NFT)

This technique is the most popular and efficient method among all hydroponic farming**.** In an NFT system, a submersible pump is placed beneath the nutrient solution, pushing the water into the pipes. The NFT is very cost-effective when compared to other kinds of hydroponic systems because of its vertical, multilevel, and matrix farming. Additionally, it is climate-resistant, requires less labor, reduces land usage, requires less fertilizer, and requires less water. It may be utilized on a local or big size, as well as on a commercial basis. Figure 1 depicts the structure of the nutrient film technique (NFT) technique and the aeroponic system [18].

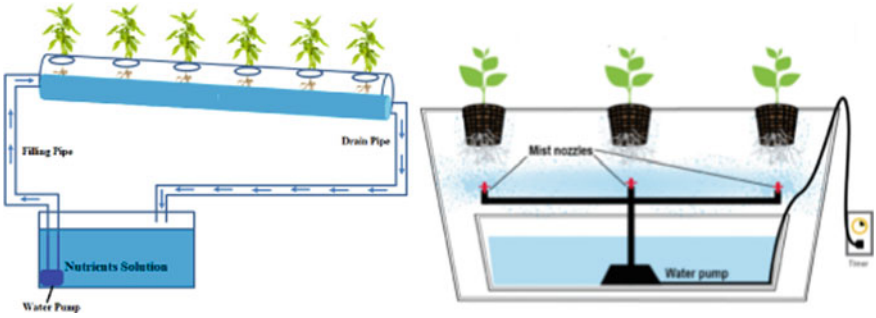

Fig. 1 Nutrient film technique (left) and aeroponic system

4.6 Aeroponic System

Aeroponic farming is the most advanced and technically complex kind of hydroponic system available. Also known as integrated farming methodology, it is a method of incorporating plant-based agriculture with other forms of aquaculture, such as fish farming. As a result, the combination of plant production and aquaculture may result in an advanced ecologically sustainable system in which water and nutrients are used in an optimal manner [21].

5 Nutrients Consumption

Table 1 gives the consumption and control of nutrients by leafy and fruity vegetables in terms of electrical conductivity (EC), pH value, and total dissolved solids (TDS) in parts per million [22].

Table 1 Utilization of EC, PH, and TDS in leafy and fruity vegetables

Vegetable name	EC	pH	PPM
Leafy vegetables			
Watercress	0.4–1.8	6.5–6.8	280–1260
Cauliflower	0.5–2.0	6.0–7.0	1050–1400
Lettuce	0.8–1.2	5.5–6.5	560–840
Parsley	0.8–1.8	5.5–6.0	560–1260
Basil	1.0–1.6	5.5–6.5	700–1120
Spinach	1.8–2.3	5.5–6.6	1260–1610
Swiss chard	1.8–2.3	6.0–6.5	1260–1610
Chives	1.8–2.4	6.0–6.5	1260–1680
Celery	1.8–2.4	6.3–6.7	1260–1680
Mint	2.0–2.4	5.5–6.0	1400–1680
Fruity vegetables			
Pea	0.8–1.8	6.0–7.0	580–1260
Strawberries	1.0–1.4	5.5–6.5	500–700
Sage	1.0–1.6	5.5–6.5	700–1120
Watermelon	1.5–2.4	5.8	1050–1680
Cucumber	1.7–2.5	5.8–6.0	1190–1750
Pumpkin	1.8–2.4	5.5–7.5	1260–1680
Squash	1.8–2.4	5.0–6.5	1260–1680
Melon	2.0–2.5	5.5–6.0	1400–1750
Tomato	2.0–5.0	5.5–6.5	1400–3500
Brinjal	2.5–3.5	5.5–6.5	1750–2450

6 Conclusion

In this article, we have discussed the many kinds of hydroponics agricultural systems, as well as their benefits and drawbacks, in detail. On the basis of their use in hydroponic farming, the six most important factors have been discussed: land, labor, water, climate, consistency, and fertilizers (among others). As a result of all of the analysis and comparison, it has been determined that the hydroponics system is economical, less complex, requires less labor, is not dependent on climate conditions, consumes less water, requires less land, consumes less fertilizer, produces more at a faster rate, is more profitable, and is more useful for commercial purposes. Furthermore, the NFT technique is the most efficient and cost-effective of all the hydroponics systems available, and it can be utilized for both commercial and non-commercial reasons.

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Chapter 18
Internet of Things: The Next Generation Internet

Shruti and Shalli Rani

1 Introduction

Internet is growing all over the world. With this, many new technologies and inventions are emerging which will help to make human life a lot easier. Internet of Things is one of such inventions. This is a trending concept in which objects being used in our daily life are connected to the Internet and make themselves available to the other devices. Internet of things encourages communication, exchange of data, aggregation and integration among the objects in the surrounding [1, 2].

So, we can define IoT as a structure of interconnected computing devices, machines, objects, animals or people that are given unique identification numbers (UIDs) and the capacity to exchange information over a system without any kind of human-to-human or human-to-PC collaboration. In IoT, all things connected can be categorized into three different types:

1. **Things that gather data and then send it further**: These are basically sensors that sense or gather required information from the source and pass it further. There are different types of sensors like temperature sensors, motion sensors, humidity sensors, air quality sensors, light sensors, heart beat sensors, rain sensors, smoke sensors, etc. The working of sensors includes automatic collection of data which helps in more precise results.
2. **Things that get data and then follow up on it:** Machines of these types are everywhere around us. These machines receive information from us and then

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acts on it. Some of the examples of such machines are printers and automatic washing machines.

3. **Things that do both things**: Smart farming is its best example. Sensors are deployed in the field which gathers data about the amount of moisture in the soil and forward this information to irrigation system. The irrigation system automatically turns on/off according to need thus avoiding the presence of farmer. This system can be improved further by connecting it to Internet for weather forecast so that if there are chances of rain, the irrigation system will not water the crops [3].

2 History of IoT

Internet of Things may be 16 years old technology but its work started long ago in 1970s. The term "Internet of Things" was given by Kevin Ashton in 1999 at P and G when he was working there. He wanted to attract the attention of his seniors to the new technology named radio frequency identification (RFID) and with the Internet as a new trend; Kevin named his invention as "Internet of Things." In spite of his efforts, Internet of Things did not get much attention till 2009. Coke machine at Carnegie Mellon University in 1980 was the first machine with Internet connection. This makes the programmers to check whether there is any cold drink in the machine so they can go and grab it, while sitting on their seats. It was also able to check that the cold drinks in the machine are cold or not. Machine-to-machine interaction gave the main lead for the development of IoT.

3 How IoT Works

An IoT environment contains Internet enabled devices that consists of sensors, processors and hardware that collects and forwards the data so that an appropriate action can be taken on it. The data collected by the sensors is sent further for analysis. All the data collected is not useful, therefore, devices can select only the significant data and execute an action. IoT devices can also communicate with other devices and acts on the information they receive from the other device. In this whole process, there is no human interference but they can instruct/set them up. There are some components of IoT that helps in the working of IoT devices discussed below:

Sensors: A large number of smart objects in IoT network generate enormous amount of data with the help of sensors that helps in taking critical decisions in various real-time applications [4]. The data collected by sensors can be very complex/simple in form. A device can also be equipped with more than one sensor so that different tasks can be performed by it. Latest example is of smart rooms in which light and heat sensors detect the human entering the room and will switch on/off the light or adjust the AC temperature according to the time of day outside.

Connectivity: After the sensor collects the data, it is sent further to cloud for analysis. For this, a medium is required which can be a cellular network, Wi-Fi, Bluetooth, etc. The medium selected should be such that it provides the best possible connectivity in every term (range, bandwidth, etc.) to the IoT system.

Data Processing: After data collection and connectivity, data processing starts. Software is used for processing of data. The whole process can be simple or complex depending on type of task; this may also require user interaction.

User Interface: At the end of the whole process, the required information is to be made available to the user. For this a user interface is required, like we can check the cameras installed in our house on our phone screens or we can switch on the AC of our room with the help of our phones before reaching home.

4 Architecture of IoT

Mainly, there are three main layers in the architecture of IoT but to make it more generalize and understandable for research purposes, the five layer architecture was proposed [5].

The perception layer consists of sensors and actuators which help in sensing and gathering the information from the surrounding environment. It senses by identifying different conditions around or by identifying other smart objects. The transport layer sends the data collected by sensors from the perception layer to the processing layer and the other way around. The transfer of data is done by different connectivity technologies like cellular networks, Wi-Fi, Bluetooth, NFC and many others depending on the one being used. The third layer is the processing layer also known as middleware layer analyzes and processes the data send by the transport layer. It also provides services to the lower layers. The application layer which is responsible for providing application-based service like for smart homes, smart cars, health care and many more, to the end user. And the last one is the business layer that has the responsibility to manage the entire IoT system. It looks after different aspects of IoT system like applications, policies, etc.

5 Technologies Used in IoT

The IoT connectivity depends on various factors and environment conditions. Like, some options work well in limited closed space, whereas others work well in open area or outdoors. So, some of the factors that need to be kept in mind while considering connectivity options are coverage area, power consumption, bandwidth, infrastructure, security and other factors like noise, external interference, obstructions, etc.

There are different technologies that are being used in IoT, some of them we are going to discuss in this section. These technologies work in such a way that fulfills

Table 1 Specifications of different technologies used in IoT

Technology	Data rate	Power usage	Cost
Bluetooth	Up to 0.27 Mbps	Low	Low
Wi-Fi	Up to 54 Mbps	Medium	Low
Cellular network	Up to 1 Gbps	Large	High
NFC	Up to 430 kbps	Very low	Very low
Zigbee	Up to 250 kbps	Low	Low
RFID	30 kHz–3000 MHz Ranging from low to ultra-high frequency	Low	Low to high depending on the type of RFID used
Satellite	Up to 506 Mbps	Very high	Very high
LTE-M	Up to 380 kbps	High	Low

all the requirements of the IoT system. Different communication technologies have different specifications like data rate, power usage, cost and features (Table 1).

- **Bluetooth**: Bluetooth is used to share data between the devices over short distance. Its purpose was to replace the menace of wires. Today, this technology has become a part of our lives and most of the devices are Bluetooth enabled. One of its advantages is its low-power consumption but it is prone to network threats also [6].
- **Wi-Fi (Wireless Fidelity)**: Wi-Fi is available everywhere in offices, colleges, shops, home, restaurants, etc. It provides connectivity with LAN at no extra cost. Most of the current wireless network transmits data using Wi-Fi only, making use of Internet services [7]. Wi-Fi offers fast data transfer, can handle large amount of data and range of up to 20 m. This technology uses 2.5 GHz of ultra-high frequency and 5 GHz of super high frequency band and provides with the speed of up to 54 Mbps in 20 MHz channel [8, 9].
- **Cellular network**: The long distance IoT application can make use of cellular networks (3G, 4G or 5G). These networks are able to transfer large amount of data with high speed, but only disadvantage is their high power consumption and cost. Cellular network is a more concerned term with mobile market, video streaming applications and voice/video calls. The emergence of 5G technology made it viable for IoT applications also. It provides high data transfer rate and long-range connectivity with less latency. The 5G new radio network will cater for both massive and critical IoT use cases for connecting large number of smart devices [10].
- **NFC (Near Field Communication)**: It is a short-range communication technology which enables data exchange between the devices when they are 4–10 cm in distance. Due to their short range and high frequency, NFC provides higher degree of security than Bluetooth. It also helps in accessing digital content and connects electronic devices.

- **Zigbee**: Zigbee is a wireless technology designed especially for sensor networks. It is a low cost, low data rate and low-power wireless network, therefore, it is suitable for IoT systems.
- **RFID (Radio Frequency Identification)**: It uses radio waves to transfer data within a short-range using RFID reader from RFID enabled tag. RFID tags are applied on objects and have specific address. By adopting this technology in IoT, retail and logistic sectors will be profited. This will help in keeping check on objects even when they are not in our sight [11]. Inventories can be maintained in real time and will enable smart checkout and smart shelves applications.
- **Satellite**: Satellite provides the coverage all over the earth. It can handle very large amount of data that any other technology. It is highly reliable and provides high bandwidth. But setting a set up with satellite is very costly. In IoT, it is basically used to send data to remote areas, where the human presence is hardly available (mainly in oceans).
- **LTE-M**: LTE-M is short form of LTE-MTC (machine type communication). It has high bandwidth which means higher data rate and low latency. On the other hand, it consumes more energy. LTE-M can be used to replace 2G or 3G cellular network in some applications like fleet management. One of its additional advantages is that it supports mobility (in connected cars or asset tracking) and has voice connectivity.

6 Applications of IoT

As Internet of Things plays a vital role in transforming our lives, an insight into different areas in which it can be used is discussed below (Fig. 1):

Smart homes: Homes where smart devices are used are known as "Smart Homes." Homes are suitable place for smart devices as they already consist of many technical devices; homes are under controlled environment so devices can be easily maintained and can provide many different services and uses [12]. One of the famous examples of smart homes is "Jarvis," it is a home automation system deployed by Mark Zuckerberg.

Wearable: There are many companies releasing their wearable devices now and then, some of the popular ones are Apple smart watch, Galaxy watch and Fitbit. This is one of the earliest industries to adopt IoT as its service. These devices can monitor one's health and helps to access messages, calls, music and much more from the single interface.

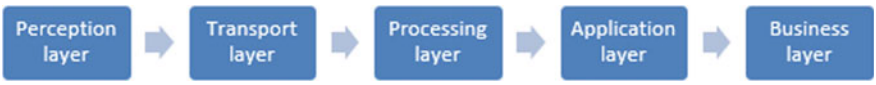


Fig. 1 Architecture of IoT

Smart City: Smart city concept varies from city to city. The problem faced by one city is different from another city. It is used for traffic management, security, congestion control, weather monitoring, pollution control, checking air quality and much more. Sensors are embedded at different places or devices to monitor the activity and control it accordingly. Example of smart city is Palo Alto in San Francisco, where the problem of car parking is solved by installing sensors at parking lots all over the city.

Smart grids: It is the latest trend in IoT. Smart grid will control electricity in different regions by studying the behavior of suppliers and consumers. This will improve the efficiency and reliability.

Smart cars: Smart car is the concept, where cars are provided with the sensors so that they can be monitored for any type of collision and accidents can be avoided. This concept can also be used to check traffic congestion. This idea is coming up slowly.

Health care: Connected healthcare system is one of the hidden gems in IoT. The potential of connected healthcare system and smart medical devices is more than what has been recognized by the people. With this concept, health reports can be sent regularly to the doctor with the help of wearable and he can monitor it from his place directly. Many countries and organizations around the world have developed policies and guidelines for setting up IoT technology in medical and healthcare [13].

Smart farming: To feed such a huge population, technology need to be introduced in agriculture. Crop monitoring and smart farming are the way outs. This will help the farmers to predict the growth of the crops and make required changes. Smart farming leads to better crop production as real-time status of the crops can be monitored. An automated water pump controller was developed that uses moisture sensor to detect level of moisture in the soil this will help farmers from manually operating the pumps to water the fields [14, 15].

Smart Industry: Industrial IoT is advancement of industry which will bring transformation in manufacturing and product designing, thus resulting in increase of economy. It will give more value to the customers and provide efficiency in terms of cost to the industry. Industrial IoT basically combines artificial intelligence with machine learning.

Smart Retail: IoT has gained popularity in the field of retailing with time. Retailers have now started to embed IoT systems to ensure automatic inventory management system, increase in purchase, improved customer shopping experience and reduced chances of theft. Retailers can use their smart phones to interact with the customers to serve them better. They can also track the areas in the store, where the customer traffic is more so that they can place their premium products there for their benefit.

Tracking and monitoring: IoT can be used to track assets using GPS or radio waves. Devices can be embedded with the chip with which they can track or verified over a long distance.

IoT in Education: IoT in educational field can be used to fill the gaps in our education system. The quality of education offered to the students can be improved without spending much. Moreover, students'/teacher's responsiveness and behavior

Table 2 IoT applications according to the communication technologies used in IoT

Technology	Application
Bluetooth	Wearable, smart phones
Wi-Fi	Smart homes, smart city, smart cars, smart retail
Cellular network	Smart farming, smart industries, health care, smart retail, logistic tracking
NFC	Contactless payments
Zigbee	Smart homes, smart industry
RFID	Smart retail, logistic tracking
Satellite	Remote monitoring and asset management at unmanned areas, smart grids
LTE-M	Smart cars, tracking and monitoring

can be monitored to increase the overall performance. IoT also helps in professional development of the teachers as they can learn and develop better strategies to educate students instead of following the old methods of teaching.

Smart Environment: IoT can also help us to prevent natural calamities like earthquakes, cyclones, landslides, forest fires, etc., by monitoring the environmental conditions. It can also detect emissions and wastes by factories and cars (Table 2) [16].

7 Scope and Challenges of IoT

With the day-to-day advancement in the technology, we are lucky to experience new things every day. One of the most recent and advanced one is IoT. It is like boom to mankind as with this we can manage or control anything from anywhere and in some cases even a human intervention is not required. IoT uses the concept of machine-to-machine communication [17]. With IoT, our personal devices can be connected to the Internet and it will help us to manage our lives easily. Alarms can be set in the house which can detect any unwanted human intrusion and inform us on our phones, devices can also be used as wearable which predict heart rate and strokes, automatic door locking systems can lock the doors of the house when it senses no movement, similarly the lights can be switched on or off when no one is there and much more. All these give companies a new scope to develop devices that will be helpful to consumers and thus lead to their economy.

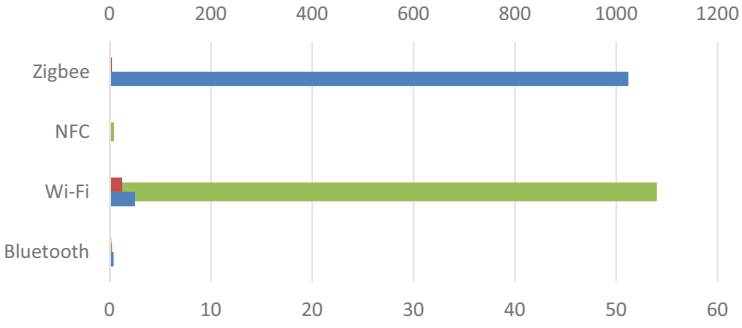
This dynamic environment of IoT gives way too many unseen opportunities which will change our view point on communication and networking. But at the same time, privacy, interoperability and security should also be carefully taken into consideration to prevent it from being transformed into a pervasive surveillance object [18, 19]. Like other emerging technologies, IoT is also facing challenges and issues. Being low powered and less secure, IoT devices can act as doorway for attackers to enter our homes and offices so that they can easily access our data [20]. In the countries like

India where the speed of Internet is not that fast as compared to USA, the quality and cost of receiving data are also an issue. Once the policies are properly implemented, the user will be able to make maximum use of this technology [21]. Moreover, as IoT is at its early stage, more awareness should be spread among the user. They should be given knowledge about its features, benefits and future scope.

8 Comparative Analysis of Communication Technologies in IoT

We have studied various wireless communication technologies in IoT that can be used for data transmission [22]. Their specifications and use in particular application are also considered. Now, we are going to compare few of these technologies on the basis of different matrices like data rate, number of nodes and cost. Bluetooth, NFC, Wi-Fi and Zigbee will be compared keeping in mind these metrices. Line graphs of the analysis done are shown in Fig. 2.

From the results, we have found that Zigbee can hold large number of nodes as compared to other three technologies whereas NFC is limited to two nodes only. Whereas in case of overall average cost, Wi-Fi is on higher side due to the requirement of hardware and other devices and NFC on lower. Number of data bits transferred per unit time is higher in Wi-Fi due to its bandwidth and higher data rata compared to Bluetooth, NFC and Zigbee.



	Bluetooth	Wi-Fi	NFC	Zigbee
Data rate (Mbps)	0.27	54	0.43	0.25
Average cost (in dollars)	3.5	25	1	5
Number of nodes	8	50	2	1024

Fig. 2 Comparison of number of nodes, average cost and data rate in communication technologies

9 Conclusion

Internet of Things connects virtual world with the real one making our life comfortable and a better one. But with the increasing widespread of this technology, it also bought some downside with it. As smart objects make us dependent, we will not be able to do anything or control our lives without them. Moreover, setting up an IoT environment requires proper infrastructure for communication and device setup.

Since it is a new technology, there are also concerns related to its security as no proper precautions are there to protect its data. So, a lot of work is still required to be in this field to make it a blessing not a punishment to the mankind. We have also done a comparative analysis of few communication technologies to find out which one is better depending on particular specification.

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Chapter 19
GIS for Disaster Management: A System to Aid Users with Relevant Information

Shubham Aghav, Prashant Solanki, and Sushila Palwe

1 Introduction

The natural disaster affects a lot of people, leaving them helpless in many situations. Due to climate change, they are going to occur more frequently and would affect the most in places like India [1]. Climate change needs broad changes in lifestyle, and to help the people affected by it expertise is needed from various domains from social science, natural science to engineering. Support from the government, an initiative from the people, and interdisciplinary collaboration is needed. The problems we face are difficult and wide-ranging and need various types of perspective and solutions. On the technological side, we can use GIS to build systems for disaster management incorporating knowledge from various fields about the locations of safe zones, locations where users can get help and assistance. GIS contains a varied amount of data containing locations of man-made static objects, data about terrain, and geography from different perspectives. This can be used to leverage for aiding in emergency situations. Geographic information system is a system that is most helpful in the application of planning and management land mapping and analysis. The GIS has been used in a variety of situations, for environment conservation, agricultural activities to traffic management, and urban planning. Since GIS has many uses, it is difficult to give an exact definition, it is best described as the collection of hardware, software, and data which are integrated operating in an institutional context [2]. GIS has two broad classes of geographic information: field based and object based, in field-based spatial distributions over a geographic area is taken into account and in object based deals with discrete identifiable entities on the geographic space [3]. Paper goes through the literature study of papers using GIS in varied ways. And based on the study the paper proposes a system that can be further expanded. The

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solution is to identify locations the user wants to know about and give information accordingly. Using geopandas, we get geocode of the location that the user wants to know about and using Overpass API, we get the information around that area, the results are shown on map and as well as saved in table format if needed for other purposes. The paper also implements the proposed system.

2 Literature Review

In [4], they propose a system that uses information collected from GIS databases to do semantic segmentation of the given image with its geolocation and address. The image is first divided into a set of super pixels. Then, it is projected from GIS information and a set of priors of approximate locations are obtained. The inaccuracies are handled by fusing the data with an interactive approach and at each iteration their reliability is checked and then only fused with super pixel segmentation. The iterative approach is continued until the segments and projections are well aligned.

In [5], they propose a technique using a GIS database through which they can improve object detection. They have taken GIS data with location and a query image, using the query image they find related spatial location of the objects. In order to properly classify the object, they also do object detection and merge it with possible detections of GIS priors. In order to handle inaccuracies of objects, they use RANSAC. Their system outperforms other object detectors with a greater margin.

In [6], they propose a novel technique, create 3D viewpoints and find its location and region and pose of objects. They also pursue models of various types of interactions between scene components to overcome the problem of joint interference. The result shows that their model performs better than the SFM algorithm, and their framework recognizes objects and regions more accurately. Their model for car, person, and office detection gives 62.8%, 76.8%, and 45.7% accuracy, respectively.

In [7], they have represented an effective framework for city modeling which gives compact and visually realistic 3D representation which can be used for easy distribution and pre-visualization of ground-level traffic situations.

In [8], the author uses contextual information for understanding the scene with the help of GIS resources. For this, they use motion techniques which generate 3D data with minimum user input. Their accuracy is much better as compared to single-image depth estimation methods.

Based on literature study, we have observed the varied way the GIS is being used. The studies done are helpful in generating databases of important points of the Internet, to generate proper geocode, which could be used by various stakeholders. Thus based on literature review, we have proposed a system that can leverage all the information generated by GIS and help in aiding emergency situations during a disaster.

3 Proposed System

Figure 1 is the flowchart of the system we have proposed.

Algorithm for Implementation:

Step-1 Prompting user to enter location and what emergency service is needed
Step-2 Using geopandas location's, geocode is retrieved
Step-3 Using overpy Overpass API is used to retrieve relevant information around the geocode that was retrieved in the previous step. With the amenities latitude and longitude
Step-4 Data is saved in table format
Step-5 Using Folium the data collected is shown on map using amenities latitude and longitude

3.1 Techniques/Technology

Geopandas is an open-source project, which helps in analyzing geospatial data with Python. It helps in spatial operations on geometric types. For plotting geopandas is dependent on matplotlib and for file access it depends on fiona [9]. The system uses geopandas to retrieve geocode to be used further in the system to retrieve information.

OSM Data Model consists of nodes, ways, and relations which come with an ID. Other elements come with tags which tell about its features represented as key-value pairs. Nodes show points on a map with latitude and longitude. Way shows the street or outline of the house, and the relation shows relationships between objects in geographic areas (Fig. 2).

Overpass API is a read-only API that retrieves selected parts of the OSM map data. The client sends a query to the API which has a database over the web and

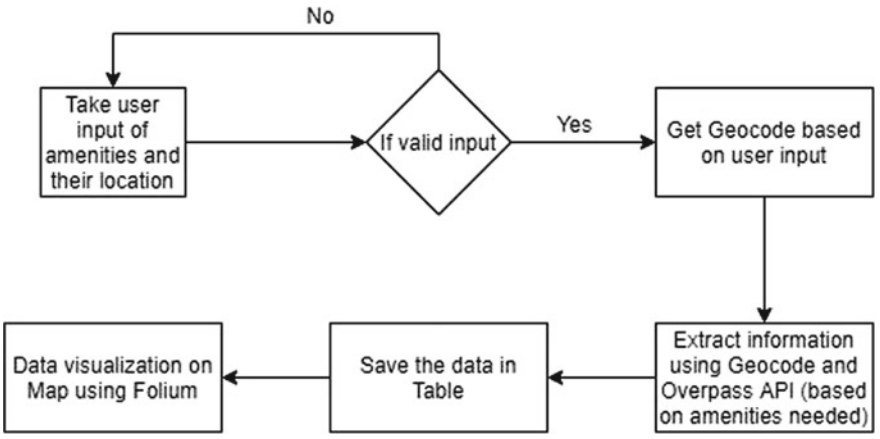

Fig. 1 Block diagram for the system

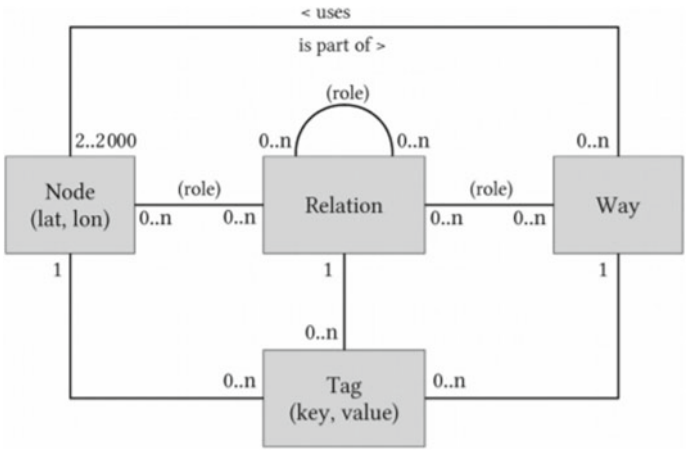

Fig. 2 OSM data model [10]

retrieves the data that corresponds to the query. In the project, we have used overpy which is a wrapper to access the Overpass API. To access the Overpass API, the paper uses overpy which is a Python wrapper. Overpass API uses query language for doing certain operations. We have used Overpass QL, which is a query language for the Overpass API apart from Overpass XML. The code is divided into various statements ending with semicolon, which are executed sequentially. Overpass QL manipulates sets, results of statements are written into sets and sets are read by input. Overpass QL contains a combination of nodes, ways, relations, and area elements of OpenStreetMap. In the system, we have used an amenity key to get hospital data. Using key in Overpass QL data like pharmacy, refuge site can be retrieved.

Folium is the Python library helpful in visualizing geospatial data which is simple to use. It visualizes data on an interactive leaflet map. It binds data to map for visualizations, which also pass vector/raster/html visualization as marks on the map. This library has a built-in title set from OpenStreeMap (OSM), Mapbox, etc. For this system, we have used it to show the information the user needs on the map. Geocode is passed to show correct location and using a for loop, and we iterate through tables and show the information that the user needed on a map using latitude and longitude, using this information Folium is used for mapping [11].

3.2 Mathematical Representation

User Input $L = \{\}$

$A = \{\text{'Hospital'}, \text{'Pharmacy'}, \text{'Refuge Area'}\}$

$S = \{L, A\}$

L: Location

A: Amenities

S: L ⋃ A

Output: Dataset {'amenity', 'name', 'latitude', 'longitude', 'ID', 'city', 'full address', 'House Number', 'Postcode', 'Street', 'Suburb', 'Health care', 'Name', 'Operator'}

4 Experimental Results

Using geopandas, we retrieved geocode shown in Fig. 3.

Using Overpass API relevant information, in this case, hospital around the geocode is retrieved and shown in Fig. 4.

Using Folium and information retrieved using the overpass API, the hospital is displayed on the map (Fig. 5).

Failure Analysis: The Overpass API has incomplete data regarding amenities. As seen in the dataset retrieved using Overpass API. Geolocation is available but data like street and city are missing. Thus, it needs further data preprocessing to create a good database.

	geometry	address
0	POINT (73.85445 18.52143)	Pune City, Pune District, Maharashtra, India

Fig. 3 Geocode

	amenity	name	wikidata	latitude	longitude	id	addr:city	addr:full	addr:housenumber	addr:postcode	addr:street	addr:suburb	healthcare	name:mr	operator
0	hospital	Sassoon Hospital	Q7425789	18.5253020	73.8696302	772571829	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
1	hospital	Surya Sahyadri Hospital	NaN	18.5214574	73.8555760	2289294093	Pune	Near Shaniwar Wada	1317	411011	Agarwal Road	Kasba Peth	hospital	सूर्या रुग्णालय	Sahyadri Hospitals
2	hospital	Gupte Hospital Of Accurate Diagnostics Pvt Ltd	NaN	18.5190510	73.8398724	2921897064	NaN	904, Bhandarkar Road , Deccan Gymkhana	NaN	411004	NaN	NaN	NaN	NaN	NaN
3	hospital	Naik Hospital, Pune	NaN	18.5102879	73.8594694	3238255107	NaN	781/782, Shukrawar Peth, Opposite Jain Mandir	NaN	411002	NaN	NaN	NaN	नाईक रुग्णालय	NaN
4	hospital	Paranjape Hospital	NaN	18.5143979	73.8460515	5832579347	NaN	NaN	NaN	NaN	NaN	NaN	NaN	परांजपे हॉस्पिटल	NaN
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
62	hospital	David Sassoon Hospital	NaN	18.5252790	73.8704990	7651453417	NaN	Agarkar Nagar, Pune	NaN	411001	NaN	NaN	NaN	NaN	NaN

Fig. 4 Data retrieved using overpass API

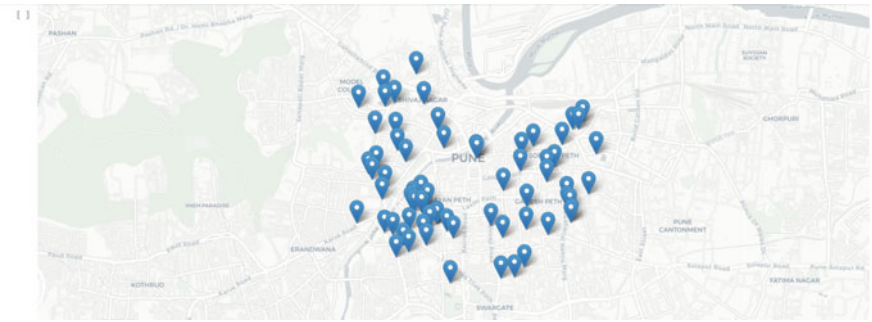

Fig. 5 Displaying data using Folium and geocode

5 Conclusion

We have shown how to use GIS to identify and collect data for service needed by the client and mapping those areas to aid the user in understanding. A dataset is created for data processing and cleaning, which can be used to create a good database with relevant information filled. The system can be used for emergency use by the user but needs a proper database and way to access the information. Drawbacks of Overpass API is that it doesn't have an extensive list of amenities services and missing data that users might need. And the system needs existing robust network infrastructure. Future work would be to integrate more areas, fill in the missing data and create a proper database which is updated regularly to aid the user and so as to let the system run smoothly using messaging services.

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Chapter 20
Recent Trends in E-Learning Using Web 4.0

Juhi Singh, Arun Kumar Singh, and Mukesh Singla

1 Background Study

The concept of learning via Internet comes in the trends with the evolution of Internet from Burners Lee World Wide Web to a semantic Web that contains an intelligent structural Web [1]. The World Wide Web (WWW) as the largest global information media through which user can share, read, and writes data through computers connected with Internet. To provide the accurate and precise educational information on single click is very difficult task since this is the Internet era. The continuous development of Internet provides the unique and single platform to all, where you can watch and share the information with anyone easily but this also rises the difficulty to find out the authenticity of available resources. To filter out this thing, some intelligent mechanism requires controlling all, as the education concern on virtual mode it is very necessary. For better understanding of the intelligent control of Internet, the comparison is given in Table 1 [2].

As mention in Table 1, Web 1.0 was introduced as the platform to share the knowledge that can be accessible by all in a read mode only, which is the simple HTML pages with some hyperlink and simple SQL command processing ability to fetch the information [3]. Almost a decade, the concept of Web 2.0 arises that considered as the second generation of the Internet, which brings the revolution in the Internet business. The Web 2.0 equipped with the new feature and communication

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Table 1 Comparison in between Web 1.0, Web 2. 0 and Web 3.0 [2]

Parameter	Web 1.0	Web 2.0	Web 3.0
Year of foundation	1994	2002	2006
Coined by	Tim Berners-Lee	Dale Dougherty	John Markoff
Generation	Cognition	Communication	Cooperation
Known as	"The Web" or "The Internet"	"Web of documents"	"Web of data"
Human interaction	"Read-only"	"Read-write"	"Personalized"
Data representation	HTML	HTML, XHTML, XML	RDF, RDF a, micro formats
Semantics	Not applicable	Not applicable	Applied Using RDFS/OWL
Linking	Hyperlink	Hyperlink	URI
Metadata	Relational schema	XSD/DTD	Ontology
Data model	Relational	Relational, hierarchical	Graph
Machine learning	Not applicable	Not applicable	Applied
Query language	Simple SQL	SQL along XPath	SPARQL: Protocol and RDF query language
Used for	To search the data	To share the data with others	To search, integrate, and control data

facilities; here, the user of Internet can read and write the Web document, and it was popular as the "Web of document" but Web 2.0 suffers the problem of data reliability and integrity issue [4]. The market of Internet in this era was flourished in second generation but due to the constant development of Internet, there is a need of some intelligent and structural tool to manage the Internet automatically so here is the birth of Web 3.0. The concept of Web 3.0 was emerges like a "fire on jungle" [5]. The Web 3.0 is an intelligent third generation of Web, popular as semantic Web, which provides the meaning the existing Web as the growth of Internet speed up rapidly [6], and the communication is not limited only with the humans but with the machine too [7]. The purpose of semantic Web is to enable the communication for the machine and from the machine to resolve the human query in an optimized way. As Web 3.0 equipped with the advance and structured machine intelligence, likewise it resolves the problem of decentralization of data [8] but this will lead some drawback like it needs some advance hardware support and have the complex structure [9]. The Web 3.0: A semantic Web is not sufficient alone as per the increasing dependency of humans on the Internet from anything to everything. The users of Internet want a power-pack intelligent Web tool that is capable to provide some emotion intelligence also.

The Web is moving toward using artificial intelligence to become as an intelligent Web. This is the sign of inclination from the semantic Web to symbiotic Web that Web 4.0.

2 Introduction

Web 4.0 can also be considered as webOS, which provides the interface between the user and Web in a control manner. The control will be an intelligent control that can read–write–execute concurrently and react as per the given query and take the decision to that what could be loaded first [7]. The Web 4.0 is a symbiotic web that is ubiquitous in nature that provides the better connectivity and commutation to its user not only as an intelligent electronic agent but also the emotionally as well. The symbiotic nature of Web 4.0 will bring a new era of "human social engagement" with the Web [10]. Since the use of advance technological feature makes the Web 4.0 an intelligent electronic agent Web tool, it is can be easily comparable with the human brain. The use of machine learning techniques helps to provide more accurate and right decision making ability in optimized manner. The Web 4.0 uses the cloud computing techniques to assure the availability of data anytime anywhere to everyone. As Web 4.0 focused on the anytime, anywhere availably of data, the security and integrity are big concern over here, which is efficiently managed and maintained by the use of more advance and secure mechanism that is the blockchain technology. The blockchain technology assures the security, privacy, and integrity of decentralized information of person or any large database of an organization [8]. The highly intelligent interactions of Web 4.0 based on the easy and transparent governance policy to the society [3].

2.1 Main Features of the Web 4.0 [8]

- **Symbiotic Web:** Provides the human and machine interaction with the faded boundaries which means it is always on.
- **Artificial Intelligence:** The use of AI makes it more intelligent as compared to the previous generation of Web. Mainly it uses the machine learning and natural language processing concept of AI to build the better man and machine interaction and provides the accurate response.
- **3D Graphics:** This feature provides the live view and also enhanced the services provided to the users.
- **Connectivity:** As Web 4.0 motive is "always on," it requires the better connectivity based on the connected to metadata.
- **Ubiquity:** The content of Web can be accessible from everywhere through any device with the Internet connectivity.

2.2 The Five Dimension of Web 4.0 [11]

The Web 4.0 works on the strategic development and analysis for complex problem, which evolve the cognitive and multi-dimensional approach for better understanding.

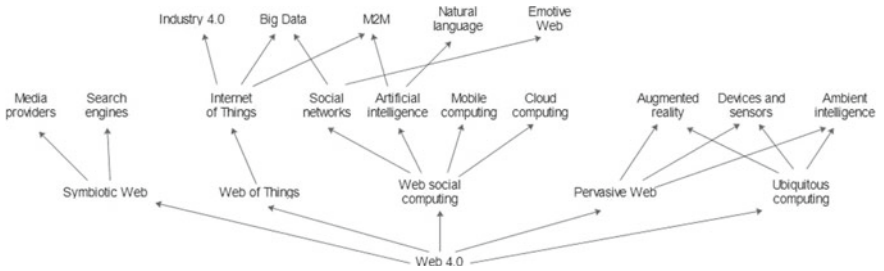

Fig. 1 Five dimension of Web 4.0 [11]

There are five dimension of Web 4.0, which helps it majorly to follow the strategic development approach.

(i). Symbiotic Web
(ii). Web of Things
(iii). Web social computing
(iv). Pervasive Web
(v). Ubiquitous computing

As shown in Fig. 1, the multiple elements that are common in between the dimensions so some time the dimensions can be considered as a synonyms to each other like "ubiquitous computing" and "pervasive Web" or "Web of Things" and "Web social computing". Now, it can be said the three major paradigm of Web 4.0 symbiotic Web, Web of Things, and ubiquitous computing work as a active force which ensures the connected always on communication.

3 Web 4.0 as an Intelligent Solution for E-learning

The emergence of Web plays a vital role in the field of E-learning system and also provides the potential scope as online learning becoming a popular nowadays [12]. Even in this COVID-19 situation, the online platform is fulfilling the need of every sector in best possible manner especially in education system as country like India, where most of the population belongs to the young age group. It is a big responsibility to provide the education to masses on a large scale as education is the right for all policy [7]. This is again a challenging task in this pandemic to make the online education via E-learning policy to masses on large scale by fulfilling the societal need as well. The Web 4.0 symbiotic nature helps to conduct the E-learning smoothly and promises to deliver the education as virtual mode, online class teaching, E-learning, distance education, etc. Without the high computational intelligent and ubiquitous way of Web 4.0, this could be a difficult task, as the Web 4.0 is incorporated with the emotional machine intelligence and machine learning in it [2].

Because of the availability of powerful and intelligent Web resource like Web 4.0, the E-learning system is going to the integral part of the normal education system in India as well. The E-education is not a new concept, it evolves with the growth of Internet as well that can be easily divided into generation like the Web generation in following manner [13].

- **E-learning 1.0 with Web 1.0:** Simple one way mode of E-learning in a read only.
- **E-learning 2.0 with Web 2.0:** Advance, interactive mode of E-learning system.
- **E-learning 3.0 with Web 3.0:** Systematic, structured, and intelligent mode of E-education.

The paradigm shift of E-learning system from the offline computer-based learning to online live learning emerging constantly with the growth of Internet. The concept of E-learning is always a challenging compared to the traditional teaching. The concern of this conflict arises with inability to include the emotional affection in teaching.

4 Challenges and Opportunities of Web 4.0

Since every technology has its own possibilities and challenge as well, same in this case of the Web 4.0, it also offers many challenges to be cure so that users can use it seamlessly.

- **Huge dataset:** The Internet is now for everyone, the user can make its own data and make it available on Internet as per their choices due to this easiness' and availability there, and the data is rapidly growing on daily basis. There are billions of data which can be created by Internet user daily. So, it is a huge challenge to manage those dataset efficiently. Although, the Web 4.0 provides the cloud storage and computation to manage as per the priority but it is a great challenge to manage such a large amount of data efficiently.
- **Scalability:** It is again a new challenge in term of management of data in a scalable manner; it needs some cost effective intelligent techniques to store and organize the data. And whenever required, it will able to fetch the right content.
- **Visualization: due to overloading of information, it is another key challenge** to represent the huge dataset effectively in a presentable manner like the right content on right time.

4.1 Opportunities [14]

There is always a second side of the coin; the Web 4.0 can be seen as the mobile Web also because of its symbiotic and ubiquitous nature. This is one of the opportunities for mobile companies and the Internet service provider, the manufactures of smart appliances this on only limited with this. It may also open the doors for the growth

of the gaming sector also as the increasing demand of augmented and virtual reality devices.

5 Conclusion and Future Scope

This paper includes the tabular comparison between the Web 1.0, Web 2.0, and Web 3.0 [2, 6], which leads towards the orientation of Web 4.0 as a strong intelligent and emotional Web incorporated with ability of machine learning as well. The symbiotic Web promises the growth in the field of digital technology to connect anything from anywhere and surly it affects the lives also in a positive manner by providing the better service to our society likewise the current pandemic. This will also reforming the education system and policies as E-learning 4.0 with the Web 4.0 [13] is moving toward using artificial intelligent techniques and Web of highly intelligent interactions in close future.

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Chapter 21
Dosimetry Effect of Flattening Filter Free Energy Beams in Prostate Malignant Cells in Intensity Modulated RT

Manjeet Kumar, Sunita Dahiya, and Sunil K. Chaudhary

1 Introduction

Around 45–55% of all malignant cells patients are treated with RT. External beam RT (EBRT) is a non-intrusive cure that aims to convey a high dose of energy to the malignant tumour while protecting the surrounding usual tissues. Years of specialised and computational development have resulted in cure procedures that are now widely available. The therapies, like the energy beams, have gotten increasingly complex since the first medical LINAC was installed in 1953 [1]. In the 1990s, developed intensity-modulated arc therapy (IMAT), a rotating cure that uses a few covering bends to maintain beam regulation at a secure part rate and framework rotation speed. Otto (2008) improved on this procedure and proposed the volumetric-modulated arc therapy (VMAT) procedure, with the goal of delivering superior cure plans with high part similarity in a precise and effective manner [2].

With modification of the multileaf collimator (MLC) and a variety of framework rotation speeds, the VMAT approach permits beams on during a full 360-degree framework rotation. VMAT is a type of energy therapy that can be used to treat a variety of malignant cells. It is, for example, the most effective RT for prostate malignant cells, providing top-notch cure at all times. Prostate malignant cells is the most well-known malignant cells in males, bookkeeping for more than 1/5th of all malignant cells diagnoses in men, and the number of prostate malignant cells patients is on the rise. Different RT cures for considering prostate malignant cell have been seen as operative, non-invasive cure options, particularly for older patients and those who are unable to undergo a medical procedure [3, 4].

Stereotactic ablative body RT (SABR) with volumetric-modulated arc therapy (VMAT) is an outside beam energy cure approach that conveys a high percentage

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of energy to an extra cranial focus inside the body in a single or several fractions in an extremely precise manner. It's a seductive method of dealing with portion acceleration. Because intrafractional mobility is reduced, the faster delivery of VMAT makes the cure much more beneficial and enhances cure precision. VMAT improved conveyance time, resulting in highly conformal portion dispersion and exact portion delivery, according to a previous report [5]. Furthermore, when compared to intensity-modulated arc therapy, VMAT was linked to more productive screen use, improved portion inclusion, and modification to the planning objective volume (PTV) (IMRT). Another linac with flattening filter-free (FFF) beams has recently been put into clinical use. Eliminating the flattening filter has two advantages: (1) faster beam conveyance due to high portion rates, which means a faster SABR cure; and lower out-of-field portion due to reduced head dissipation and spillage, which results in less openness of typical tissue to dispersed dosages outside the objective field. Due to the superposition of multiple power designs, a flattening filter (FF) beam is not required for VMAT. When higher-fraction doses are needed, such as in hypofractionated SABR of the lung, liver, and other body parts, an FFF beam is frequently used. SABR and three-dimensional conformal RT with the use of an FFF beam (3D CRT).

2 VMAT

VMAT is a revolutionary energy cure that uses volumetric-modulated arc therapy. In under 2 min, it can convey a 2Gy fraction to the target with high portion adjustment while sparing the sound encompassing tissue (Palma et al. 2010). Varian Medical System dubbed their VMAT technology Rapid Arc, which was introduced to the market in 2008, after the exceptional precision of the cure. The linacs' outputs are consistently coordinated and validated, resulting in identical cure delivery [5–8].

This examination's estimations were done on one of the true beams, and the outcomes are believed to be valid for all of them. Power-modulated bend therapy is the inspiration for VMAT. The section can be transferred during a full 360° rotation of the gantry thanks to the computation improving the cure plan. A rotational medical linac with a dynamic multileaf collimator (MLC), the ability to modify part rate, and a framework turning speed that can be in the swing of things as needed is the innovation requirement [9, 10].

3 Flattening Filter

Since the 1950s, flattening filters have been a norm in medical linac designs, however there are flaws in their implementation. To ensure a consistent power contour through the entire degree of the beam, a significant portion of the beam force is removed at the focal hub, reducing the machine's total output while also producing dissipated

energy. This dissipated energy (which includes both photon and electron components) contributes to the patient's discomfort and is challenging to visualise properly in RT cure planning systems (TPS). According to Monte Carlo (MC) calculations, photons entering the flattening filter are exposed to a varied amount of ingestion depending on which purpose of the filter they pass through resulting in increased following of beam energy away from focal axes.

Mohan et al. 1985 used a modified linac model to show that the normal photon energy drops from 1.90 MeV on-axis to 1.50 MeV in an annular area 15–20 cm off-axis for a 6 MV clinical beam estimated isocentrically (100 cm from the successful energy source) [11–13]. The off-axis mellowing effect was also depicted as a reduction in the half-esteem layer in a similar report. The resultant non-uniform parallel constriction of the beam is one of the consequences of the non-uniform spectral piece along the side inside the beam; a notable impact of this is the occurrence of purported 'buzzers' on horizontal portion profiles estimated at depths narrower than the predetermined orientation profundity, as shown in Fig. 1.

There is an increase in out-of-field portion due to the beam solidifying (evacuation of lower energy photons), the on the axis, there is a relative decline in fluence, and the expanded dispersal from the filter (Almberg et al. 2012; Kry et al. 2010). In addition, for photon beam energies greater than the limit for photonuclear responses (10 MV), the flattening Fig. 2. Parallel beam profiles for a comparable photon beam at various depths with a fixed source-to-surface distance by renormalising the off-axis distance, the beam difference has been removed, and all beams have been standardised to the portion at the bottom.

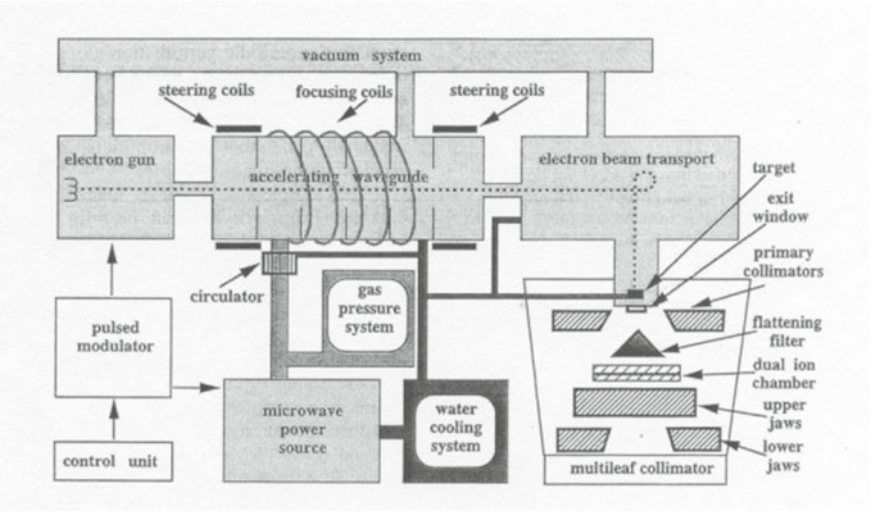

Fig. 1 Schematic diagram of a typical medical linear accelerator. Reproduced from Van Dyk, J. The modern technology of energy oncology Madison, WI, USA: Medical Physics Publishing; 1999. 1073

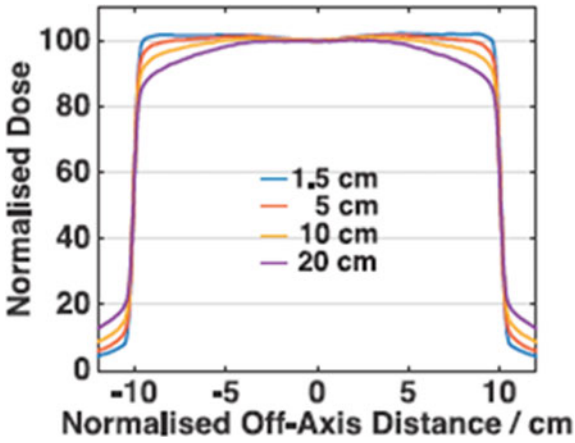

Fig. 2 Parallel beam contours for a similar photon beam at various profundity with fixed source-to-surface distance. The disparity of the beam has been taken out by renormalising the off-axis distance, and all beams are standardised to the portion at the focal axis

This response occurs in several parts, including filter. The flattening filter is responsible for around 10% of the neutron generation in the cure head, according to Monte Carlo calculations for an 18 MV photon beam from Varian accelerators. The substance of the flattening filter has an impact on this figure. The flattening filter must be emptied. The characteristics of 'unflattened' beams were compared to those given with a flattening filter at the beginning. Without a filter, a previous study found that (or collimating framework), the normal photon energies in a 15 MV clinical beam ranged just from 2.8 MeV at the focal axis to 2.5 MeV in an annular area 10–25 cm off-axis, while the mean energies in a typically straightened and collimated framework were 4.11 MeV on-axis and 3.3 MeV off-axis, respectively. Various studies looked at the impact on the biggest portion's depth (Sixel and Podgorsak 1994), spectral alterations at off-axis positions, and head dispersion. In the cure head of medical linear accelerators, the flattening filter is a standard part. The x-beam component profile is smoothed and a uniform beam is produced by the cone-formed filter. Nonetheless, as cure techniques have progressed and modalities such as power-modulated rotational therapy (IMRT) and VMAT have been introduced, the level beam profile is no longer an absolute need, and in some cases, removing the flattening filter may be beneficial [14].

4 Flattening Filter-Free X-Ray Beams

The beam quality alter when you remove the flattening filter. The FFF beam has a softer range and a cone-shaped form. The appropriation of the forward crested section is the fundamental reason why flattening filter-free (FFF) beams have not been widely used. The most thorough investigation into the effect on cure conveyance after the removal of the flattening filter looked at the reduction in cure conveyance time for stereotactic body RT (SBRT) and was aided by removing the flattening filter from the

cure top of the linac. The cure beam was reduced from 15 min to 7 min on schedule for a 25 Gy fraction, with a 15–50% reduction in the part of basic body parts outside the cure volume. In the cure head of medical linear accelerators, the flattening filter is a standard part. The cone-shaped filter makes a homogeneous beam by smoothing the x-beam component profile (Metcalfe et al. 2007). Nonetheless, as cure techniques have progressed and modalities such as power-modulated rotational therapy (IMRT) and VMAT have been introduced, the level beam profile is no longer an absolute need, and in some cases, removing the flattening filter may be beneficial (Gasic et al. 2014) [12–16].

The beam quality alter when you remove the flattening filter. The FFF beam has a softer range and a cone-shaped form. In unflattened beams, the effect of off-axis relaxation is less important than in levelled beams. As a result of the reduction in this impact, the profundity portion 13 characteristics are nearly uniform over the field. This may also be seen in the fact that for straightened beams, the status of the section profile changes little with depth.

Furthermore, when flattening filter, which is one of the primary sources of disperse, is detached, there is less head dissipation, which may reduce the overall risk of out-of-field auxiliary malignancy [17].

5 Materials and Methods

For the confined prostate malignant cells trial, a total of eight individuals were chosen for cure with outer beam energy cure. Prostate with original vesicles is the focus of this examination. All patients had their CT scans taken with a vacant rectum and a full bladder, which were then imported and registered into the Eclipse cure planning framework. On the basis of CT images, the visiting energy oncologist physically sectioned the prostate and basic vesicles [18].

With the exception of the rear bearing, where a 0.5 cm edge was added, the essential planning objective volume (PTVP) was defined as a 0.7 cm edge around the prostate and original vesicles in every direction. The lift planning objective volume (PObV) was designed with a 0.7 cm boundary around the prostate towards all paths except the back, which had a 0.5 cm edge. In view of estimated confinement weaknesses, such as client repeatability and intrafraction mobility, the complete prostate patient population at our facility was treated using image direction. Body parts at risk were shaped as the rectum, bladder, and left and right femoral head. It was decided to utilise the anisotropic scientific calculation. Throughout the experiment, dosing structure sizes of (3 3 3) mm^3 were used. The CT images used for planning the object had a cut thickness of 3 mm. The total dose was 78 Gy divided into 39 portions for the entire therapy. The essential plans' solution portion was 56 Gy to PTVP, and the lift plans' remedy portion was 56 Gy to PTVP [19, 20].

Using FB and FFF beams, an essential PTVP configuration and a different PTVB arrangement were created for every patient. All the patients' photo sets were chosen

in such a method that living systems were extremely similar. The anterior pharyngeal (AP) and sidelong detachments of all of the patients were exceedingly near. The collimator was pivoted 20o for the clockwise curve and 340o for the counterclockwise curve to reduce the impact of between-leaf leakage. The volumetric portion augmentation strategy followed a similar methodical system in terms of the aim and needs, and all plans were created using the Eclipse planning framework [15–19]. Table 1 shows the progress requirements for all plans. These imperatives and weightings were initially defined and then altered during the improvement cycle by either unwinding or fixing based on continuously refreshed part volume histograms (DVHs) of structures Fig 3.

The cure plan was based on the RT goal of conveying a therapeutic portion to a defined target while restricting portion to the nearby normal tissue and fundamental body parts. It necessitates to optimisation of the solution portion's similarity to the planning objective volume, portion homogeneity inside the PTV, and portion to the surrounding normal tissue and basic body parts. For contrasting combined section volume histogram of the patient, the following boundaries were assessed: Sigma index, similarity index, *D* mean to rectum, entrails, bladder, right femoral head, and left femoral head [12–18].

Table 1 Dose–volume imperatives and relative weightings utilised for optimisation of both FB and FFF Rapid Arc plans

PTV and OARs	Dose volume constraints	Relative weighting
PTV*p* and PTV*s*	D100% 98% D100% 102%	110–120
Rectum and bladder	V70% 30% V50% 50% V30% 70%, D5–D10 total Of 60–70 Gy D100%	60–80
Bowel	V50% 30% V30% 50% V10% 70%, D5–D10 total 45 Gy D100%	50–60
Femoral heads	V20% V30% 30%, D20% total of 45 Gy	50–60

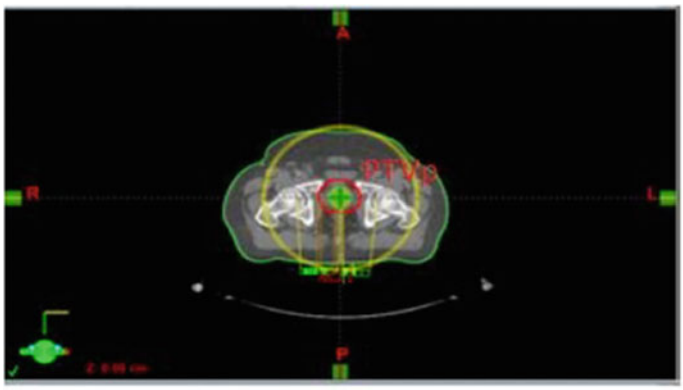

Fig. 3 A cross-over perspective on fast arc plan arrangement utilising 2 arcs and the PTVP

The depiction of homogeneity in a more accurate manner could be beneficial. In terms of Sigma index, the Sigma characterised (S-index). In contrast to other listings that use combined DVH, this one employs differential DVH. The S-index is a percentage of the doses' SD around the mean component. The following is a list of indexes:

$$\mathrm{S-index} = D_{\mathrm{SD}} = \sum \sqrt{(D_i - D_{\mathrm{mean}})} \times \frac{v_i}{V}$$

D mean refers to the average bend of the objective (in this case, PTV). D_i refers to the capacity of the container v_i. V stands for the objective's total volume. To think about the cure programmes, the congruity index (CI) was defined. The similarity index is distinct as the percentage of the 95% isodose volume separated by the primary target volume that is encompassed by the 95% isodose line [19].

6 Dose Circulation, PTV Inclusion, and Body Parts in Danger

Dose volume histograms can be used to assess target inclusion index, which is defined as the % of the tumour volume that received the recommended fraction, in addition to providing information on energy dosage homogeneity. In an ideal world, tumour dose volume histograms would be a staged procedure with 100% of the target receiving the required portion. The PTV rules were created with the purpose of covering at least 95% of the PTV with the endorsed component (D95) In addition, in accordance with ICRU reports 50 and 62, the PTV volume receiving more than 107% of the solution was limited to 2%. To achieve this goal, in the optimisation cycle for the two plans, a restriction for D100 was set to acquire 98% of the solution, and a requirement for the most extreme component (D_{max}) was set to get 102% of the solution. TP was created for all instances using 6 MV at a maximum part rate of 500 MU/min for FB beams and 1200 MU/min for FFF beams using the same parameters, such as portion volume requirements, arc angle, and no of arcs. To assess high dosage volumes, the volumes that received at least 50 Gy, 55 Gy, 60 Gy, 65 Gy, 70 Gy for the rectum, 65 Gy, 70 Gy, 75 Gy, 80 Gy for the bladder, and 15 Gy, 45 Gy for the stomach were chosen [16–21].

7 Typical Tissue Integral Dose and Monitor Unit

The fundamental portion (measured in litre-Gy) was distinct as the consumed portion of the volume, excluding PTV. Portion volume histograms were used to calculate the necessary portion (ID) (mean portion tissue volume) obtained by typical tissue (NTID). The vital portion proportion was calculated by dividing the vital portion of

an FB plan by the basic portion of an FFF plan for testing purposes. FFF and FB designs were discovered when investigating MU.

8 Statistical Analysis

Statistical Analysis Software (SAS) was used to conduct the quantifiable analysis. The standard deviation of the mean (SD) as well as the mean characteristics were collected. Using the combined *t*-test, relative dosimetric changes were analysed. A two-sided p esteem of less than 0.05 was deemed measurably important. 95% of the purposeful information was included in certainty stretches (CI) [20, 21].

9 Result

Tables 1 and 2 summarise the S-index and similarity records for all prostate patients in the FB and FFF beams. The relative viability (FB/FFF) values for S-index and similarity index for and primary target volume 1.113, 0.999 for PTVB are 1.045, 0.998, and 1.113, 0.999, respectively.

Figure 4 depicts a cross-over perspective on near-portion appropriation between the FB and FFF beam layouts. There were no dosage differences in the volume presented to 50, 65, 70, and 70 Gy between the two cure techniques for the rectum. The volume presented to 50 Gy, which isn't truly critical ($p = 0.239$), showed only a minor difference. In the case of the bladder, there were no portion differences for the volume presented to 70, 75 and 80 Gy, but there was little distinction for the volume presented to 60 Gy, the 2nd cure modalities in the volume presented to 45 Gy or 15 Gy, and all patients' femoral heads were within the obligatory requirements. For the complex

Table 2 Sigma index and similarity index of primary target volume plans for FB and FFF beam

	FB	CI	FFF beam	CI
Pt. No.	S-index		S-index	
1	1.9	0.990	1.8	0.991
2	2.4	0.971	2.4	0.997
3	1.9	0.997	1.8	0.998
4	1.7	0.998	1.7	0.999
5	1.9	0.986	1.6	0.994
6	1.7	0.998	1.4	0.999
7	1.2	0.999	1.4	0.998
8	1.1	0.998	1.1	0.998

Mean ± SD 1.726 ± 0.38, 0.993 ± 0.01, 1.66 ± 0.362, 0.994 ± 0.01

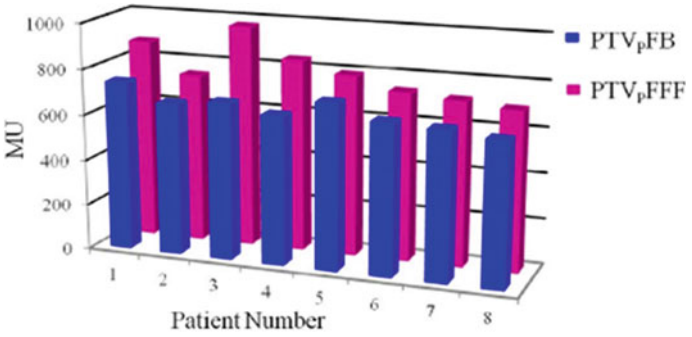

Fig. 4 For PTVP Rapid Arc plans, a comparison of the MUs for the FB and FFF beams. The essential volume planning flattening filter-free beam plans are referred to as flattened beam plans and the key planning cure volume to as PTVP FB and PTVP FFF, respectively

arrangement, Table 3 shows the cruel portion insights with standard deviation (SD) of body part in danger. Table 4 depicts normal most extreme portion measurements (with SD) as well as normal dosimetric files with standard deviation (SD) of PTV and body part in danger for complex arrangement. In the typical dosages conveyed to the bladder, femoral heads and rectum no important differences between FB and FFF beam designs were found. In comparison to FB beam plans, FFF beam plans had a massive expansion in mean portion of 2.5%. P=0.048, 95% CI 0.960 to 0.999. For both FB and FFF beam designs individually, the normal greatest percentage of

Table 3 Mean portion insights (standard deviation) of body part in danger for complex arrangement

Structure	Dose volume	Constraints	Volume achieved in % (FB)	FFF	*P*
Rectum	V 50 Gy	< 50%	29.80 ± 5.8	28.62 ± 4.4	0.24
	V 60 Gy	< 35%	20.08 ± 4.1	19.36 ± 3.1	0.244
	V 65 Gy	< 25%	16.04 ± 3.3	15.62 ± 2.7	0.39
	V 70 Gy	< 20%	12.4 ± 2.9	12.12 ± 2.4	0.54
	V 70 Gy	< 15%	8.36 ± 2.8	8.62 ± 2.6	0.633
Bladder	V 50 Gy	< 50%	19.3 ± 10.2	18.12 ± 4.1	0.425
	V 60 Gy	< 35%	14.5 ± 7.5	15.02 ± 4.0	0.125
	V 65 Gy	< 25%	10.8 ± 5.6	11.62 ± 9.6	0.421
	V 70 Gy	< 20%	11.8 ± 4.32	4.6 ± 4.4	0.33
	V 70 Gy	< 15%	3.38 ± 1.08	0.60 ± 1.06	0.74
Bowel	V 65 Gy	< 195 cc	0.58 ± 1.1	28.62 ± 1.08	0.81
	V 15 Gy	< 120 cc	4.79 ± 7.72	28.62 ± 7.03	0.27
Rt femoral head	V 50 Gy	< 5%	0.00	0.00	
Lt femoral head	V 50 Gy	< 5%	0.00	0.00	

Table 4 Average D_{max} measurements (with SD) and normal dosimetric lists (standard deviation) of PTV and body part in danger for complex arrangement

Structure	Mean dose in Gy (FB)	FFF	*P*	Maximum dose in Gy (FB)	FFF	*P*
PTV	79.56 ± 0.82	79.64 ± 0.82	0.303	82.48 ± 0.94	82.4 ± 1.17	0.675
Rectum	37.47 ± 4.76	37.46 ± 4.59	1.00	80.99 ± 1.52	81.19 ± 1.28	0.417
Bladder	37.7 ± 11.86	37.7 ± 12.2	0.203	81.99 ± 0.61	81.67 ± 0.66	0.873
Bowel	3.1 ± 2.89	3.87 ± 2.85	0.046	30.7 ± 24.2	30.4 ± 23.6	0.301
Rt FH	15.71 ± 1.88	15.96 ± 1.82	0.083	35.1 ± 4.44	34.86 ± 5.14	0.467
Lt FH	15.94 ± 1.85	16.04 ± 1.95	0.170	37.38 ± 4.39	37.3 ± 4.52	0531

PTV is 105.74 and 105.62% of the recommended portion. There were no important differences between the two modalities in the mean normal largest part to bladder, rectum, femoral heads and entrails.

Because energy might cause secondary malignant cells, two essential portions were recycled as an index to examine energy convinced secondary malignant cells. For the FB plan, the NTID was 125.1, 23.57 litre-Gy and for the FFF beam, it was 126.98, 24.14 litre-Gy. In comparison to the FB beam, the FFF beam delivered 1.50% more portion. P=0.002 95% CI=0.045 to 535. Figure 5 shows the correlation of the required portion for the FB and FFF beam in Rapid Arc complex layouts. The quantity of MU necessary for levelled beam-force adjustment cures such as IMRT and Rapid Arc is a marker for the mean body dosage.

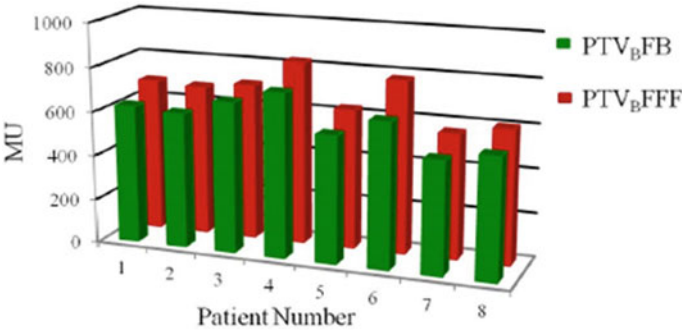

Fig. 5 Description for designing goal volume Rapid Arc designs, a comparison of the MUs for FB and FFF beams. Flattened beam plans and planning goal volume are referred to as FB. FFF stands for flattening filter-free beam plans for boost planning cure volume

10 Conclusion

FFF beams resulted in effect on acetabular depth and posterior coverage of the femoral head and entrails. Typical tissue basic dose and MU milar to levelled beams for cure plans using Rapid Arc. In mean and biggest area of the bladder and rectum, there were no important differences between FFF and FB plans. Because the entrails and femoral heads are clinically far from the PTVs (prostate and basic vesicles), they usually have small amounts. Sigma files are low, indicating greater section homogeneity for both PTVP and PTVB, as well as lowering HI in FFF beam plans. For both procedures, no violation of portion imperatives occurred. FFF beams have nearly comparable congruency and a higher NTID than FB beams. The soft photon beams range and resulting higher skin portion from FFF beams can be credited for the increased NTID. As a result, higher skin doses reaching internal body parts aren't fully demonstrated. Despite the minor differences, it was imaginable to grow clinically adequate Rapid Arc cure plans for prostate malignant cells with 6 MV using an FFF beam accelerator.

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Chapter 22
Crop Disease Prediction Using Deep ConvNet Architecture Technique

Angshuman Roy, Deepthi Sehrawat, and Juhi Singh

1 Introduction

Due to the rapid growth of the global population, the quality of living has become more challenging. Around 70% of the world's population will live in cities by 2050. By this fact, more technology and infrastructure are needed to be updated. This will also in turn surge demands of food quantity and quality and hence need advanced technological support. Protection of crops is more needed than having genetically modified crops because of their accessibility and affordability by the farmers. According to reports, almost 42% of the annual crop production of some of the most essential crops is affected due to crop-related diseases. This raises a serious concern about the survival of human beings soon. Almost 70% of the rural population depends upon farmers for their livelihood but due to loss of quality and quantity crop production, they do not get buyers for it and thus some of them attempt suicide. This issue can be solved efficiently by using technology [1, 2].

Smartphones have now become a basic entity found in every single house. This is due to the drop in price and competition as in India, almost every common person needs a device which is cheaper or more affordable and better technology in hand. With this comes a high-quality camera for better images and an Internet facility which costs less than 2$ per month. In this paper, the deployment of a deep neural model has been discussed with a client–server (provider) and user smartphone device.

In recent times, machine learning and deep learning have undergone an immense level of advancement. In the last few years, a convolutional neural network has made it possible to achieve the talent of image classification and has helped many modern day risk management systems and achieved greater accuracy predictions which a normal human being cannot do it. The two-model prediction in this paper will help

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newbies to explore more about the field of machine learning and understand the power of deep learning methodology.

The main contributions of the current paper are as follows:

- A robust deep learning model is proposed for crop disease classification.
- Trained the model using TensorFlow-v2 and saved the model for the client-side server.
- Analyzed the accuracy of both the proposed models and picking the one with higher accuracy.

The paper begins with a detailed review of the methods used previously for crop disease detection and is presented under Sect. 2. An overview of the proposed system and the process of deployment of both the models are explained under Sect. 3. Section 4 displays an overview of the performance of both the saved models. Section 5 concludes the paper. Finally, Sect. 6 provides some future aspects for model advancement.

2 Related Works

Predicting a diseased crop consists of a vast area for research and is now a trending topic to focus upon. Many papers have been written exploring the field considering different data types, i.e., in any numeric or image data set. This section consists of some of those works that have been proposed in the last 5 years.

Wani and Ashtankar et al. [3] used wireless sensor network to capture real-time essential data related to soil and climatic conditions. Thus, making early predictions about the crop and informing the owner about it which will result in higher yield and profit. The whole set up consists of proper installation of the WSN network and building an appropriate ML model for capturing the data and predict the output. More specifically, Naïve Bayes Kernel algorithm has been used for modeling.

Vardhini et al. [4] considered paddy crop image data set and used CNN for model building. The system consists of a Raspberry Pi which will be storing the database and with the help of which the image of the crop is clicked by the farmer and analyzed by the application which will display whether the crop is affected or not. If it is affected, it will display the type of disease and then necessary prevention techniques can be adapted by the farmer.

Jayakumar et al. [5] proposed a disease detection model for an image data set of watermelon leaves. Here K-means clustering and stacked RNN is used to classify the type of disease.

Kaur et al. [6] considered leaf image data set of soybeans and classified the diseased and non-diseased images. The model efficiently uses K-means clustering and after the various testing phase, it was able to achieve an accuracy rate of more than 50%.

Yashaswini et al. [7] a combination of two concepts was provided, i.e., irrigation system and disease prediction which will be done by the same system. The irrigation

system can be remotely controlled by over through their smartphone and for disease prediction hidden Markov model was used. The concept of IoT made it possible which can perform almost all the operations automatically and can be controlled from any location. The system was established with the help of Arduino UNO and a GSM module to control it wirelessly.

3 Proposed System and Deployment

The model is divided into two parts: data set and methodology. The data set component is used to collect data, while the methodology is used to establish a method.

3.1 Data Set

We gathered three data sets of three different crops: paper bell, potato, tomato, into each of the test and train data sets and categorized them into 15 different classes consisting of a healthy variant of each crop and a total of 13 diseases related to their respective crops [8, 9].

Train data set Use this dataset to train the model. This folder contains 22,346 images categorized into 15 classes (sub-folders) with the crop names and some common diseases related to them.

Test data set Use this dataset to check the validation and working of the model. This folder contains 5685 images categorized into 15 classes (sub-folders) with the crop names and some common diseases related to them which are the same as mentioned in the train data set folder.

3.2 Methodology

Data Augmentation and Image Pre-Processing All the 22,346 images of the training data set are resized and preprocessed. Data augmentation is done only on the training set as it helps the model become more generalize and robust. So, there is no point in augmenting the test set and hence only preprocessing is performed on it. In computer vision, we can use data augmentation during test time to obtain different views on the test image. Preprocessing the images suppresses unwanted noise and distortions and hence results in the enhancement of important features for further processing [10, 11].

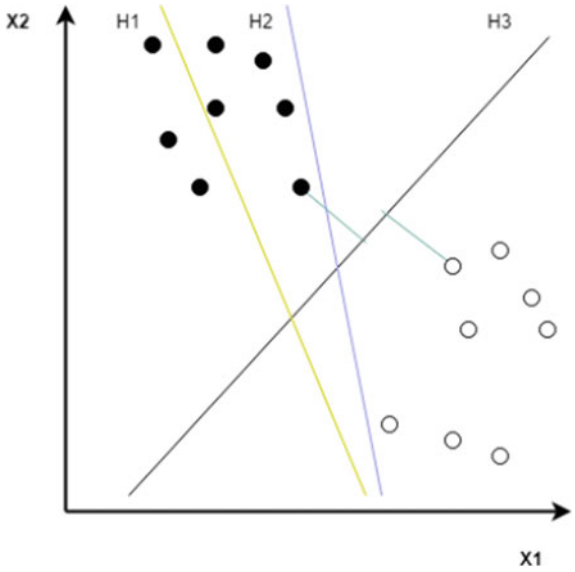

Fig.1 Classifying boundaries using SVM

Deployment of SVM version of LeNet-5 Basic CNN model uses LeNet-5 which consists of seven layers and hence is easy to modify each layer according to system requirements (Fig. 1).

To implement SVM, the last layer will be modified by adding a regularizer that applies an l2 regularization penalty. The default value used is $l2 = 0.01$.

The l2 regularization penalty is computed as:

$$\text{loss} = l2 * \text{reduce\_sum}(\text{square}(x)) \tag{1}$$

Deployment of Inception V3 Inception V3 architecture is the pinnacle of many ideas developed by multiple researchers over the years. It is a commonly used image recognition architecture which has been shown to achieve greater than 78.1% accuracy on the ImageNet database. It consists of 48 layer which does a variety of filtering for better classification. Inception V3 is not as accurate as ResNet-50-based architectures but it provides a decent accuracy score with faster execution speed than ResNet pre-trained models are good at detecting certain high-level features like edges and patterns. Here, we pre-train the model to make it more accurate. Doing so allows us to work with it without taking too much time to assemble.

Training Model Training of our modified models takes place on the training set and evaluation on test with a minimum number of 15 epoch. For the SVM-based LeNet-5 model compilation of the modified CNN (LeNet-5) takes place with a modified argument (for SVM) loss as squared_hinge instead of a hinge. The Inception V3-based model will take time to compile due to a greater number of parameters (Fig. 2).

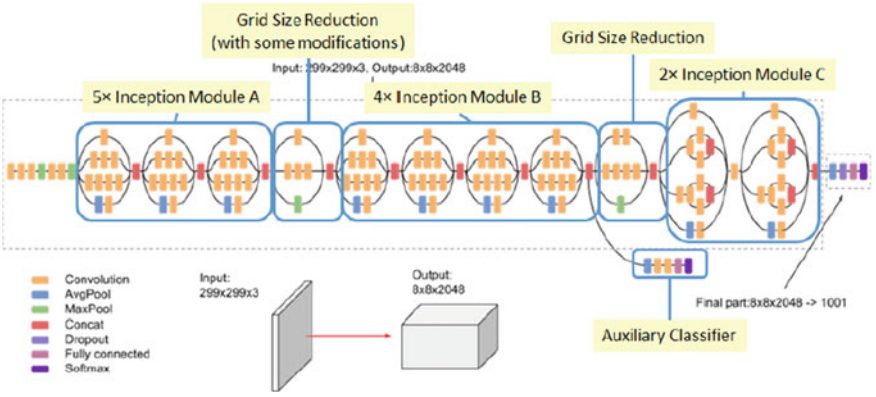

Fig. 2 Inception V3 architecture [12]

Saving the model. Both the models are saved and can be imported to other code or systems as well and saving the initial time of compiling the models (Fig. 3).

4 Performance Analysis of the Saved Models

Accuracy and loss graph is plotted for both the models of train and validation data sets. The model with a better accuracy score is selected. In this case, the SVM-based LeNet-5 architecture displayed performance of 84.28% accuracy while the Inception V3-based architecture presented a greater of 91.24%. Hence, we select the 2nd architectural model for prediction. We randomly pick an image of a crop that should belong to three types of pre-defined crops on which our model was built (Fig. 4).

Some of the limitations of our proposed model are that initial investment is required by the user, i.e., a smartphone with a good camera, internet service, and a service provider which will have control over the server base and it is only able to detect three types crop-related disease. Training the model with more different images and related diseases will take more time to compile due to client system restrictions (Fig. 5).

5 Conclusion

The model is a bit hardware involved at the server and distributer end but is easier for end users and hence this becomes both cost and end-user-friendly.

Government or any private firm can invest in server management and set up at a different location for monitoring high yield and more affected areas. This will

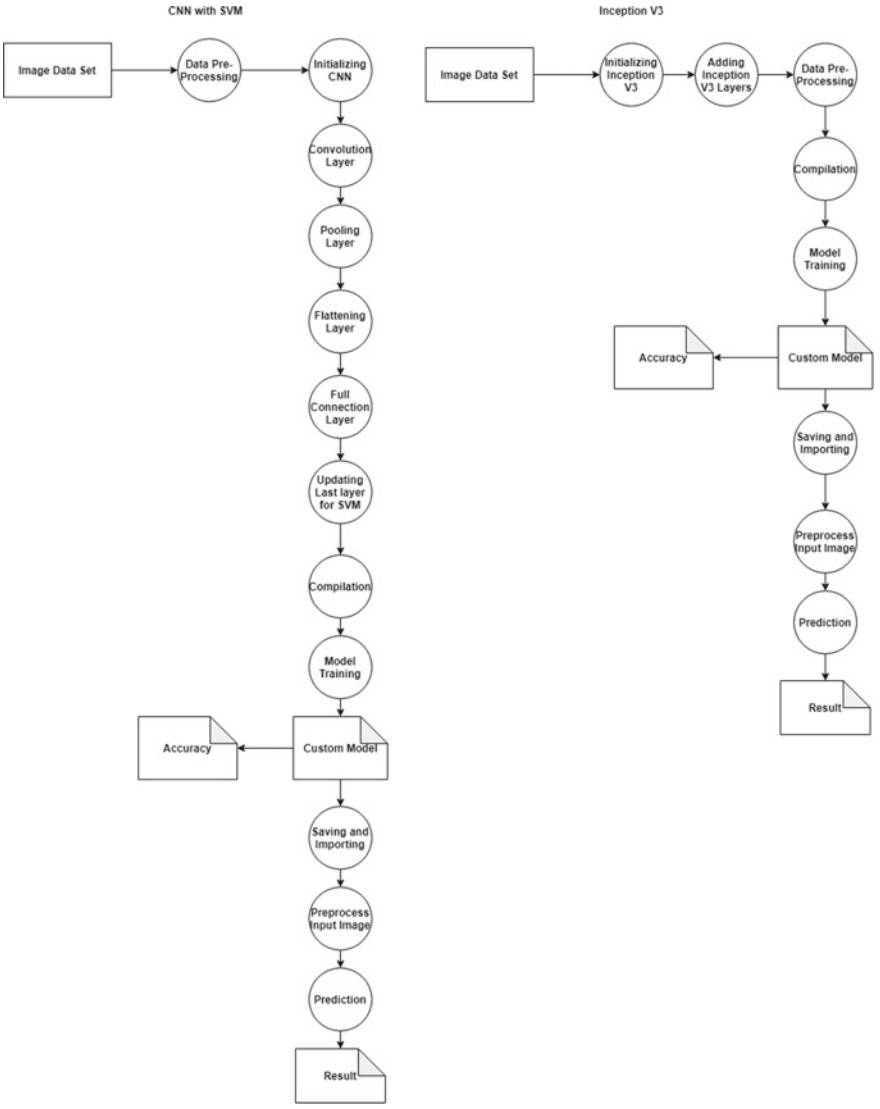

Fig. 3 2-Level DFD diagram of the system

increase the overall production and profit of crop yield. The only requirements at the user-end are a smartphone, internet connection, communication system, e.g., WhatsApp, Telegram, Discord, etc., and proper knowledge about its usage. Any skeptical area of the crop can be captured in jpg format by the farmer and can be further analyzed and detected accurately by the server side. To ensure the stability and reliability of the proposed system, the model undergoes multiple testing phases using different data sets and predictable images. The app has been able to predict 12

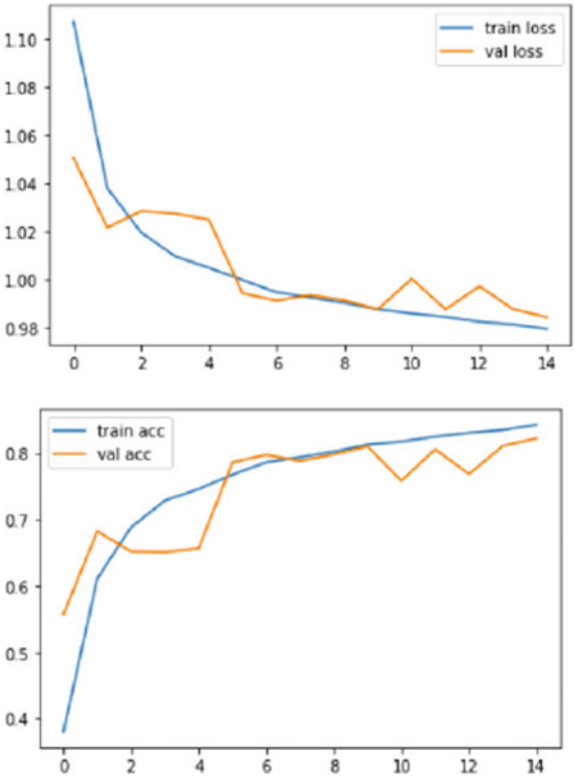

Fig. 4 Accuracy and loss graph of train and validation data set of CNN (LeNet-5) integrated SVM model

types of disease and three types of crops with the model stores at the server side and thus can be used by farmers all around the globe, only with a smartphone and access to Internet connectivity.

The system helps any farmer with a smartphone to prevent any further damage to the yield of their crops. After identification of the disease, the pesticide or fertilizer to use can be recommended. Our first model analyzed the data set using CNN (LeNet-5) integrated SVM which provided accuracy of 84.28% on train data set and accuracy of 82.23% on validation or test data set. Our second model analyzed the data set using Inception V3 with proved to be more accurate than our previous model with an accuracy of 91.24% on train data set and accuracy of 86.14% on validation or test data set. The accuracy may vary by $\pm$ 3% every time the model is build using the same data set but the accuracy of Inception V3 will always be greater than the previous model [13, 14].

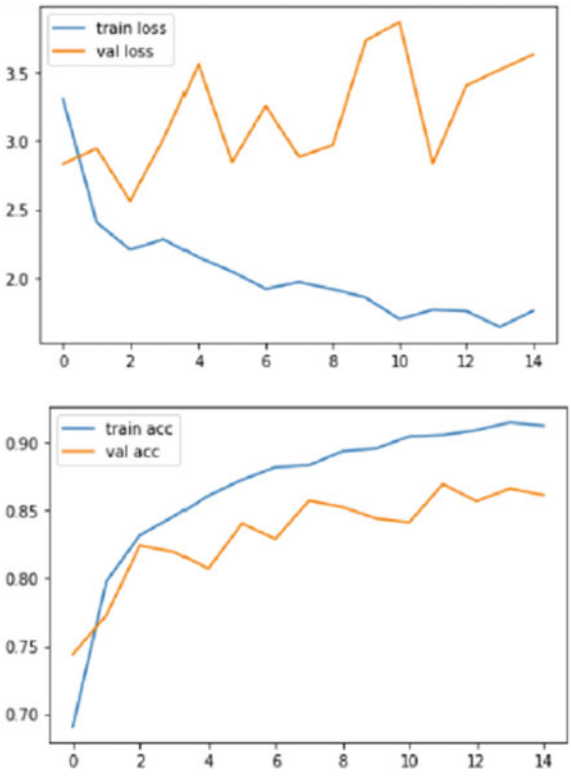

Fig. 5 Accuracy and loss graph of train and validation data set of the inception V3 model

6 Future Scope

Some of the future scopes of the project are described as follows:

- From a future perspective, the model can be further trained using different versions of residual neural network (ResNet-50, Resnet-152 V2, etc.), MobileNet, and DenseNet which will result in greater accuracy but decreasing the speed of prediction and increasing the initial time taken to train the model.
- A mobile application can be created which will allow end users or farmers to predict the disease without any Internet connection and get instant results without being dependent on the server side [15, 16].
- Images of more crops can be added which can be categorized by the names of the crops with their respective disease. The user can select the type of crop that needs to be analyzed which will make the predictions faster and more accurate.
- IoT devices can be used to collect more data related to soil and weather which will provide a better result with a greater accuracy rate.

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Chapter 23
High Dimensional Data Clustering Using Forward Feature Selection Framework for Medical Data

D. Karthika and K. Kalaiselvi

1 Introduction

Because data is acquired using a range of techniques, procedures, and technology, handling large amounts of data has become a challenging problem for academics in the digital era. Because raw data is noisy and includes numerous characteristics, it reduces the efficacy of machine learning algorithms by inducing overfitting, increasing the time required to create machine learning modes, and decreasing their accuracy [1]. In general, high dimensional data contains features that are superfluous or redundant. Irrelevant features cannot be employed in the learning process, and redundant features transmit the same information, leading to a misunderstanding of the learning process. As a result, feature selection may be utilized to overcome these challenges. Feature selection is the act of removing redundant and superfluous information from a dataset to improve the performance of machine learning algorithms [2]. There are two types of machine learning algorithms: supervised learning algorithms and unsupervised learning algorithms [3]. Data that has been efficiently preprocessed by data processing technologies to decrease data creation is referred to as feature selection [4]. Classification and prediction are initially used to train data to create model data processing technology, and model prediction is then used to evaluate the outcome [5]. This study focuses on different classification algorithms that have been fitted with sickness datasets to detect chronic illnesses, with the HDFFSC approach showing the most promise. The most important problem is to develop new

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classification approaches that can aid in the diagnosis of chronic diseases more swiftly and simply. Based on the categorization results, the best performance necessitates the use of genuine performance-enhancing measures. As a result, any categorization approach that provides more generality while requiring fewer processing resources is chosen.

2 Literature Review

According to Marmarelis [1], the scientific community is stepping up efforts to analyze the dynamics of the COVID-19 epidemic to predict significant epidemiological outcomes, assist clinical administration in reasonable planning, and guide sociopolitical decision-making regarding inappropriate mitigation measures.

Nithya et al. [2] used an Artificial Neural Network (ANN) and multiple kernel k-means clustering to create a system for renal disease detection and segmentation in ultrasound pictures. Initially, a preprocessing method was used to eliminate noise from an input picture. The noise-free data was then used to extract features from the image using GLCM, and the image data was classified as normal or abnormal using ANN.

Zhan et al. [3] focused on a multi-view clustering method using deep characteristics to develop an epilepsy detection technique. The developed Electro-Encephalon-Gram (EEG) detection used a multi-view Fuzzy C-Means to train the data (FCM). The weight of each view was used to calculate the value of view weighted membership for fresh prediction samples.

Jelodar et al. [4] defined it as "comfortable channels for users to discuss health problems and share information based on machine learning prediction." The features of the patients are used to make references depending on the classification approach.

According to Nair et al. [5] extracting microscopic data for disease prediction is a difficult machine learning challenge. As the percentage and sample size drop, so does the calculation risk.

3 Proposed High Dimensional Forward Feature Selection Clustering (HDFFSC) Framework

The High Dimensional Forward Feature Selection Clustering (HDFFSC) technique is provided to build ensemble sets, and it makes the benefits of the Incremental Ensemble Member Chosen (IEMC) process reliant on local and global objective functions, $E_s = \{f(X_1, \ldots)(A_1, X_2, A_2), \ldots (X_y', A_y')\}$ (where $Y' < Y$) Based on the preceding ensemble, E_s global search, the current objective function is well suited for local exploration.

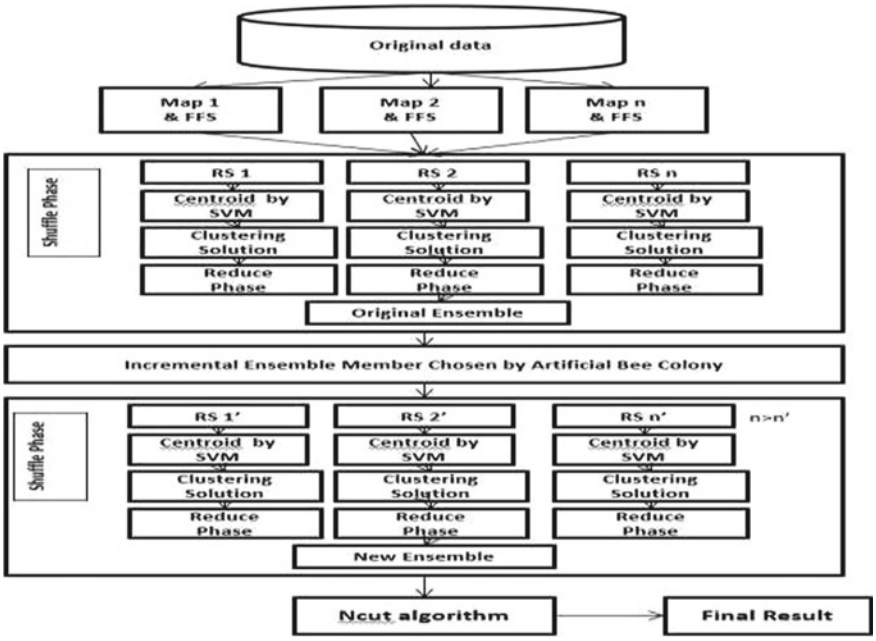

Fig. 1 High dimensional data forward feature selection clustering framework

Mostly, recognized high dimensional dataset $D = \{D_1, \ldots, D_R\}$, Random Subspace Semi-Supervised Clustering Ensemble (RSSCE) examines the method of the RS algorithm to create a set of random subspaces using the resources of each feature vector with "m" features $S = (S_1\ S_Y)$ at the first stage The constraint propagation technique (CPM) [6] is provided in the next step to construct an SSC model in the direction of generating a set of clustering outcomes Fig. 1.

A well-known programming technique for working with large datasets is MapReduce [7]. The MR model includes three main phases: map, shuffle, and reduce. The core notion of information generation, which is defined as a key-attribute pair, underpins the MR paradigm. The following form demonstrates this:

$$\text{map}(\text{key 1},\ \text{attribute 1}) \rightarrow \{(\text{key 2},\ \text{attribute 2}), \ldots\} \tag{1}$$

Feature selection is the process of selecting relevant features or a candidate subset of attributes. The four fundamental stages in feature selection are subset formation, subset evaluation, stopping criterion, and outcome validation (shown in Fig. 1). If the new feature subset outperforms the previous best feature subset, the old best feature subset is deactivated and the new feature subset is used instead. This process is continued until a predefined stop condition is reached. By monitoring a limited set of must-link and cannot-link restrictions utilizing pairs of feature vectors provided by algorithms, CPM decomposes a CPM problem into a group of SSC issues. The

dataset $D = \{D_1 \ldots D_n\}$ an undirected weighted graph should be able to generate it G (FV, A), where FV is the collection of feature vectors associated with the vertices, and A is the similarity matrix through a weight value a_{ij} connected with the edge connecting the vertices, and D_i and D_j:

$$a_{ij} = \begin{cases} \rho_{ij} \text{ if } D_i \in S_c \\ 0 \quad \text{else} \end{cases} \tag{2}$$

$$\rho_{ij} = \exp\left(\frac{-\left|\left|D_i - D_j\right|\right|^2}{\text{dis}^2}\right) \tag{3}$$

The support vector machine (SVM) was created as an estimator to deal with the centroid selected issue of Q-clustering learning's capabilities.

$$|s_k - f(x)|_s = \max\{0, |Q - f(x)| - \varepsilon\} \tag{4}$$

An Artificial Bee Colony is a good analogy. According to [8] the ABC algorithm is a swarm-based, met heuristic algorithm based on honey bee colony foraging behavior. IEMC assembles the ensemble members one by one and computes the objective function in the first step, E used for all clustering consequence *Es* made by CP by respect relates to the subspace X_y. (Xt, A_t) is also taken out of the current ensemble and is characterized by Eq. (5)

$$\hat{E}_s = \hat{E}_s \backslash \{(X_t, A_t)\} \tag{5}$$

4 Results and Discussion

Three benchmark medical datasets from the UCI machine learning library are used in the studies. Some of the measures used to evaluate the results of these datasets include precision, recall, F-measure, and accuracy. The conventional approach of 20 iterations is used to calculate these measures. The clustering results obtained by some clustering algorithms associated with the HDFFSC algorithm and ISSCE are assessed using datasets as shown in Table 1 (where "*n*" represents the total number of data samples, "*m*" represents the number of features, and *k* represents the number of classes), with the clustering results obtained by some clustering algorithms associated with the HDFFSC algorithm.

Figure 2 shows the results of three datasets comparing the ISSCE and the proposed HDFFSC algorithms for clustering. The suggested HDFFSC method produces better outcomes, but the ISSCE clustering technique produces inferior results.

Table 1 Metrics comparison versus clustering methods

Dataset	No. samples (n)	Attributes (m)	Classes (k)	Metrics	ISSCE	HDFFSC
Gene expression cancer RNA-Seq	80	205	15	Precision (%)	83.7453	93.3766
				Recall (%)	82.4453	92.3056
				F-measure (%)	83.5881	93.0956
				Accuracy (%)	83.4444	92.8889
Heart failure clinical records	299	90	4	Precision (%)	83.1749	90.4188
				Recall (%)	83.0926	91.6364
				F-measure (%)	82.7827	91.0236
				Accuracy (%)	83.2748	91.1851
Breast Cancer Wisconsin	569	32	2	Precision (%)	86.4038	94.3489
				Recall (%)	86.7162	93.3628
				F-measure (%)	86.5597	93.8533
				Accuracy (%)	87.1387	94.1613

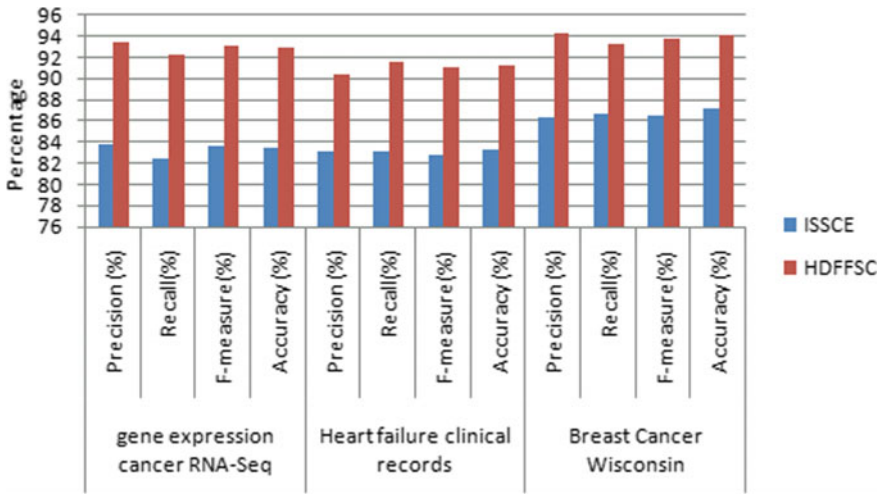

Fig. 2 Result of HDFFSC and ISSCE

5 Conclusion and Future Work

For high dimensional data clustering, the High Dimensional Forward Feature Selection Clustering (HDFFSC) technique is described in this work. To minimize clustering running time, this HDFFSC method has used the Map Reduce (MR) structure. When dealing with medical data, it is utilized for managing large quantities of samples and grouping high dimensional data using machine grouping. The suggested HDFFSC method employs a combination of the random subspace algorithm and the Constraint Propagation Method (CPM), as well as the proposed IEMC procedure and the normalized cut algorithm to integrate the results of multiple CE to process high dimensional data. The support vector machine (SVM) classifier is used to determine the centroid. The Artificial Bee Colony (ABC) method is then used to execute the IEMC process. The findings of three UCI datasets show that the HDFFSC method works better for medical data than traditional SSCE techniques. Future research will investigate how to make the dataset's temporal complexity less.

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Chapter 24
Artificial Intelligence (AI) Startups in Health Sector in India: Challenges and Regulation in India

K. Gagandeep, M. Rishabh, and Sonali Vyas

1 Introduction

According to Niccolo Machiavelli, an Italian diplomat and political philosopher have gave a wonderful statement on intelligence:

> There are three kinds of intelligence: One kind understands things for itself, the other appreciates what others can understand, and the third understands neither for itself nor through others. The first kind is excellent, the second good, and the third kind useless (Niccolo Machiavelli).

At present, AI, i.e., artificial intelligence is a study of making computers and machines intelligent so that they can act better than people do. In other words, it is the use of coded computer algorithms with specific instructions for completing a task for which a human brain is normally considered necessary. However, this meaning of artificial intelligence to some extent is ephemeral due to the reference to the current state of computer science and fails to include other areas with the greatest impact, namely problems that cannot be solved successfully by computers or by individuals. Also, it provides a good framework for what constitutes artificial intelligence and avoids the philosophical issues that govern attempts to define the meaning of artificial intelligence [1].

This is making a huge difference in the world of technology where it can be incorporated to make it more productive and effective to simplify the system. The rise in Indian startups and developing artificial intelligence solutions in the field of education, health, financial services, and other fields. The inclusion of artificial intelligence (AI) in healthcare has reported slow growth over the past few years, but

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with the larger inclusion of the public and private sectors across the economy, the rate of growth in adoption of artificial intelligence is forecast to gain momentum. The growth of artificial intelligence in 2020 has been raised in the field of healthcare after the breakdown of COVID-19 in the whole world. Also, the growth rate of startups has also been increased with innovative and creative ideas to provide more opportunities to the people. The government also providing support by introducing a platform, i.e., startup India platform where the people can produce their startup or innovative/creative ideas which can be converted into startup, and if the ideas or startup are liked by the government, then the government will provide them financial or infrastructure support.

The healthcare startup is also developing new technologies or software which helps from booking a doctor to diagnose the diseases by using artificial intelligence (AI). NITI Aayog is also strongly pressing to introduce artificial intelligence (AI) in healthcare and direct the Indian medical environment to become a state-of-the-art defense care model. Most of the healthcare startups are facing some legal or other challenges. The Indian government has introduced some rules and regulation related to governing the startups. In this paper, the authors will discuss all the challenges faced by artificial intelligence (AI) startups in the medical sector, its laws, and regulations in detail.

2 Definitions of Artificial Intelligence

As the definition of artificial intelligence (AI) is evolving, therefore, artificial intelligence has no universally accepted definition. Numerous philosophers have defined and proved the term with their valid theory. Artificial intelligence (AI) is intelligence established by machines, i.e., a machine performed its activities with the knowledge of human. In other complex words, machines that imitator cognitive functions which interact with people and the human mind, such as learning and problem-solving. It is a multidisciplinary and active field, combining computer science, mathematics, psychology, linguistics, philosophy, and among others. However, the three major levels in the development of AI described by Nick Bostrom, a philosopher at the University of Oxford, i.e., [2].

2.1 Artificial Narrow Intelligence (ANI)

ANI already has an amazing pattern that recognizes capabilities in large data sets, making it ideal for resolving text, voice, or image editing, and integration challenges/issues. In other terms, narrow AI refer to ability of computer's to perform one task very well such as playing chess or crawling Web pages. Nowadays, ANI still getting mature.

2.2 Artificial General Intelligence (AGI)

It is considered ideal and human-level artificial intelligence (AI). As it can reason, argue, memorize, and solve issues as humans do, i.e., executing an intellectual task by a computer program what a human can do.

2.3 Artificial Super Intelligence (ASI)

Theoretically, there may be the combined intellectual capacity of humanity or even more. But it would not be able to grasp its knowledge and understand its reasoning. Many organizations are working hard to avoid reaching this stage. In layman language, ASI try to surpass human intellect.

The definition gets changes over time, due to rapid development. Below there are few features that find a place in almost all the definitions which are generally used [3]:

- The power of a digital computer or computer-controlled robot to perform tasks that are often associated with intelligent creatures.
- A machine that completes tasks that involve a certain level of intelligence which was only deemed to be done by humans
- Whether the simulation of human intelligence systems with machines, especially computer systems. These processes include reading, consultation, and self-preparation.
- The power of a machine to mimic intelligent human behavior.
- It is hard to differentiate which definition is universally accepted, hence, all of these definitions are accepted and used commonly.

Artificial intelligence has tremendous advantages. One of the benefits is to increase the efficiency of doctors in hospital services. Situation is conducive to the interest of patients who are considered clients. Hospital staff uses a computer programs specially designed to identify high-risk patients [4]. Through the drug-making process and clinical research, artificial intelligence been used to investigate a large volume of molecular information relating to those seeking drug use in order to find common effects on them. This way, there will be an opportunity to ensure that they can get the standard results of certain drugs which they export in the market. Pharmaceutical establishments obviously can look at the various aspects of growing drugs. This process will help them to put in place numerous measures which will help them to cope with the side effects of the drugs [5]. Artificial intelligence is also very important in business. It is widely used in cargo handling areas by carriage/freight companies to ensure that they can handle the various loads they carry properly. With the proper installation of a computer program, it can monitor and monitor the movement of thousands of loads in various parts of the world, to the point that they can reach their destination on time and make a company involved in that competitive case [6]. There

are a lot of other benefits of artificial intelligence (AI) in different fields or sectors and more is developing.

3 Indian AI Healthcare Startups

It has been forecasted that the practice of artificial intelligence in the field of healthcare will cost INR 431.97 Bn by 2021. Ability of artificial intelligence (AI) apps to improve physician performance, help to address concerns such as the unequal treatment of doctors and patients by providing rural people with quality healthcare with training to physicians and nurses in order to manage complex medical procedures.

Worldwide health emergency like COVID-19 (coronavirus)—a major light in a healthcare industry, where all stakeholders are fighting from the front. The epidemic has been called for by the transformation of digital health infrastructure in various countries including India. Many said, this is the time for India to re-launch healthcare and support the implementation of health technologies to fill gaps in the traditional healthcare system. Several Indian healthcare industries also need to use them for a variety of purposes and use artificial intelligence (AI) to assist themselves in their industry.

In recent years, the Indian startup ecosystem has seen tremendous growth. The country is among the world's leading countries that have earned millions of technology startups in the last year. These priorities will focus on their new functionality and excellent service. On the flipside, the healthcare sector in India expected to grow by 23% CAGR to market $ 280 billion by 2020. With the "Digital India" initiative, the government has been intensifying its efforts to close the gap in health technology—an area where Indian startups already have momentum. Some examples will prove that how healthcare could benefit from artificial intelligence (AI) are:

3.1 Effective Consultations In-Person and Virtual Mode

Babylon Health introduced an application which provides consultation run by AI by using patient's medical history and general medical information. Patients can report their symptoms by using an app which tests those disease records using speech recognition [7].

3.2 Competent Aid in Health and Medication

First medical Sense.ly established Molly, a nurse—designed to have a smiley face accompanied by beautiful voice. The aim is to assist patients in monitoring their health or disease management during a doctor's visit using ML. Also furnish

customized follow-up care, focused on chronic diseases. The same method was accessed by AiCure app which access a smartphone camera with the artificial intelligence (AI) to ensure that patients follow their instructions. It will be useful for people having serious health conditions or who are taking part in medical trials [8].

3.3 Smart Maintenance of Medical Record

IBM Watson have established a software which provides evidence-based treatment options to oncologists. Design was made in order to analyze systematic information that is not built into medical records—may influence the decision-making process. The software incorporates data from a patient medical record and clinical expertise, as well as research papers to propose promising programs [9]. There are several similar instances for other specialties. Building a radioactive delivery system usually takes days. Artificial intelligence (AI)-based technology helps speeding up and completing the process in a few minutes [10].

4 Challenges Faced by Artificial Intelligence Startups

Within the Indian market, there have been a series of artificial intelligence (AI)-centric startups such as DRiefcase with the aim to integrate personal health records and provide users with a single point, easy access to medical information. In order for the number of startups to continue to grow and grow, their entry should be encouraged by government programs that provide infrastructure. However, few challenges have been mentioned in Fig. 1 that are faced by artificial intelligence (AI) startups [11] (Sejuti 2020).

Fig. 1 Challenges faced by AI startups

4.1 Lack of Adequate Business Infrastructure

These days, although many companies using machine learning (ML), does not make them artificial intelligence (AI) corporation. To become an actual artificial intelligence (AI) corporation, businesses need to take self-decision with the help of AI. Industry use cases in artificial intelligence-based applications require proficient understanding of present artificial intelligence (AI) technologies, appropriate business practices, and limitations. For an artificial intelligence (AI) system to produce good outcomes, it needs the appropriate combination of in-depth learning, NLP and related technologies, which are far less likely to fail.

4.2 Lack of Equit Talent, Expertise, and Resources

In order to be successful in startup companies, business requisite the appropriate combination of diverse talents. Similarly, the introduction of artificial intelligence (AI) requires technologies and resources that are highly scientific and interested in dealing with complex models with many problem-solving and mathematical skills. Few of the most important skills are cognitive science, computer-focused computer learning, and robotics. It requires a lot of patience and perseverance to set up a startup, and the supply of the right talent may not have been improved, leaving many startup corporations without the right talent to work with emerging technologies. People with technically skilled are the backbone of driving development, but lack of access to the appropriate resources can be a barrier to using artificial intelligence (AI) in early startups.

4.3 Lack of Trust and Patience

Artificial Intelligence (AI)—a comparatively fresh and complex technology in some way. To build an artificial intelligence (AI) program usually takes a long time and it is common to wait at least two years before the program can make its first investment. The cavity between theory and actual use is vast, making it a most important challenge for beginners who wish to see a particular profit from the first day of their business. Article/product growth in artificial intelligence (AI) requires a lot of communication with possible consumers who can identify their problems and suitably train models appropriately, which is time consuming and costly. Sometimes, it is very difficult for beginners to discover the right balance between research and its' application. Receiving the right information and using the right tools can be one of the biggest challenges in developing artificial intelligence (AI).

4.4 Expenses Involved in Advanced Computing Equipments

Using artificial intelligence, as well as machine learning (ML) and in-depth learning solutions, it requires complex pieces of advanced equipment and PCs that can solve difficulties at hypersonic speed. Also, to create greater workflow speeds, businesses required more advanced processors, which is a major startup problem due to their budget limitations. However, in order to have a temporary resolution, cloud computing and similar processing systems have provided implementation necessities. However, the actual problem arises when data volume continues to grow, and in-depth learning brings more complex skills. To resolve this issue, startups need to use infrastructure that uses the next gen-gen, such as quantum computing, which works on the idea of pluralism to accomplish tasks on information much faster than modern processers.

4.5 Poor IT Set Up and Swift Getting Software Outdated

Artificial intelligence (AI) technology works with a lot of data and therefore requires very efficient hardware. For having a successful artificial intelligence (AI) advertising strategy, getting started requires—strong IT infrastructure and advanced computer systems behind it, which can be very expensive to set up and operate. However, these systems may also need to be maintained and updated frequently to ensure a smooth flow of work. Moreover, it can be a major setback for startups and small establishments with modest IT budgets. Whereas, profound organizations such as Amazon, Apple, Microsoft, or Google having different budget shares for artificial intelligence execution, which may become hard for startups and small companies to use artificial intelligence resolutions in their corporate processes. Additionally, speed with which software gets outdated also cause challenges for startups.

4.6 Data Scarcity

The business is indeed able to access more information nowadays than ever before; however, the data sets used in the artificial intelligence (AI) system for learning are rare. Though the utmost powerful artificial intelligence (AI) machines are specifically trained in surveyed learning, this exercise usually requires labeled data—limited. And then, for businesses, the automation of the more complex algorithms only makes problematic. For a business to use artificial intelligence (AI) tactics effectively must have a simple set of data and keep a continuous foundation of important inbound data to ensure that artificial intelligence (AI) can be valuable to their business. To begin with, this has become a major obstacle as—a huge problem with relevant information available to them. Beginners can gather their data in a variety of applications in a

variety of formats, for example, text, audio, images, and videos. However, various forums for collecting the data's adding to the challenges of artificial intelligence. For effectiveness, all the gathered data must be compiled in such a way that artificial intelligence (AI) able to understand and be transformed into useful results. However, lapse of time, startups started investing in building channels, and focus on how to build artificial intelligence (AI) models without the lack of labeled data.

Now especially, in the field of healthcare, there has been an attempt at negligent cooperation between numerous stakeholders. Although, India has adopted an electronic health record (EHR) policy, but data distribution between various hospital chains is still an ongoing process, as different chains have adopted different definitions of "digitization" records. There needs to be a guide that clears the ambiguity of these words. Relevant data are usually not available because there are solid clinical data sets ("electronic health records" [12]).

5 Indian Legislative Framework on Artificial Intelligence Startup: An Overview

Rapid developments in many sectors have led to price growth and startup quality in India. It can be classified in a variety of ways as a company including a one-person company, a limited liability partnership or a corporate partnership. Each type of business is governed by a set of different rules, or rules. In addition to the laws relating to inclusion, tax laws, labor laws, environmental laws, safety laws, contract law, intellectual property laws, and various other laws are expected to be complied with. Startups should also know how to resolve disputes including litigation, arbitration, arbitration, conciliation, and negotiation.

The GOI introduced a platform named Startup India Government Scheme under which an initiative to build startups and nurture innovation. Through this initiative, the government plans to empower startups to promote entrepreneurship, economic growth, and employment throughout India. Startup India will help grow business and economic development—by ensuring that people who have the power to start and start their businesses are encouraged—with proactive support and incentives at multiple levels ("Startup India" [13]).

On the Website of startup India (www.startupindia.gov.in), the list of schemes and all information related to startup was uploaded, and it helps the entrepreneur to turn innovative ideas into business. On that platform, all rules and regulations and basic requirement need to be fulfilled to register a startup. Similarly, related to artificial intelligence, a national artificial intelligence (AI) platform was launched by the government (www.indiaai.gov.in) under a joint venture by MEITY, NEGD, and NASSCOM, to prepare the nation for an artificial intelligence (AI) future. It is a single center of knowledge in artificial intelligence and integrated industries for entrepreneurs, students, academics, academics, and all other people. The site focuses on building and nurturing a cohesive artificial intelligence (AI) system to drive

excellence and leadership in India's artificial intelligence (AI) journey, to promote economic growth and improve lives through it. Also, artificial intelligence-based startups are registered like Instoried, Wijungle, and much more on this platform ("India artificial intelligence").

Table 1 Important Indian laws in respect to startups

S. No.	Statutory act/rules	Section/rule	Section/rule statement
1	Information Technology Act, 200	Section 43A	Compensation for failure to protect data
2	Information Technology Act, 2000	Section 67C	Storage and retention of information by intermediaries
3	Information Technology Rules, 2011	Rule 4	Duty of Body Corporate requires sensitive personal information to draft a privacy Policy
4	Information Technology Rules, 2011	Rule 5	Guidelines that need to be followed by Body Corporate while collecting information
5	Information Technology Rules, 2011	Rule 8	Reasonable Security methods and procedures may be implemented by Body Corporate
6	Personal Data Protection Bill, 2019	Clause 31(3)	The data processor will act on the instructions of the data fiduciary
7	Indian Contract Act, 1872	Section 10	Conditions for making a valid contract
8	Insolvency and Bankruptcy Code, 2016	Section 55–58	To efficiently monitor the insolvency resolution process and the fast-track process
9	Foreign Exchange Management Act (FEMA), 2000	Schedule 6	For regulating the foreign investment in the startup
10	Trade Mark Act, 1999	Section 2 (zb) and Section 2 (m)	Meaning of Trade Mark and what all comes under mark
11	Copyright Act, 1957	Section 13	Describes what all works fall under copyright and can copyrighted or not
12	Patent Act, 1970	Section 2 (1) (j)	Describes what all come under the term invention and can be patented or not

Table 2 Other relevant regulations

S. No.	Statutory act/ rules	Objective
1	Drugs and Cosmetics Act, 1940 r.w. Drugs and Cosmetics Rules, 1945	Regulate the manufacturing, import, sale, and distribution of medical devices
2	Indian Medical Council (Professional Conduct, Etiquette and Ethics) (Amendment) Regulations, 2020 r.w. Section 33 of the Indian Medical Council Act, 1956	Guidelines for telemedicine practice in order to give practical advice to doctors so that all services and models of care used by doctors and health professionals are encouraged to consider the use of telemedicine as a part of normal practice
3	Electronic Health Record (EHR) Standards, 2016	Aim is to bring standardization and uniformity, inter-operability in recording, storage, transmission, and use of healthcare information across the various health IT systems
4	Drugs and Cosmetics Rules, 1945	Specifies the type of drugs which require authentic medical prescriptions for retail purchase

In India, there is a list of Acts which can be applicable in startups, and Table 1 shows some of the relevant Act that can be used, that is.

Apart from startup rules and regulations, there are other regulations which are relevant related to healthcare sector, those are (Table 2).

6 Indian Artificial Intelligence Healthcare Startups

As a dynamic field of modern science, robotics is blessed with both enormous prospects and numerous ethical, social, and legal challenges too. In addressing those challenges, the regulators will have to devise the workable solutions. It is admitted that there is no one-size-fits-all solution. Therefore, the scientist, manufacturers, policymakers, and regulators should work together for striking the balance between the problems and prospects encompassing robotics. Again, the challenges in the field are not against a particular nation or a region, but to the whole world at large, hence, international collaboration and cooperation led by the United Nations are strongly advisable.

6.1 MFine

In the month of February of 2017, Mr. Prasad Kompalli and Mr. Ashutosh Lawania who was the former co-founder of Myntra started an online telemedicine startup,

"MFine". It was started with an intent to provide artificial intelligence-driven, on-demand healthcare services which helps the users to access the virtual consultations and connected care programmers from different hospitals across the country. The platform allows users to look up doctors from top healthcare institutions via video or chat. Unlike others in the space, Mfine partners with leading hospitals rather than aggregating individual doctors on the platform. The product has to start with zero data/information and building the artificial intelligence funnel takes time which was difficult task in order to train the system. They created a "care team" of human beings that acted as an extension of the doctor and his or her team. This, done with artificial intelligence, helps the doctor with summarizations and preliminary investigations [14]. In the amidst COVID-19 pandemic, according to PR News wire, MFine raised $16 m in a new financial round led by Heritas Capital through the participation of Singapore-based family office of Y'S Investment Pte Ltd. The above-mentioned cycle wraps up a solid year for MFine and a company that achieves 10× growth between the clear acquisition of telemedicine and digital life in India by 2020. The COVID-19 epidemic, subsequent closure measures, and the issuance of telemedicine guidelines by the Indian Government have led to widespread adoption of telemedicine in India. A new standard of digital health services including health IDs, health records, Digi Doctor, and health facility register was announced in August 2020 under the National Digital Health Mission (NDHM) to support the global health inclusion of Indian citizens [15].

6.2 Qure.Ai

Founded in 2016, Mumbai-based startup, addresses the need for affordable and accessible diagnostics using deep learning technology. The company claims that its algorithms can detect non-clinical traumatic stress from X-rays, CT scans, and MRIs in a short time that doctors take less than three minutes with 95 percent accuracy. They use in-depth study techniques to diagnose diseases and create automated diagnostic reports from CT scans, X-rays, and MRIs. This helps radiologists to make quick and accurate decisions and provide automatic radiology support to physicians even in rural areas where radiologists are not available. Qure.ai algorithms help physicians and radiology institutions to be more efficient and accurate in their diagnosis. The company claims to have used more than 7 million data sets to train its artificial intelligence (AI) capabilities and verify test results and accuracy in its availability at international institutions such as Stanford University, the Mayo Clinic, and Massachusetts General Hospital ("Qure.ai").

7 Conclusion

It has been concluded that artificial intelligence (AI) has mesmerized the business sector and the startup in medical businesses are on the upsurge in almost all the dimensions of the worldwide economy. The potential opportunities and risks of implementing artificial intelligence systems for healthcare purposes have been given more importance by the outbreak of the COVID-19 virus, which plunged the world into a public health crisis of unprecedented proportions from early 2020. Artificial intelligence (AI) systems could help overburdened health administrations to plan and rationalize resources, and to predict new ailments in body and transmission trends, as well as provide a critical tool in the search for drug treatments or vaccines. However, several challenges have been faced by new startups in the medical sector as highlighted in this paper by the authors. The governments around the world scramble to adopt technological solutions to relieve them contain and mitigate the crisis, questions around the ethics and governance of artificial intelligence (AI) are arising with equal urgency. There are already growing concerns about how the current crisis is going to expand governments' surveillance capacities, as well as accentuating the power and influence of so-called "big tech" companies. These concerns are particularly acute for developing countries such as India where public health infrastructure is already weak. Man-made intelligence can without a doubt carry new efficiencies and quality to medical care results in India. Notwithstanding, holes and difficulties in the medical services area reflect profound established issues around deficient financing, powerless guideline, deficient medical services foundation, and profoundly inserted socio-social rehearses. Therefore, the efforts should be made at government level to remove all the hurdles on the way of development of artificial intelligence (AI) in the medical sector.

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Chapter 25
Analysis of Deep Learning Models for Security in IoT

Ankita, Himanshi Babbar, and Shalli Rani

1 Introduction

IoT "Internet of Things" is defined as an interconnection of the network of various physical objects that enclosed with sensors, software, and many more technologies so that all the devices, objects can exchange data with each other and systems over the Internet. The number of connecting physical devices is kept on increasing as the technology era is growing rapidly. This is the time of being fast and furious. The recent data according to the reports in 2020 about 8.4 billion connected things worldwide. It is expected that by 2022 this number will grow up to 20.4 billion. The present era connects machine to machine known as M2M connections and is expected to grow from 5.6 billion in 2016 to 27 billion in 2024. Various applications that come under machine-to-machine connections are smart environment, smart health, smart metering, smart retail, smart agriculture, smart cities, etc. [1]. In the upcoming future not only the connectivity of the devices with the Internet but can also expect the communication of a device with the other devices on the Internet directly. With this, an important concept namely social IoT (SIoT) is also taking place at the highest rate. SIoT not only enables data exchange among devices but also enables different social networking users connected to the user of the device to share the devices over the Internet [2].

There are various IoT applications such as smart home, smart cities, smart grids and metering, and smart farming; each of these IoT applications needs security as a major parameter as all contain some sensitive or personal information being confidential, and the attacker should not be able to access any of the personal information [1]. IoT is having four layers which are the sensing layer, network layer, middleware

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layer, and application layer. Every layer in IoT is vulnerable to attacks; therefore, the need for security for all the layers is also a major concern to work upon [2].

Many security algorithms can exist, but this paper will introduce the deep learning classifiers that will help in providing security [3]. Some tools and technologies are also required for the implementation of deep learning techniques are also being discussed in the following paper.

Security Critical Application Areas of IoT

In all IoT applications, security and privacy play a major role. The IoT applications are growing at a higher rate and are entering most of the already existing industries. There exist some networking technologies that can be supported by various operators, but most of them need more security and privacy support from the technologies being used by them. Here are some of the applications of IoT being discussed below and refer to Fig. 1.

1. **Smart Cities**: The use of communication resources and also computation resources for leading people to the best overall quality of life is the major requirement for cities to be smart. Further, Smart cities comprise smart homes, well-managed smart traffic, and disaster management, etc. The government is providing incentives and giving its best and also encouraging people to make the cities smarter. No doubt introduction to smart applications improving the

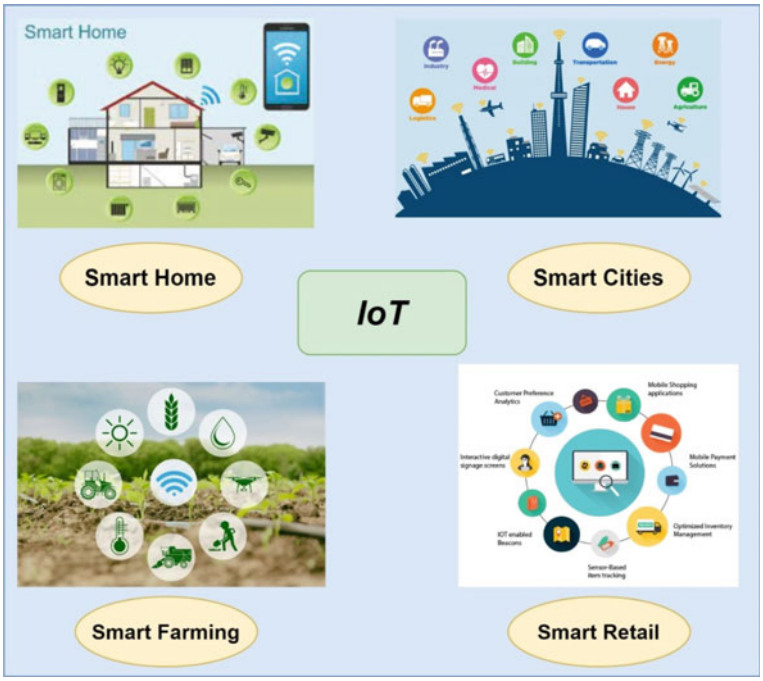

Fig. 1 Applications of IoT

overall quality of life of the people but is also increasing the threat to security and privacy of their sensitive data. For example, when we do online shopping, at the time of the payment using card details, there is a whole risk to the individual's details can be fetched leads to empty the connected bank account [2]. There exists smart mobility that can leak the user's location traces. Also, parents are using some applications to keep track of their children. Attack on such type of application leads to harm to the children's safety.

2. **Smart Metering and Smart Grids**: Three M's are important in the following IoT application that are measurements, monitoring, and management. Smart grids are the most application that comes under smart metering in which the consumption of electricity is being monitored and measured. The problem of electricity theft comes under the following category. Some more applications under this include monitoring of water level, oil level, and gas levels in storage tanks and pipes. As a result, these smart meters are also vulnerable to cyberattacks as well as physical attacks. The attacks on these smart meters affect the load and the cost parameters.
3. **Smart Retail**: The most widely used section in applications of IoT is the smart retail sector. For monitoring the stock of goods available and storage of the goods for keeping the track of goods and products in the warehouses, various applications have been developed. Smart shopping applications are there to assist how many products of the particular stock are there in the stock how many are sold as well as for assisting the customers depending upon the choices and habits. As technology is rapidly increasing, augmented and virtual reality is taking place, resulting in the requirement of strong security and privacy. There are so many companies that compromised the application just to gain benefit and for increasing their sale providing customers with the wrong information [4]. The applications used in this sector must be attack-free; otherwise, all personal details can be stolen; as in this case, use of a debit card is a must. Also, personal information such as phone numbers, emails, and the address of a customer can be at stake.
4. **Smart Agriculture and Animal Farming**: This application comprises of monitoring the moisture of soil, climatic conditions control, humidity, and temperature control. These features in the farming and agriculture field help in the high yielding of crops, and also, farmers can gain financial benefits. The protection of crops, grains, and vegetables by controlling temperature and humidity helps in the prevention of all these from fungal and microbial attacks. Also, climatic conditions affect the quality of the crops. As discussed in crop monitoring for crops, there also exist IoT applications for monitoring farm animals. The health conditions and the amount of food required for the animals can be monitored with the help of sensors attached to the animal's body. These applications must not be vulnerable to attacks as these lead to animal theft and the destruction of the crops.

IoT Layers There are four layers of IoT, namely: (1) sensing layer; (2) network layer; (3) data processing layer; and (4) application layer. Each of these layers of

IoT has its function, and each layer of IoT is vulnerable to attacks [5]. Figure 2 is showing the IoT layers with the types of technologies being used at each layer with the types of devices supporting each layer and the related applications at these four layers of IoT. Also, the following section discusses the various possible security and privacy threats in IoT for each of the four layers.

IoT Layers with all Possible Attacks This section will describe all the possible attacks on each layer refer to Fig. 3.

Security Issues at Sensing Layer The physical IoT has both sensors and actuators that came under this sensing layer. All the physical phenomenon can be sensed with the help of sensors only. Certain actions can be performed with the help of actuators on the physical environment, based on the sensed data obtained from the sensors. For sensing data, variety of sensors exists such as camera sensors, humidity

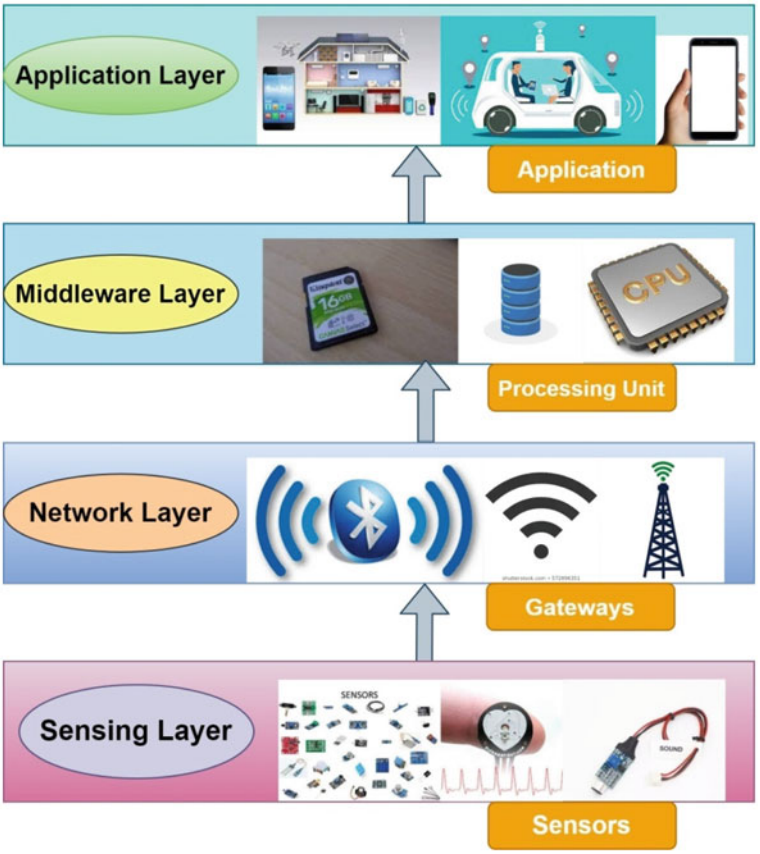

Fig. 2 IoT layers

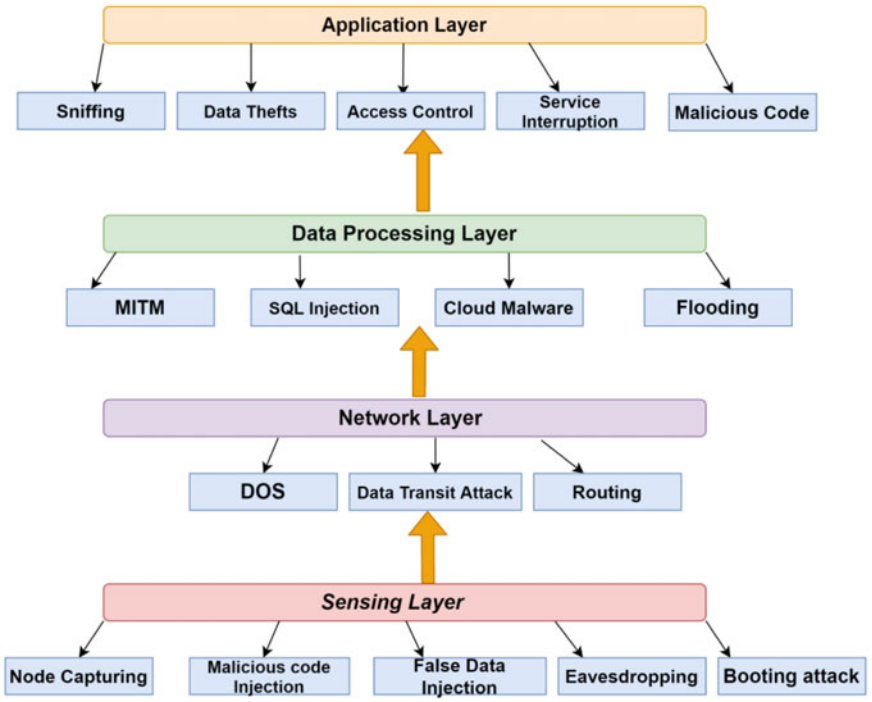

Fig. 3 IoT attacks in all possible layers

sensors, temperature sensors, and smoke sensors also mechanical, electrical, chemical sensors for sensing the physical environment [5]. Different IoT applications like radio frequency identification, global positioning system, wireless sensor networks, and regional service networks can be used by different sensing layer technologies [6]. There exist many security threats that take place at the first sensing layer which are as follows:

Security Issues at Network Layer This layer is mainly used for the transmission of the information being received from the sensing layer and can be sent to the next layer for the processing purpose [7]. The network layer is also vulnerable to attacks; each possible attack on the network layer is DDoS attack, data transit attacks, routing attack.

Security Issues at Data Processing Layer The middleware or data processing layer lies between the network and application layer that is used for computation and storage which gives the application interfaces so that the demands of the application layer can be fulfilled. A reliable and robust IoT application is being provided by the middleware layer and is prone to attacks. The main challenges in this particular layer are cloud and database security [3]. Some of the possible attacks that take place in

this data processing layer are man-in-the-middle attack, SQL injection attack, cloud malware injection, flooding attack cloud.

Security Issues at Application Layer This layer comes after the middleware layer which deals directly and provides services to the users directly. All the applications discussed above come under this layer. This specific layer has some security issues that are not being present in the other layers [8]. As specified above, many applications of IoT contain a sub-layer in between data processing and network layer usually known as the application layer. The following layer supports various business-related activities and helps in the computation and resource allocation. There are various types of security threats or attacks; these systems are vulnerable to data thefts, access control attacks, service interruption attacks, malicious code injection attacks, sniffing attacks, and reprogram attacks.

2 Introduction to Deep Learning Classifiers

There exist three types of learning models for the deep learning approach which are supervised learning, unsupervised learning, and semi-supervised learning. In the supervised learning model, the type of data used for training purposes is labeled fully. Then comes the unsupervised learning approach; the data are not at all labeled, and the architecture is being used to extract the information additionally, finally comes the semi-supervised learning approach which is the combination of both the supervised learning approach as well as the semi-supervised learning approach that is the mixture of both labeled as well as non-labeled data, but this approach is quite hard when the feature extraction comes under the picture. Also, the deep learning architectures have the following two categories and that are discriminative and generative. The supervised learning approaches can be supported by discriminative models, whereas the unsupervised learning models can be supported by the generative models. Following are the different types of deep learning models that can be described as follows and refer to Fig. 4:

1. **Autoencoder (AE)**: These are the types of neural networks in which the coding can be learned in an unsupervised manner. It consists of two layers which are input and output which can be connected to one or more hidden layers. In general, auto-encoders contain the same number of both input and output layers. The main aim of autoencoders is to transform the inputs to outputs keeping in mind the less distortion of the inputs.
2. **Recurrent Neural Network (RNN)**: Deep learning's recurrent neural network is known as the advancement in the feed-forward networks which are used to work on the sequential data. By the name itself recurrent means, the same task can be performed for each element in the sequence, and the output is being dependent on the prior computations.
3. **Restricted Boltzmann Machine (RBM)**: The difficult problems that cannot be solved by other deep learning approaches but can be solved by RBM. It is

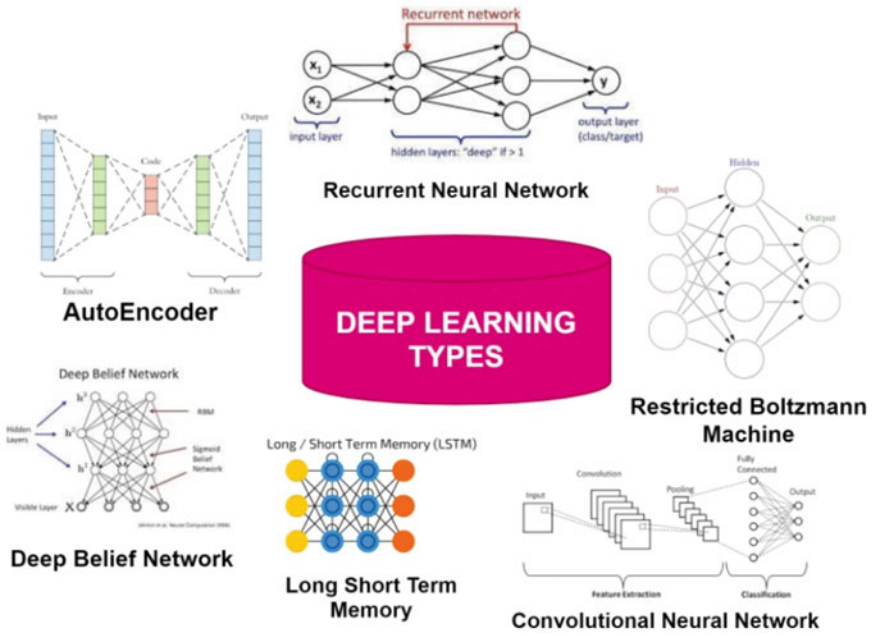

Fig. 4 Types of deep learning models

capable of solving difficult problems. It consists of two layers: learning layer and a testing layer. In the learning phase, a huge amount of input and output is being used to generate RBM which works on a simple rule that maps the input into output is learned. The next phase is the testing phase; for the new inputs of RBM, the desired outputs can be obtained persisting the learning phase.

4. **Deep Belief Network (DBN)**: This deep learning classifier consists of the multiple layers of the hidden units in which connection exists only in between the layers but not with the hidden unit of the layer. The inputs in DBNs are reconstructed probably when they are trained with the samples in the unsupervised learning approach. But additionally, a DBN can further be trained on the post-learning phase with the supervised learning approach for solving the classification problem.
5. **Long Short-Term Memory (LSTM)**: This comes under the recurrent neural networks which consist of special units that are also known as memory cells having self-dependent connections that can be used to store the sequence of information. In addition to this, it also has special multiplicative units usually known as gates through which the flow of information can be controlled [9]. Each memory block comprises two gates, namely the input gate and output gate. The input gate takes the responsibility for input activations inside the memory cell, and the output layer takes the responsibility for the flow of activations into the rest of the remaining network.

6. **Convolutional Neural Network (CNN)**: The CNN is comprised of the locally made connections that share the weight with the pooling capabilities sharing two layers, namely one is the pooling layer, and the other one is the fully connected layer. The local connections discussed above along with the weight sharing that makes the model discover the visual patterns by adjusting some of the parameters [10]. It also incorporates the backpropagation for learning of the simple units.

3 Security with Deep Learning in IoT

As discussed, there are many applications in IoT apart from security and privacy which plays a major role. The IoT is comprised of four layers that are prone to attacks. Therefore, in the following section, the deep learning classifiers about security are described and how these classifiers helps in providing security are described below:

1. **CNN**: The survey [10] came up with malware detection for android systems using CNN-based deep learning approach. By eliminating the manual feature extraction that took place in machine learning, with the application of deep learning classifier CNN, it is easy to automatically learn related features of malware detection from the raw data [10]. The basic thing of applying CNN is that a network would be able to learn the required features and classification execution collectively thus removing the main consideration of the feature extraction process in machine learning. The survey [11] shows how a CNN can work on security and can be able to break cryptographic implementations successfully.
2. **RNN**: There are several deep learning classifiers such as recurrent neural networks and the other variants that would be proved successful in sequential applications such as speech recognition and translation [12]. RNNs are also proved successful in providing security in many IoT applications. There exist many IoT applications that generate a huge amount of data in sequential mode came from various sources such as the traffic coming from the network; this is the main feature for the detection of several network attacks. The survey [13] best describes how much RNN is feasible in determining the network traffic behavior so that potential attacks can be determined and also can be used to see how accurate the RNN for detecting the malicious behavior. Therefore, the conclusion is that the RNN network can be able to provide practical solutions to real-world problems. As a result, this area needs more exploration for more improved results in the field of security specifically for the time-based sequence threats.
3. **Autoencoders**: Also, for malware detection in [13], the use of autoencoder was described. Then, the design of autoencoders in such a way that it would be able to learn the representation of a feature set. For example, for cyber-systems, the autoencoders were trained on the feature vector only. In the survey [13], the autoencoders gained successful results as compared to the classical

machine learning approaches such as support vector machines and k-nearest neighbor [14]. The combination of autoencoders with the deep belief networks in the survey [14] to build a malware detection method and a mixture of both used nonlinear mapping for the extraction of relevant features only for data dimensionality reduction. Conclusively, data belief networks algorithms were trained in such a way that they could be able to detect malicious or infected behavior.

4. **Deep Belief Networks**: Another deep learning classifier can be used in the successful detection of malicious attack detection. A study [15] came up with security in mobile edge computing with the application of this particular network for malicious detection of attacks. Also, for automatic extraction of significant features, use of DBN is proposed, and as compared to the existing machine learning algorithms, this classifier being able to provide accurate results [15]. This classifier shows that deep learning is superior and specially DBNs as compared to machine learnings manual feature extraction for detection of malware. As discussed in the survey [14], combination of DBN with AE being used for malware detection.
5. **Generative Adversarial Networks**: This approach also proved to be best in providing security as these networks can be able to learn the scenarios of different types of attacks for generation of similar samples same as that of zero-day attacks and provides the set of samples for much more security [16].

4 Conclusion

In the following IoT with its application areas, IoT layers with all the possible attacks on its possible layers are being discussed. How deep learning can overcome those attacks with some of the possible tools and technologies, and finally, we concluded the deep learning models are also vulnerable to various threats to decrease the classifier's accuracy and performance, or at the time of training, datasets-sensitive data can also be leaked. Therefore, deep learning models are vulnerable to attacks like poisoning, evasion, and impersonation.

1. **Impersonation attack** The original samples being changed by the attacker with the infected ones to imitate the data samples so that the performance of deep learning algorithms can be reduced.
2. **Evasion attack** This is the type of attack in which modification of attack features takes place based on adversarial samples which makes the detection difficult results in the performance reduction [5].
3. **Poisoning attack** In this type of attack, malicious data are injected along with the wrong labels attached in the training dataset by an attacker; as a result, the original data being modified so that the deep learning classifier would not be able to distinguish between the original and the abnormal behavior which leads to high consumption of power and also affects the accuracy.

4. **Inversion attack** The exploitation of any application by integrating deep learnings pretraining-sensitive information and this data can be possibly obtained by a process known as reverse engineering. This attack is dangerous in any field, especially in the healthcare domain as the records contain confidential and personal information with all the important health details. If the attack on the healthcare network, the patient's life will be at stake. No doubt that deep learning gained a lot of success, but still, an efficient and secure deep neural network is yet to be built. To achieve high performance, the utilization of resources like energy consumption is likely to be reduced. This requires the memory and time having an unknown number of desired layers that facilitates a sophisticated but lightweight deep learning model for resource-constrained systems, but still, a secure lightweight deep learning model has to be established which is the further area of investigation.

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Chapter 26
Adobe Photoshop Vulnerabilities

Kanishca Goyal, Kopal Chaturvedi, and Mehak Khurana

1 Introduction

Software is a basic part of system or devices that is needed in our everyday life. Software can be developed by programmers as they are usually very complex. Usually, programmers make mistakes in the code which could generate software vulnerabilities, and it is known that human errors are the main reason for any software vulnerability that occurs. Any flaw or defect during the design phase of any software is known as a software vulnerability; this might allow any attacker to get privileges in a system, which can allow a potential entry as well. Even after the advancements of securing a software, several vulnerabilities are still seen. In the design and production of a software, the presence of vulnerabilities makes it necessary to have tools that can help programmers and developers to avoid or detect them while developing the code. Thus, concerning our ongoing research on vulnerability detection, here, Adobe Photoshop vulnerabilities have been evaluated. Adobe Photoshop is not a designing software but an image editing software. Adobe provides a good deal of software which help in designing like Adobe Illustrator, Image Ready, and Adobe InDesign. Photoshop can perform tasks such as treating an image, handling, blending, transforming, and printing. Photoshop works with different file formats. Following categorization, the vulnerability data are provided for data preprocession, which includes managing missing values and removing noisy data, as well as classification using various supervised machine learning algorithms. Following that, classification

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models are examined for three security criteria known as the CIA Triad: integrity, confidentiality, and availability. All the classifiers reach the greatest level of integrity and accuracy. This study report provides an overview of Adobe Photoshop's software development life cycle as well as software vulnerabilities and their consequences.

1.1 SDLC and Its Phases

The classification of software vulnerabilities provides with security-related information, which aids in the investigation of existing flaws. The process for building mitigation solutions for clustered vulnerabilities that may be limited by a lack of appropriate classification is explained and shown. As a result, software developers and academics have realized that incorporating security into all phases of software engineering, including requirement and design, is the most effective strategy to get maximum benefits. The steps of the SDLC start with gathering and analyzing the software's security requirements, then design, and finally implementation. Following that, risk-based security is implemented during testing, and the product is then maintained indefinitely.

2 Literature Survey

Photoshop is a digital image editor and compositing software, which is used for image manipulation, digital photography, graphic design, and Web design. It is a stand-alone application, a native macOS app, and runs on macOS, Windows, and Linux. Photoshop started as a stand-alone application, but it has become part of the Adobe Creative Suite since version 7.

Photoshop is a graphical tool for editing digital photographs and other images. It is the most popular image editing software used by professional photographers and graphic designers. Adobe Photoshop has won many awards and is considered by many to be the most powerful and versatile image editing software available.

Memory corruption was one of Adobe Photoshop's key vulnerabilities, which is a significant flaw. An attacker can exploit this vulnerability by running arbitrary code in the context of the program, generally with the application's privileges. The most prevalent sort of software vulnerability is this one. Buffer overflow and out of bounds (both read and write) are also possible. Throughout the article, all the vulnerabilities and their remedies are extensively described.

Research in [1] was done by the FortiGuard Labs and was published on August 16, 2019. In the past, they had reported numerous zero-day vulnerabilities which

were critical in Adobe Photoshop. These vulnerabilities were CVE-2019-7990, CVE-2019-7991, CVE-2019-7992, CVE-2019-7993, and lots more. The basic vulnerabilities were memory corruption and heap overflow. The mitigation for these vulnerabilities was performed when the Fortinet IPS signature was released to protect the customers from these vulnerabilities.

In research [2], Trend Micro found a critical remote code execution vulnerability advised on February 15, 2011. Simply, there are many vulnerabilities related to buffer overflow in Adobe Photoshop that allowed attackers to attack and run any random code via (1) ASL (2) ABR files.

This article [3] by Lindsey O'Donnell, August 13, 2019, explained 22 critical flaws patched in Adobe Photoshop. The major flaws were the heap overflow, a flaw enabling information leakage and a privilege escalation vulnerability in the Creative Cloud desktop application. A serious authentication bypass vulnerability was determined by Adobe Experience Manager. As the article came into view, all the major and minor vulnerabilities were patched by Adobe Photoshop.

On January 12, 2021, major patches were resolved by Adobe Photoshop. In this research [4] by the Qualys, it was found that the major vulnerability was heap-based buffer overflow, which affected the execution of any arbitrary code. The version 22.1 and earlier versions were affected on both Windows and macOS platforms. The company updated the version to 22.1.1 and patched all the vulnerabilities.

Research [5] done on 12.01.21 by the cisecurity.org research team discovered a buffer overflow vulnerability. Successful exploitation for this buffer overflow can allow for execution of arbitrary code. The latest version of Adobe Photoshop 21 and the versions before 22.1 were affected. The principle of least privilege was applied to all systems and services to mitigate the vulnerability.

A critical vulnerability was found in Adobe Photoshop in 2019 [6] by VULDB on March 26, 2020. A manipulation with an unknown input led to memory corruption vulnerability and was classified as CWE-119. The versions 20.0.8, 21.1, and other earlier versions were affected. Patching tried for mitigation.

Securityaffairs.co Web site released an article [7] on ten critical security vulnerabilities that were fixed by Adobe Photoshop on April 21, 2021. These vulnerabilities included buffer overflow, out-of-bounds reads and write, and memory corruption as well. Photoshop 2020 version 21.2.6 and earlier and Photoshop 2021 version 22.3 and earlier were affected on both Windows and macOS.

In early April 2021, bleepingcompurter.com published an article [8] describing how seven major vulnerabilities in Adobe Photoshop affected four sub-products, allowing arbitrary file writes, or arbitrary code execution. These code execution flaws are the most dangerous, as they might allow attackers to run any command in the operating system, including malware installation.

ZDNet published an article [9] on 13 major vulnerabilities that Adobe Photoshop patched on July 22, 2020. Out-of-bound reads and writes vulnerabilities were discovered in Photoshop 2019 versions 20.0.9 and older, as well as Photoshop 2020 versions 21.2 and prior. For mitigating these vulnerabilities, an emergency patching was carried out. Adobe fixed around 41 security vulnerabilities, which included 21 critical ones in its major products. Five of them was in Adobe Photoshop as researched

by secpod.com in their article [10] published on June 15, 2021. These flaws affected both Windows and macOS. They were termed critical for their CVEs being APSB21-38, CVE-2021-28,624, CVE-2021-28,582, APSB21-46, and CVE-2021-28,597. The impact of these was privilege escalation and arbitrary code execution.

3 Adobe Vulnerabilities

Various vulnerabilities have affected Adobe Photoshop and have caused various snags. This section showcases the few crucial software vulnerabilities and their effects.

3.1 Types of Vulnerabilities

A piece of brief information about the vulnerabilities that have been observed in Adobe Photoshop are discussed in this section. These vulnerabilities can cause major problems for the user, and the organizations, and thus, are required to be studied and mitigated**.**

Buffer Overflow. A buffer overflow is a sort of coding mistake in software that can quickly lead to an attack. To put it another way, a buffer overflow is the equivalent of putting 12 L of water into an 8-L jar. The buffer's bounds are exceeded because of the overflow, and neighboring memory regions are overwritten. Buffer overflows can be leveraged by attackers in a Web application to corrupt the execution stack. In a Web application, to corrupt the execution stack, attackers can use buffer overflows. An attacker can acquire control of a system by giving correctly crafted data to a Web application, causing it to run arbitrary code.

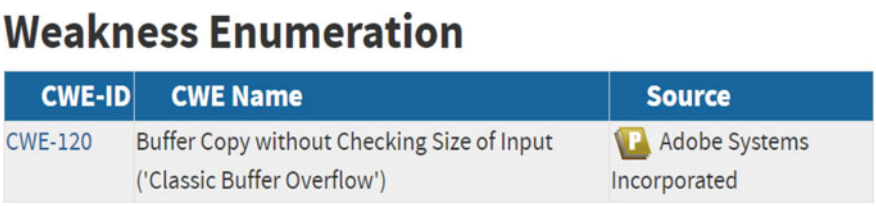
Memory Corruption. In a computer program, memory corruption occurs when the contents of a memory location are changed because of programmatic behaviors which differ from the actual intentions of the programmer or program. This is the easiest way to violate the safety of the memory by the attacker.

Out Of Bound (Read). In an out-of-bound (read) vulnerability, the program reads data from outside the bounds of the allocated memory. This results in overwriting of the information on the call stack, making the code more accessible to the attacker.

Out Of Bound (Write). The software writes data before the beginning of the code or past the end of the intended buffer. This makes the attacker easily swipe in the code as the out-of-bound vulnerability results in a crash of code execution or corruption of data.

3.2 Impact of Vulnerabilities on Software

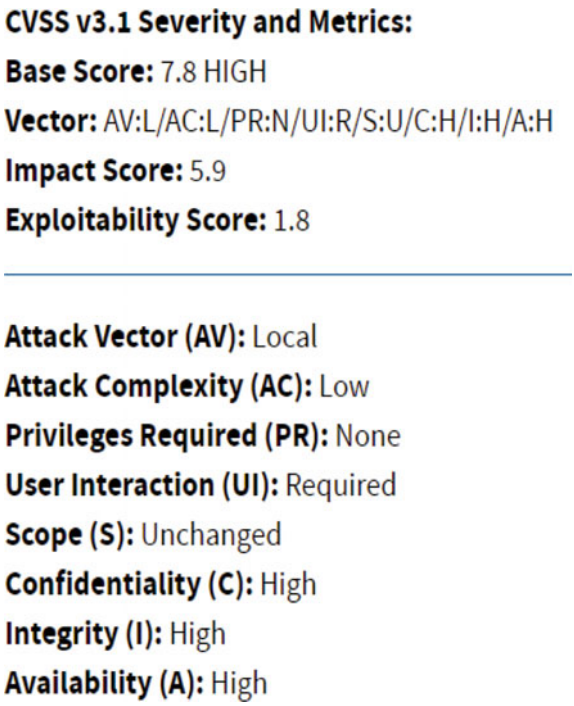
Buffer Overflow (CVE-2021-21,051). When parsing a specially designed JavaScript file, Adobe Photoshop versions 21.2.4 (and before) and 22.1.1 (and earlier) are vulnerable to a buffer overflow vulnerability. This vulnerability could be exploited by an unauthenticated attacker to execute arbitrary code in the current user. This vulnerability necessitates user input, as a victim must open a malicious file. In Fig. 1 [11], the weakness enumeration for buffer overflow for Adobe Photoshop is presented. Figure 2 [11] demonstrates the severity of the vulnerability is quite high as the base score is 7.8, while Fig. 3 [11] portrays the graph for the severity score of the vulnerability.



Weakness Enumeration

CWE-ID	CWE Name	Source
CWE-120	Buffer Copy without Checking Size of Input ('Classic Buffer Overflow')	Adobe Systems Incorporated

Fig. 1 Weakness enumeration for buffer overflow



CVSS v3.1 Severity and Metrics:

Base Score: 7.8 HIGH

Vector: AV:L/AC:L/PR:N/UI:R/S:U/C:H/I:H/A:H

Impact Score: 5.9

Exploitability Score: 1.8

Attack Vector (AV): Local

Attack Complexity (AC): Low

Privileges Required (PR): None

User Interaction (UI): Required

Scope (S): Unchanged

Confidentiality (C): High

Integrity (I): High

Availability (A): High

Fig. 2 CVSS score for buffer overflow

Fig. 3 Graph for the severity score

Weakness Enumeration

CWE-ID	CWE Name	Source
CWE-125	Out-of-bounds Read	Adobe Systems Incorporated

Fig. 4 Weakness enumeration for out of bound

Out-Of-Bounds Reads Vulnerabilities (CVE-2021-21,050). Out-of-bounds issues also impact Adobe Photoshop versions 21.2.4 (and older) and 22.1.1 (and before). When processing a carefully constructed file, there is a read vulnerability. This vulnerability might be used by an unauthenticated attacker to execute arbitrary code in the context of the current user. Exploiting this flaw also necessitates user engagement. In Fig. 4, National Vulnerability Database [12] presents the weakness enumeration for out of bound in Adobe Photoshop. Figure 5 [12] showcases that the severity of the vulnerability is quite high as the base score is 7.8, while Fig. 6 [12] portrays the severity score of the vulnerability.

Memory Corruption (CVE-2021-21,048). When processing a carefully constructed file, Adobe Photoshop versions 21.2.4 (and prior) and 22.1.1 (and earlier) were later impacted by a vulnerability known as memory corruption. This vulnerability might be exploited by an unauthenticated attacker for the execution of arbitrary code in the current user. The exploitation necessitated the involvement of the user. In Fig. 7 [13], the weakness enumeration for memory corruption in Adobe Photoshop can be observed. In Fig. 8 [13], that the severity of the vulnerability is quite high as the base score is 7.8, while Fig. 9 [13] portrays the graph for the severity score of the vulnerability. Figure 10 [14] shows the vulnerability distribution for memory corruption.

CVSS v3.1 Severity and Metrics:

Base Score: 7.8 HIGH

Vector: AV:L/AC:L/PR:N/UI:R/S:U/C:H/I:H/A:H

Impact Score: 5.9

Exploitability Score: 1.8

Attack Vector (AV): Local

Attack Complexity (AC): Low

Privileges Required (PR): None

User Interaction (UI): Required

Scope (S): Unchanged

Confidentiality (C): High

Integrity (I): High

Availability (A): High

Fig. 5 CVSS score for out of bound

Fig. 6 Graph for the severity score

Weakness Enumeration

CWE-ID	CWE Name	Source
CWE-788	Access of Memory Location After End of Buffer	Adobe Systems Incorporated

Fig. 7 Weakness enumeration for memory corruption

Fig. 8 CVSS score for memory corruption

CVSS v3.1 Severity and Metrics:

Base Score: 7.8 HIGH

Vector: AV:L/AC:L/PR:N/UI:R/S:U/C:H/I:H/A:H

Impact Score: 5.9

Exploitability Score: 1.8

Attack Vector (AV): Local

Attack Complexity (AC): Low

Privileges Required (PR): None

User Interaction (UI): Required

Scope (S): Unchanged

Confidentiality (C): High

Integrity (I): High

Availability (A): High

Fig. 9 Graph for the severity score

3.3 Severity of Vulnerabilities

Through Figs. 11 [11], 12 [12], and 13 [13] showcase the differences between the impact of these vulnerabilities caused on Adobe Photoshop. This shows the differences between the CVSS severity score and information about the CIA triad. Figure 11 [11] represents the buffer overflow; Fig. 12 [12] represents the out of

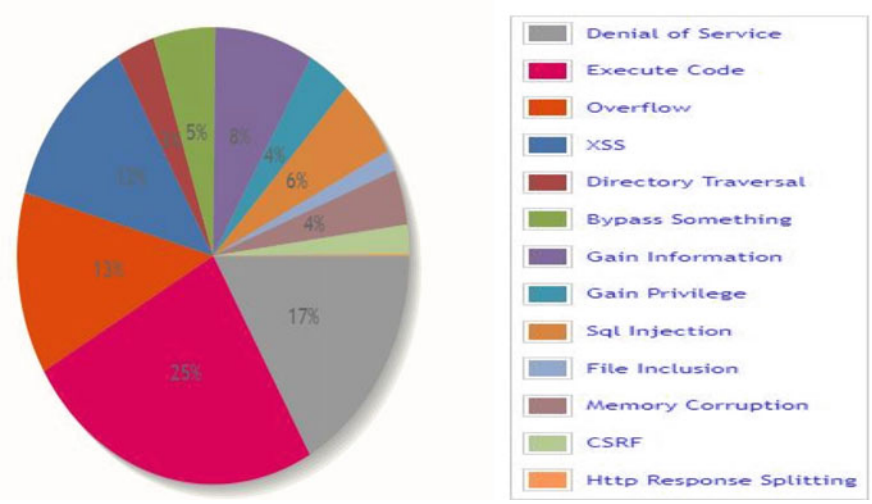


Fig. 10 Vulnerability distribution

Fig. 11 Buffer overflow

CVSS v3.1 Severity and Metrics:
Base Score: 7.8 HIGH
Vector: AV:L/AC:L/PR:N/UI:R/S:U/C:H/I:H/A:H
Impact Score: 5.9
Exploitability Score: 1.8

Attack Vector (AV): Local
Attack Complexity (AC): Low
Privileges Required (PR): None
User Interaction (UI): Required
Scope (S): Unchanged
Confidentiality (C): High
Integrity (I): High
Availability (A): High

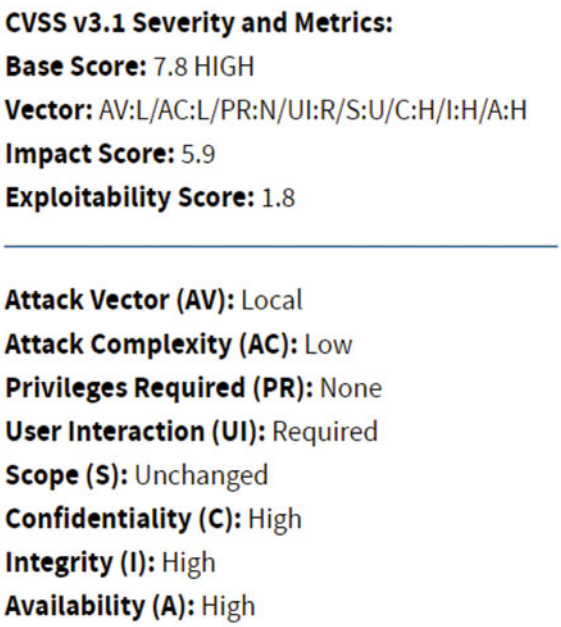


Fig. 12 Out of bounds

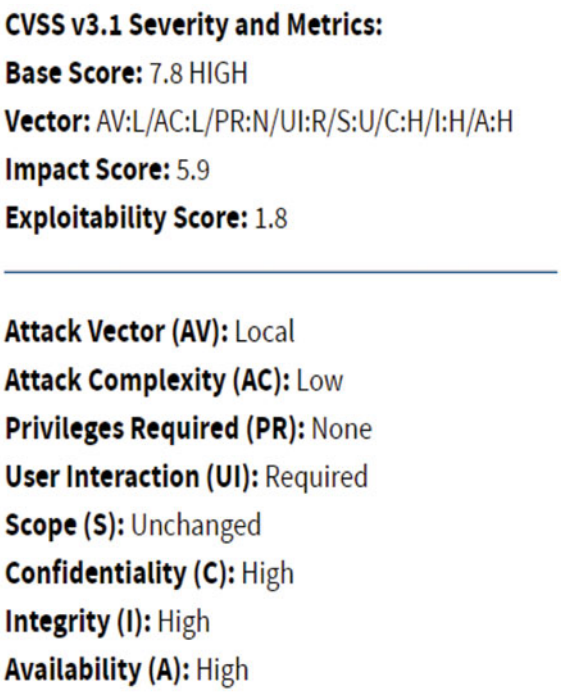


Fig. 13 Memory corruption

bound, whereas Fig. 13 [13] represents the memory corruption occurring in Adobe Photoshop.

4 Adobe Vulnerabilities Until 2021

Figure 14 [14] presents all the vulnerabilities that have occurred till date in Adobe Photoshop. There were 26,469 denial of service, 39,087 execution code errors, 20,306 buffer overflow, 6148 memory corruption vulnerabilities, 19,647 XSS errors, 4985 directory traversals, 8021 bypass errors, 12,848 information gain, 5542 gain privilege errors, 8807 SQL injection, 2312 file inclusion, 3269 CSRF, and 188 HTTP response splitting errors.

In Fig. 15 [15], the number of vulnerabilities that occurred in Adobe Photoshop from 1999 to 2021 can be visualized. It is observed that the year 2020 had the soaring number of vulnerabilities with 18,325, whereas the year 1999 had the lowest with just 894.

4.1 Mitigation of the Vulnerability

The Adobe team takes all considerations of security seriously, and because of their diligence, Adobe remains one of the most secure software companies in the world. Their security team is dedicated to the protection of their customers, as well as the protection of their employees, customers, and the public at large. The team's focus is to protect the network topology and architecture, as well as the applications that run within it, and is working with leading third-party security firms to perform

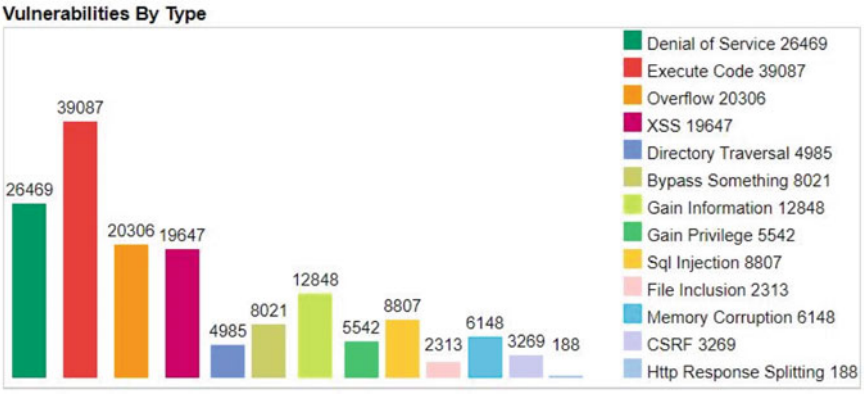


Fig. 14 Types of vulnerability

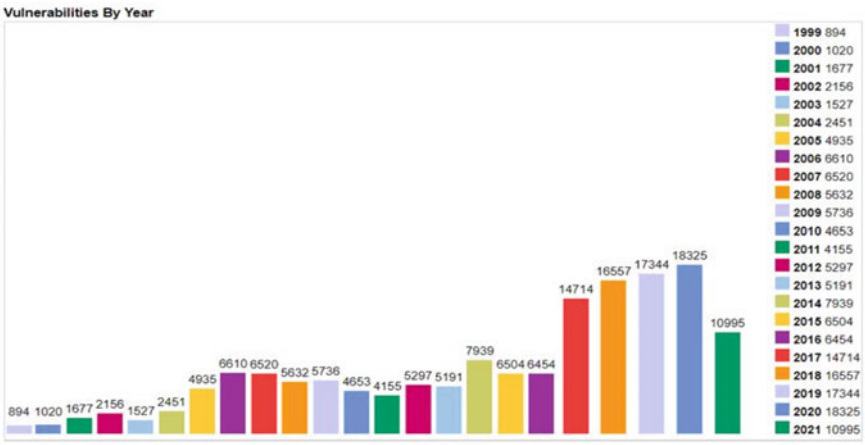


Fig. 15 Vulnerabilities by type

vulnerability assessment and pen-testing that can reveal security vulnerabilities and help in improving the overall security of Adobe products and services.

All security modifications are also recorded in a Security Change Request (SCR), and the risk associated with the change is recognized. Before going into production, this guarantees that the modification has been thoroughly evaluated and tested. Before each release, Adobe Photoshop collaborates with product development, and technical operations lead to guarantee that any higher-risk vulnerabilities are addressed. This comprises doing different functional and non-functional tests on the application.

Adobe Photoshop versions 20.0.8, 21.1 and older were impacted by a serious vulnerability discovered in 2019. To mitigate, patching was done. Out-of-bound read and write vulnerabilities in Photoshop 2019 versions 20.0.9 and earlier, as well as Photoshop 2020 versions 21.2 and older, were discovered on July 22, 2020. For the mitigation of these vulnerabilities, an emergency patching was applied to it. After a few months, important fixes were discovered, and the firm upgraded the version to 22.1.1 and fixed all the vulnerabilities. Information on Adobe Photoshop vulnerabilities and mitigations, as well as reactive security measures, may be found in [18].

5 Result and Conclusion

The authors of this study looked at the National Vulnerability Database's list of various Adobe Photoshop vulnerabilities. The classification findings are assessed based on three criteria: integrity, availability, and secrecy, allowing software developers to build in a secure manner. In 2021, the Adobe software version 20.0.9 was patched to offer customers with safe software. Vulnerabilities discovered in our

analysis are categorized as the vulnerabilities which were discovered in the software that were exploitable and can be used by an attacker. These vulnerabilities may be exploited by attackers if a flaw allows the attacker to alter the structure of the system. Every vulnerability was reported in the vulnerability database and patched in latest version. But if, user has not updated to the latest version, this can lead to exploitation by the attacker. It can be concluded that software vulnerabilities are a big boon toward software development, but on the same hand, with advancements in technology can't be avoided. Thus, it is one of the major topics to expand knowledge and improve so that it can be helpful for every user today and in the future.

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Chapter 27
Digital Information Management in Agriculture—Empirical Analysis

C. Ganeshkumar and Arokiaraj David

1 Introduction

Agriculture is the major source and is considered as a backbone of the Indian Economy. We feed the entire nation and also create employment opportunities. India is exported to more than 101 countries, mostly in SAARC, especially the United States, Southeast Asia, European Union, and the Middle East. But they are a lot of difficulties and challenges faced by the Indian farmers. The global population is projected to expand to more than 9.7 billion in 2050, so there was a huge demand for food in near future [1, 2]. Therefore, we need to increase the food production capacity as well [3]. The agricultural production is not enough to feed the entire world. There are more than 821 million people who suffer from hunger. Due to population growth and urbanization, the food consumption exceeds the limit. Food and agriculture production accounts for 30% of the total global workforce and there are more than 570 million smallholder farms and family farming across the globe [4]. There was a goal by 2030 'world with zero hunger' which required a more sustainable, inclusive, transparent, efficient, and resilient food system. It requires a transformation of the current agri-food system. Digitalization innovation in agriculture and technologies is the only way to improve agricultural productivity [3].

Industry 4.0 (fourth industrial revolution) is defined as the cross-cutting impact of information and communication technologies, especially the Internet of things (IoT) in various industrial sectors translates into a phenomenon 'agriculture' is the pillar for the gross domestic product [2]. It is not only giving direct economic benefits but also facilitates better farmer lives too [5]. The role of technologies such as IoT,

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AI, BCT, playing a superior role across all sectors like IT, aviation, automobiles, robotics, food, pharma, industry, and even had a major impact on the agricultural sector also [6].

There are a lot of challenges and difficulties when implementing these technologies in agriculture. In developing countries like India, farmers have to spend huge investments to adopt these technologies. To facilitate effective agricultural planning and development, it requires to design and development of agricultural resources information systems like data warehousing (databases and model bases), application of remote sensing data, networking (Internet, intranet, and extranet), multi-media information system, decision technology system, digital library/virtual library geographical information system, E-commerce and E-governance, and expert systems and knowledge bases [7].

Drone

A drone is a tool used in farms that helps in scanning the field, monitoring the crop, seeding, and analyzing the health of plants. Field Sensors: Field sensors are capable of providing farmers scientific information about the yield of crops, pests, rainfall, soil nutrition, and others.

Internet of Things

Through monitor sensors, remotely detect the crop's growth, soil moisture, and livestock feed levels. These sensors are started adopted by the Indian farmers in agriculture. But still, most of them are following traditional methods of farming. Agriculture production contributes 18% to Indian GDP which was employed by 50% of the Indian population. The US, Europe, and China yield per acre are higher than Indian yield per acre. Whilst increasing usage of smartphones and the Internet help agri-tech companies to reach out to the people easily. The Indian Government has planned to increase the farmers' income and by implementing advanced technology which focuses on the supply chain and reduces food wastage and food production [8].

IoT-big data, smart machine, E-commerce, precision farming, fintech platform, and farming-as-a-service are used to address the above issues. Smart machines provide remotely operated machines with greater precision [9]. The Internet plays a major role in the transfer of high-tech agriculture technologies from the global arena to the farmer's field [10]. For developing countries, the use of the Internet in farm decision making is much less. Only 12% of farmers use this technology, and the majority of them use traditional technologies like radio (77.3%) and newspapers (11.3%). Agricultural extension agencies must make farmers aware of the use of the Internet in technology transfer. This can help farmers keep pace with rapidly changing agricultural technologies [11]. The objective of the study is to understand the adoption of digitalization by farmers in agriculture and identify the awareness level and perception of farmers toward digitalization.

2 Literature Review

The review of the literature has discussed the role of digitalization in the agricultural sector. Apart from the agricultural sector, most of the industries have adopted these technologies like blockchain (BCT), Internet of things (IoT), artificial intelligence (AI), immerse reality, remote sensing, services sensors, wireless technology, and others to improve their production capacity. In terms of agriculture, there are a lot of benefits with these innovations like providing data on plant health and also taking care of the soil and saving plenty of water [12, 13]. Water for agriculture is the primary and essential part of farming [14]. Nowadays, with the help of the latest technologies and also in agroindustry, the growth and development of plants reach the next level. These technologies have been started used in most agricultural farming and provided a lot of benefits to the farmers such as monitoring, communicating, and collecting data about the farm activity. It provides clear information about what to do, when to do it, and how to do farming, based on this information's and farmers grow healthy farming [14].

For example, these technologies were adopted in the production of tea. Especially for tea processing will be visualized through computer and its technologies [15] and also find out the quality of leave and thickness, and colour index. The quality placed a crucial role, and it depends upon the colour, aroma, and taste of the tea. Based on the computer sensor technology, the colour of the leave, raw tea information was sent to further processing, and it is separated based on the information. Conventionally, it was done by humans on the field. But, nowadays with the help of AI and sensor-based tools, the production of agriculture reaches the next level in terms of efficiency and effectiveness [16]. They have been estimated colour index by using OTSU methods. The quality not only depends on their leaves but also the grading system of flushes. For the good quality of tea, it also depends on the central part of the buds and the big size of leaves. At present, in most tea farming, the farmers are manually picking the tea leaves. This traditional way of agricultural farming increases the labour cost. So, there is a requirement for the farmers to shift toward automation.

The utilization of robotics in the agricultural sector has increased in the last two decades to overcome challenges and obstacles in the field. First, the automation of agriculture like greenhouse farming, precision farming, and tasks follow-ups like environmental monitoring, planting and harvesting, and crop treatment. Second, it analyzes and compiles the data that the robot has proposed to do. For example, aerial robots collect data such as presences of clouds, long data delivery time, and many more [17]. The aerial robot in precision farming can also monitor the crop to predict yield, other things like it can monitor leaf area index too [18]. Additionally, it gives more details about the robot team about to check up the crop and also outdoor agriculture, greenhouse farming, and environmental checkup [19].

The framework of digital agriculture is compiled on real-time information collecting system, digitized agricultural machinery (DAM), and digital network transmission system central processing system (CPS) have discussed the demand for agricultural modernization, the demand of building Digital Earth, the demand of

resources and information sharing, and basic strategies to develop digital agriculture [20, 21]. Agricultural technology is more adaptable and affordable for smallholder farmers to overcome economic problems and farming issues. The farmers who depend on agriculture can gain income and livelihood security [22].

3 Research Methodology and Analysis of Data

This research was conducted at the Nashik district of Maharashtra with the help of a questionnaire. A structured questionnaire was designed for the respondents. The farmers were selected as respondents, and most of the responses were collected from the local villagers. The primary data were gathered from 31 respondents through a random sampling. The questionnaire focuses on awareness level, and perception toward the adoption of digitalization in their farming and also understand the farmers' difficulties and challenges to adopt digitalization in agriculture.

The demographic profile of farmers is given in Table 1. Based on the survey, it is found that 81% of farmers are male, and most of them are aged in-between 31–40 years old. Most of the farmers have completed SSLC (29%). Almost 49% of farmers are adopting digitization and technologies in agriculture, and most of the farmers are also prepared to adopt modern technologies in agricultural production (48%). It is found that 52% of farmers have implemented automatic watering and irrigation and they got awareness about digitization through social media (32%), word of mouth (25%), and TV (20%). The operating difficulties and challenges were addressed by the technical expert (41%).

The chi-square test was conducted to find out the association between the adoption level of digitalization in agriculture. Based on Table 2, it is found that digital farming equipment and the use of the android application are statistically associated with digitalized agriculture, whereas the level of education, the awareness level of farmers, and operating guidance are not statistically associated with the adoption of digitalization in agriculture.

4 Conclusion and Implications

The majority of the respondents 81% are male and only 19% are female. Majority of the respondents we have collected data from this 48% are between 30–40 Age, 29% are 40–50 age, 16% are between 20–30 age, and 7% are above 50 Age. 32% respondents from social media, 25% from agriculture exhibition, 20% from TV shows or advertisement, and 16% of the respondent from word of mouth got awareness and information about digitalization in agriculture. From the study, it is shown that 9% of respondents use field sensors, 23% use automatic irrigation systems, 16% use other digital equipments, and 52% are not using any of this equipment on the farm. 41%

Table 1 The demographic profile of farmers

Factor	Category of groups	% of respondents
Gender	Male	81
	Female	19
Age	Below 20–30	16
	31–40	48
	41–50	29
	Above 51	7
Level of education	Uneducated	16
	Below SSLC	16
	SSLC	29
	PUC/12 standard	7
	Degree/UG	16
	PG	16
Level of digitalization adoption in agriculture	Yes	49
	Maybe in the future	48
	No	3
Digital farming equipments	Field sensors	9
	Automatic watering and irrigation	23
	Other digital equipments	16
	None	52
Source of awareness	Social media	32
	Exhibition	16
	TV	20
	Word of mouth	25
	Radio	7
Operating equipment guidance	Technical expert	41
	Social media	23
	Neighbours	11
	Others	25

of farmers trained or learn by from technical expert, 25 others like relative, shops, 23% by social media, and 11% by neighbour.

From the analysis, we find that there is no significant association between education and adoption of digitalization in agriculture hence education affect the adoption of digitalization. From the analysis, it found that there is no significant association between 'use of Android application and adaptation of digitalization hence android application does not affect the adoption of digitalization'. Around 40% of respondents said that digitalization in agriculture will help in doing precision farming,

Table 2 Chi-square analysis for level of digitalization adoption in agriculture

Variables	Chi-square value	*P*-value	Level of significant
Level of education	8.769	0.782	Not significant
Use of Android application	34.76	0.047	Significant
Digital farming equipments	28.04	0.039	Significant
Source of awareness	1.573	0.624	Not significant
Operating equipment guidance	2.674	0.851	Not significant

whilst 45% in smart farming followed by 15% efficient use of input. Digital transformation is polishing almost all the sectors like automobile, airlines, supply chain logistics, information technology, telecommunication, processing, and others [23]. Farmers need to implement these technologies in their agricultural process to increase production as well as minimize the cost. The Government of India (GoI) must create awareness amongst the farmers about the role of technologies and their benefits to farming. Farmers have to need to adopt new technologies in agriculture to order to increase efficient and effective food production. It will help in adopting smart farming, precision farming, and sustainability.

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Chapter 28
Power of Predictive Intelligence for Service Desk

Sonali Vyas and Abhimanyu Vyas

1 Introduction

ServiceNow is formulated on ITIL framework and is cloud-based software platform. ServiceNow is highly being used in IT and manufacturing industries nowadays. The customer satisfaction is always be on priority for any organization. To accomplish that service desk agents are the key factor for the organizations to achieve that [1]. The predictive intelligence is the framework ServiceNow provides, through which the large number of customer requests and issues can be managed and solved more efficiently. This also increases the customer satisfaction and enhances the productivity for the organization. Predictive intelligence is a machine learning framework which provides artificial intelligence to the ServiceNow platform. It predicts the solution or data based on the user input. By using machine learning solutions, the incoming requests in ServiceNow could automatically assigned, categorized, suggest resolutions, and more based on the unique configurations of PI machine learning solutions defined. This article focuses on solving and automating the daily problems and efforts of service desk agent and also describes how to enhance the customer interface more interactive and satisfactory.

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2 Problems for Service Desk Agents in Organization (Without Predictive Intelligence)

Without the utilization of predictive intelligence, the service desk agents in any organizations face following issues:

2.1. There is large number of requests around 1000 + similar requests generate from customers or users daily in the organization across different regions. The service desk agents really need to spend their time to triage the regular common issues again and deploy the solutions [2]. Also, for such large number of similar kind of requests or issues, the organization is spending unnecessary time costs to the agents rather than concentrating them to solve the complex issues. The resolution time to resolve the requests is high which reduces the customer satisfaction and also has impact on SLA costings (Fig. 1).

2.2. There are quite multiple categories under which the issues raised from customers in IT and manufacturing industries. So, managing the requests with correct categories is very essential in the organization. And, there are service desk agents with various skills in the particular team in organization, and the right request needs to be assigned to the right skill predictive to fulfill the request more quickly. The service desk agents in the organizations currently much needed the right categorizations, prioritizations, and right assignment of the issues to boost the resolution time of the customer requests or issues.

2.3. The service desk agents overload with the large chunk of requests, and there are scenarios where the request or issue is not very complex, but the predictive is not known about the issue and need to search some references to rectify the issue or request from customers/users. They need to search manually the related knowledge articles or other references. Also, most of the requests from customers are just informational requests and don't require agents to be assigned on them. These kind of issues or requests occupies agent's time and bandwidth unnecessary [3].

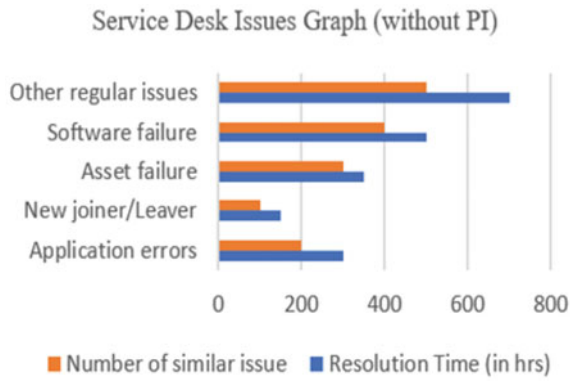

Fig. 1 Service desk issues graph without PI

2.4. There are various large number CIs in IT and manufacturing industries. It is very hard to analyze the impact of assets and CIs on the business practice. To properly analyze the CIs causing the maximum number of issues and incidents and also to analyze the similar kind of identical priority issues for parent assets, the dedicated resource is required to do the analysis and reporting of the services and CIs.

3 Solutions for Service Desk Agents in Organization (With Predictive Intelligence)

3.1. The problem referred in 2.1 can be solved through predictive intelligence by using the similarity framework feature of PI. This framework provides the ability to discover the similar kind of records from the existing dataset. We could define word corpus with the PI solution definition under this framework. Word corpus configuration is a set of words which works as vocabulary for the system to compare with the existing records for the identification of similarity in the records (Fig. 2).

We can use the predictive values in flow designer actions in ServiceNow and automate the resolution of regular common issues. Through this solution, the resolution time would be reduced more than by +70%, and hence, the customer satisfaction and costings on SLA can be improved (Fig. 3).

3.2. The solution for the problem referred in 2.2, this can be solved by using the classification framework of PI. This framework solution allows system to analyze the previous data records on the basis of input fields in the solution

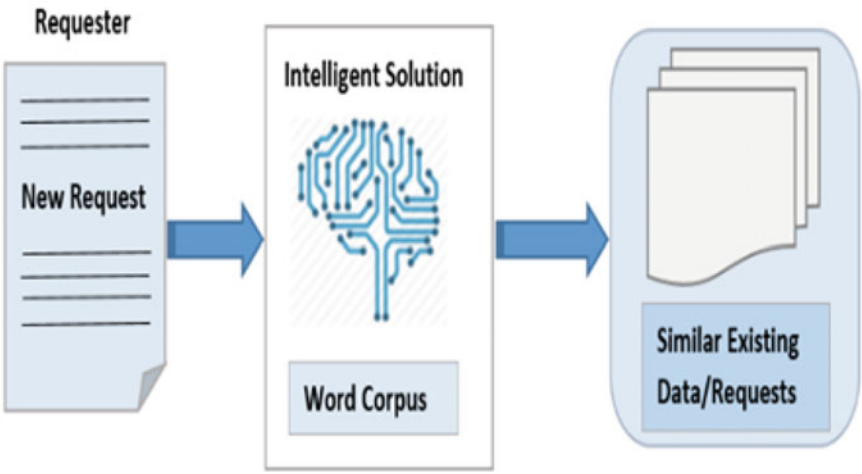

Fig. 2 Similarity framework process

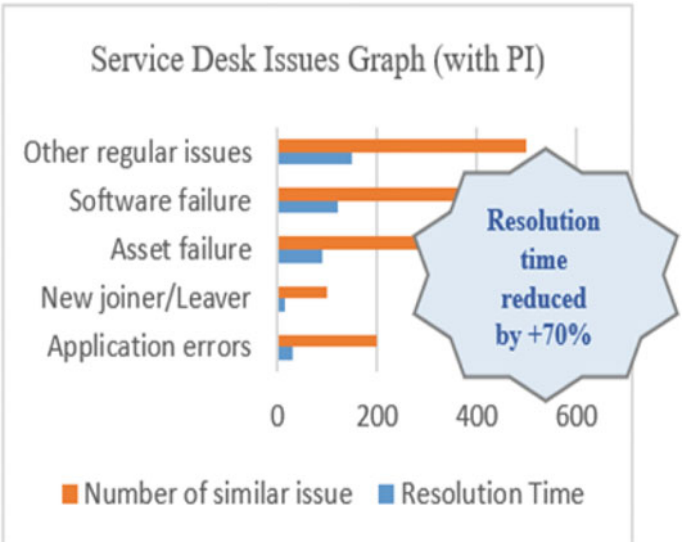

Fig. 3 Service desk issues graph with PI

definition and then set up the most precise outcome [4]. Example, incident category to be set up based on the incident short description (Figs. 4 and 5).

3.3. The solution for the problem referred in 2.3 can be achieved by using the PI with predictive workspace and virtual predictive with service portal functionality in ServiceNow. PI can be configured with predictive workspace under predictive assist widget. We can use the similarity framework of PI to provide the solutions related to the customer issue or request [5]. The PI solution in predictive assist delivers top-related knowledge articles and also resolution suggestions from the previously related resolved issues. This automatically searches the related solutions and information to agents which helps them to

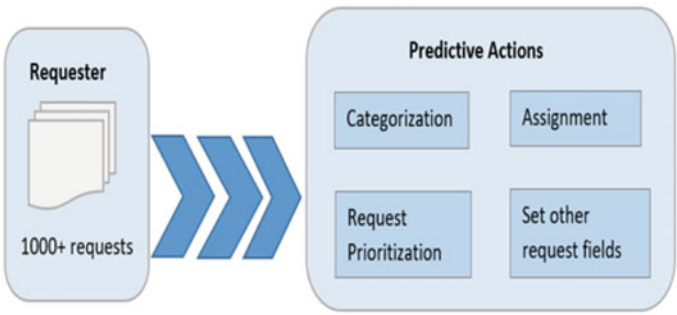

Fig. 4 Classification framework process

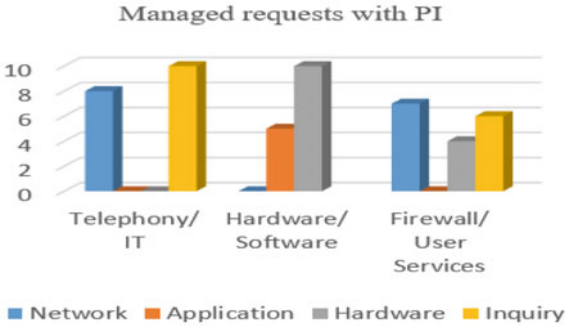

Fig. 5 Managed requests with PI

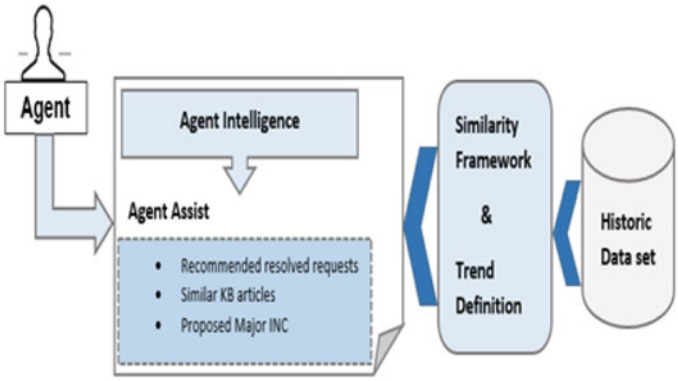

Fig. 6 PI with agent workspace

understand the issues and resolves the issues quickly. This also saves time of agents of searching the related information manually (Fig. 6).

The customer interaction can also be improved by using PI solutions with virtual agents. Most of the times customers when interact with virtual predictive on the service portal, their request can be just informational and can be solved easily under one step only without any service desk predictive intervention. The customer requests related to password reset links, invoice details, and profile modifications, these kinds of requests can be fulfilled by provide the related solutions and knowledge articles to the customers through virtual agents.

3.4 The problem referred in 2.4 can be solved by using the clustering framework of PI. The impact analysis of large number of CIs can be easily done and automated by this framework of PI. This framework first identifies the identical records and then group them into clusters. This provides the ability to operate them collectively [6]. This creates tree map plot of the grouped clusters, through which we can easily review the dependent CI issues majorly causing the business services failures (Fig. 7).

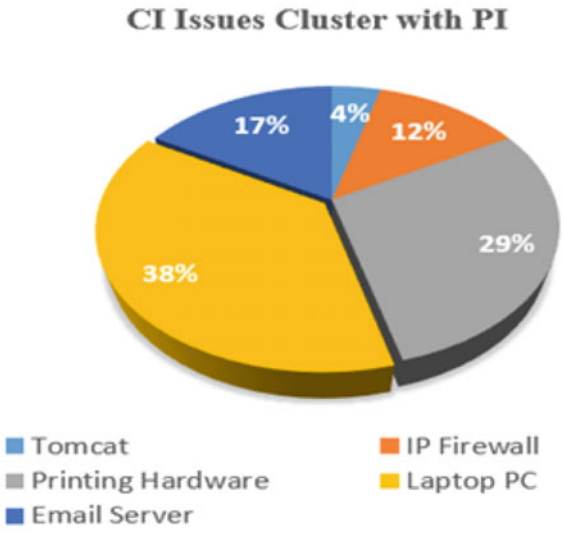

Fig. 7 CI issues cluster with PI

4 Process of Training Solutions

Before training of any solution model, there is solution definition which needs to be configured against specific table of which we want to predict the data. The solution definition specifies two major components to define—an input data or field and output data. The input data field reads the value from the same field from the incoming request and use it to identify the existing records in the dataset [7]. The outcome of the prediction then stores in the output data. When the configuration of solution definition completes, we can train the solution and activate it so that it can be available for predictions. The training process happens at the ServiceNow data center in the below steps (Fig. 8):

- Clean the data, eliminating any problematic characters
- Identifies if there are any duplicate records and indexed them
- Tokenize the input data and then break it into n-grams
- Removes stop words from input data
- Stemming of root words from input data.

5 Conclusion

Predictive intelligence is very useful in IT and manufacturing industries where the service desk agents deal with large number of customer issues. Through PI, we could develop smart and automated solutions to reduce the predictive efforts and allow them to focus on the complex problems. All the solutions described in this article can be achievable without any hard scripting knowledge, which makes it more

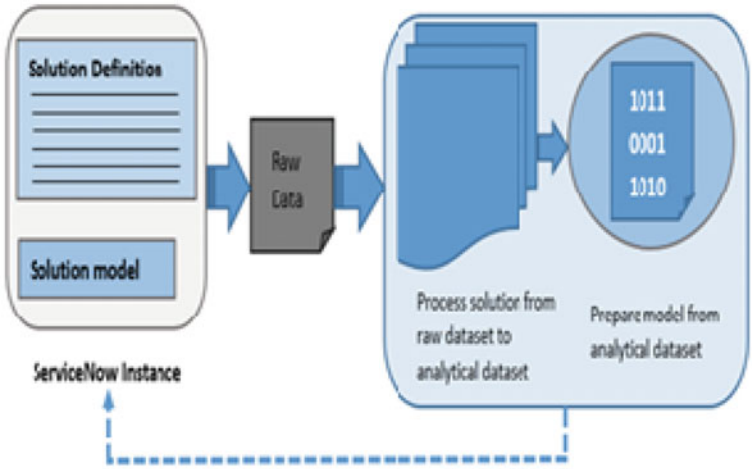

Fig. 8 Training of solutions

feasible. These solutions have less business cost and high productivity solutions for the organization. Through these PI solutions, we could also manage the services and customer requests more efficiently. This also provides the managed analysis so that we can work to improve the priority CIs and services of organizations which are majorly failing and causing issues to customers. We could enhance the customer satisfaction and interactions by providing them the related articles at front end and automate the resolution of regular similar issues.

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Chapter 29
Visual Studio Vulnerabilities and Its Secure Software Development

Tanu Verma, Yukti Ghablani, and Mehak Khurana

1 Introduction

Development of software is an advanced process because of style, client demand, and quality of the program, the code increases which creates difficulty for coders, because attackers will need the requisite experience and tools to exploit the flaws in the code, using common or repeatedly, and frequently used code in software development raises the danger of exploitation by attackers [1]. Occasionally, a developer will leave a software bug that allows an attacker to exploit a program. Exploitation of certain software program flaws might have a negative impact on the software, which could have terrible effects. Furthermore, the use of vulnerable software can either tacitly or expressly violate a company's security policy. As a result, security issues should be the most significant concern for developers in the modern era. However, to achieve the organization's purpose, most code developers compromise with software vulnerabilities.

1.1 Vulnerabilities

It is a defect in the device's security. This exists due to processes observed in implementation and designing of protection devices or inner controls that allow an attacker

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to deliberately take advantage of the device. Vulnerability compromises with the safety of the device.

Vulnerability includes three simple elements:

1. Fault within the layout of the device.
2. The attacker's ability to exploit the issue.
3. Access to the weakness by an attacker.

If an attacker wishes to take advantage of the vulnerability, then they have to have at least one approach that could connect with the weak point of the device.

Classifications of vulnerabilities. Vulnerabilities include faults caused by lack of audit trail, poor testing, and many other causes such as complicatedness and familiarity, connectivity, flaws in password management, bugs in software, unchecked user input, OS design defects, and much more. Vulnerabilities are further identified on the basis of common vulnerability exposures (CVE) [2], common weakness enumeration (CWE) [3], and common vulnerability scoring system (CVSS) [4].

Impact of Vulnerabilities. The effect of a protection breach may be very high. The reality that IT managers, or top management, can (easily) recognize that IT structures and programs have vulnerabilities and do now no longer carry out any movement to manipulate the IT vulnerability is visible as misconduct in maximum legislations. Privacy regulation forces executives to behave to lessen the effect of that protection chance. Information protection audit is a manner to permit different unbiased human beings to certify that the IT surroundings are controlled well and reduce the responsibilities, as a minimum having validated right faith. Penetration checking is the verification of the weak point and the precautions followed through a company.

1.2 Software Development Life Cycle

It is basically a chain of stages, which offers a framework for the development and management of a software program. While there is no precise approach or way to increase the components of programs and software, the developer uses integrated methodologies and models for addressing distinguishing objectives and challenges.

The software development life cycle primarily comprises six stages, namely requirement analysis, planning, design, building, testing, and maintenance. The first few stages lay the foundations of the software; the building and testing stages are the essential stages, and the maintenance stage ensures any vulnerabilities are patched.

Oftentimes, vulnerabilities are caused by errors during the building and coding stage, and these errors are the result of lack of proper secure coding practices. Therefore, it is important to eradicate coding errors and follow clean and secure coding standards in the implementation phase to avoid vulnerabilities in the deployment phase.

2 Visual Studio

Visual Studio is an integrated development environment (IDE) code editor which provides its users with various functionalities to ease their coding process. It works with various languages and frameworks and can be used for developing Web applications, Web services, computer applications as well as mobile applications [5]. Table 1 [1] shows a list of all the recent versions of Visual Studio launched and gives information about their updates and patches.

2.1 Visual Studio Functionalities

Visual Studio functions as a code editor and debugger which helps in code compilation, prediction, and has highlighting features for methods, loops, and variables. It supports an extensive array of languages and is quick in detecting errors even before compilation [5].

Table 1 Visual Studio version history

Product name	Release date	Version number	Latest update version	Latest update date
Visual Studio 2019	2019-04-02	16.0	16.9.0	2021-03-02
Visual Studio 2017	2017-03-07	15.0	15.9.33	2021-02-10
Visual Studio 2015	2015-07-20	14.0	Update 3	2016-06-27
Visual Studio 2013	2013-10-17	12.0	Update 5	2015-07-20
Visual Studio 2012	2013-10-17	11.0	Service pack 1	2015-08-24
Visual Studio 2010	2010-04-12	10.0	Service pack 1	2011-03-10
Visual Studio 2008	2007-11-19	9.0	Service pack 1	2008-08-11
Visual Studio 2005	2005-11-07	8.0	Service pack 1	2006-12-15
Visual Studio.NET 2003	2003-04-24	7.1	Service pack 1	2006-08-15
Visual Studio.NET 2002	2002-02-13	7.0	Service pack 1	2005-03-08
Visual Studio 6.0	2002-02-13	6.0	Service pack 6	2004-03-29
Visual Studio 97	1997-03-19	5.0	Service pack 3	1997-12-04

3 Vulnerabilities and Their Impacts in Visual Studio

Though Visual Studio offers its users great functionality and ease of utility, it possesses a stream of vulnerabilities in its design which could lead to potentially harmful behavior and may cause users to be prone to exploitation.

Figure 1 [6] represents the number of vulnerabilities from 2000 to 2021 in Visual Studio. Since it can be seen in the figure that the years 2009 and 2020 faced maximum vulnerabilities, we may conclude that the reason for this could be due to major change in functionalities that may have been introduced after a long time.

3.1 Remote Code Execution

An attacker can execute code on a server that has the appropriate vulnerability in their choice of system-level privileges. Once adequately affected, the attacker can access any information on a server containing the data supplied by unsuspecting customers. It is at best difficult to detect this defect and at its worst not possible.

One particular CVE pertaining to this vulnerability in Visual Studio code is CVE-2020-16,874. The analysis of this CVE is illustrated in Fig. 2 [7]. This vulnerability makes it so that the product is not able to differentiate between code syntax and user-controlled input, so it might allow the attacker to craft the code in such a way that it will alter the intended control flow of the software. Such an alteration could lead to arbitrary code execution. The CVSS of this vulnerability is extremely high suggesting the seriousness of the vulnerability. There is complete impact on all three core secure coding rules—confidentiality, integrity, and availability.

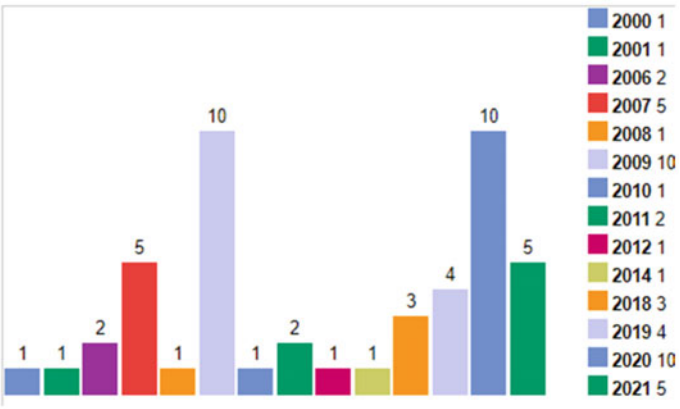


Fig. 1 Number of vulnerabilities in Visual Studio by year [6]

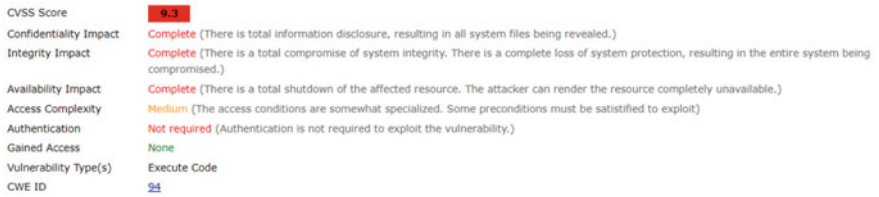


Fig. 2 Analysis of CVE-2020-16,874 [7]

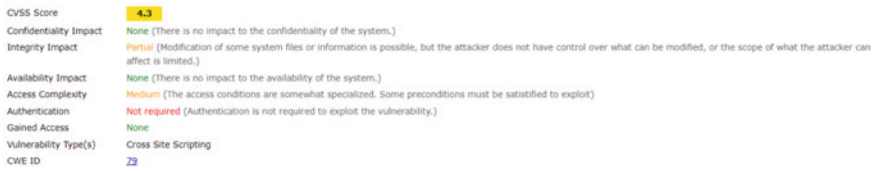


Fig. 3 Analysis of CVE-2011-1976 [9]

3.2 XSS

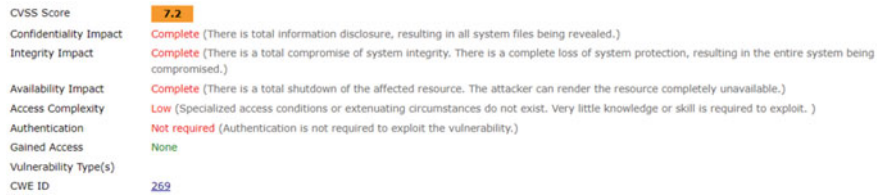
It is a sort of attack which injects malicious scripts. It occurs when an attacker sends malicious code to another end user, commonly as a browser-side script. They stop user' browser who is unaware that it is now supposed to stop the script and can instead run it [8].

One particular CVE pertaining to this vulnerability in Visual Studio is CVE-2011-1976. The analysis of this CVE is illustrated in Fig. 3 [9]. This vulnerability was present in the Report Viewer Control in Microsoft Visual Studio 2005 SP1, and it allowed users to inject random code or scripts through a parameter in a data source. The CVSS score is in the medium–low range, and there is negligible impact on the CIA triad.

3.3 Privilege Escalation

An escalation privilege attack is a kind of network intrusion that benefits from programming errors or design flaws to enable the attacker to have extensive network access and associated applications [10]. Not all system hacks initially offer full access to the targeted system for unauthorized users. It takes privileges to step up in these circumstances.

One such CVE pertaining to this vulnerability is CVE-2021-1651. The analysis of this CVE is illustrated in Fig. 4 [11]. This vulnerability allowed the user to elevate their privileges because of the Diagnostics Hub Standard Collector. As indicated by



CVSS Score	7.2
Confidentiality Impact	Complete (There is total information disclosure, resulting in all system files being revealed.)
Integrity Impact	Complete (There is a total compromise of system integrity. There is a complete loss of system protection, resulting in the entire system being compromised.)
Availability Impact	Complete (There is a total shutdown of the affected resource. The attacker can render the resource completely unavailable.)
Access Complexity	Low (Specialized access conditions or extenuating circumstances do not exist. Very little knowledge or skill is required to exploit.)
Authentication	Not required (Authentication is not required to exploit the vulnerability.)
Gained Access	None
Vulnerability Type(s)	
CWE ID	269

Fig. 4 Analysis of CVE-2021-1651 [11]

the CVSS score, this vulnerability is ranked among the higher ones and has complete compromise of the CIA triad. Such vulnerability can have devastating effects.

3.4 Bypass Something

In bypassing the security vulnerability, attackers could perform various malicious tasks by circumventing the tool authentication. Strong access policies and authentication inspections could be unable to prevent authentication from being carried out by an attacker. Many default apps and servers contain default unsecured folders [12]. Attackers are searching for unprotected file(s), accessing unprotected files, collecting information, and then trying to bypass the authentication system to attack protected applications.

3.5 Tampering Vulnerability

The attack is based on a Web parameter manipulation. Useful to build software functions and controls, these data are normally stored in cookies, hidden fields of form, or URL query strings [13]. The success of the attack is based on integrity and logic validation errors, and its use can lead to various outcomes such as XSS, SQL injection, file inclusion, and path disclosure attack.

3.6 Denial of Service

There are many methods of manipulating network packets, programming, logic or resources, among others, that make a service unavailable to legitimate users [14]. If a service receives a whole range of requests, legitimate users could cease to be able to access it. These attacks lead to extensive delays in response, excessive losses, and interruptions of service that have an indirect influence on availability.

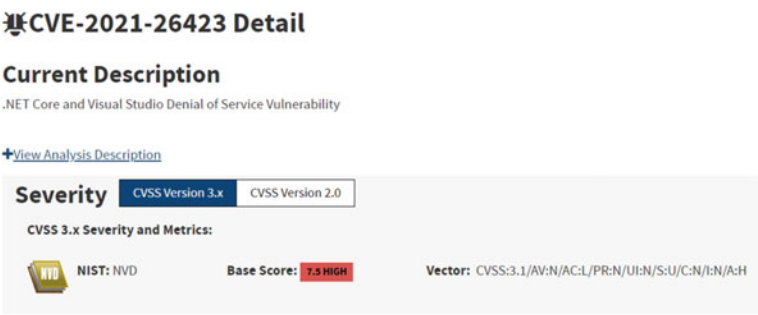


Fig. 5 Analysis of CVE-2021-26,423 [15]

CVSS Score	5.0
Confidentiality Impact	None (There is no impact to the confidentiality of the system.)
Integrity Impact	None (There is no impact to the integrity of the system)
Availability Impact	Partial (There is reduced performance or interruptions in resource availability.)
Access Complexity	Low (Specialized access conditions or extenuating circumstances do not exist. Very little k exploit.)
Authentication	Not required (Authentication is not required to exploit the vulnerability.)
Gained Access	None
Vulnerability Type(s)	Denial Of Service
CWE ID	CWE id is not defined for this vulnerability

Fig. 6 Analysis of CVE-2021-26,423 [16]

One such CVE pertaining to this vulnerability is CVE-2021-26,423. The analysis of this CVE is illustrated in Figs. 5 [15] and 6 [16]. The severity of this vulnerability ranks medium–high, and there is impact on availability.

3.7 Memory Corruption

The contents of memory location are changed because of an error in programming, which allows an attacker to execute malicious code.

One CVE associated with this vulnerability is CVE-2009-2528. The analysis of this CVE is illustrated in Fig. 7 [17]. The severity score of this vulnerability is extremely severe, and there is complete compromise in confidentiality, integrity, and availability.

Figure 8 [6] highlights the trend of vulnerabilities in Visual Studio in the years and indicates the type of vulnerabilities and their frequencies over the years. The graph shows that there is a high frequency of vulnerabilities between the years 2009 and 2012, and also, after 2018, which may indicate that the Visual Studio version 2008 till 2015 contained a lot of vulnerabilities, which were then patched in the later versions.

CVSS Score	9.3
Confidentiality Impact	Complete (There is total information disclosure, resulting in all system files being revealed.)
Integrity Impact	Complete (There is a total compromise of system integrity. There is a complete loss of system protection, resulting in the entire system being compromised.)
Availability Impact	Complete (There is a total shutdown of the affected resource. The attacker can render the resource completely unavailable.)
Access Complexity	Medium (The access conditions are somewhat specialized. Some preconditions must be satisfied to exploit)
Authentication	Not required (Authentication is not required to exploit the vulnerability.)
Gained Access	None
Vulnerability Type(s)	Execute Code Memory corruption
CWE ID	94

Fig. 7 Analysis of CVE-2009-2528 [17]

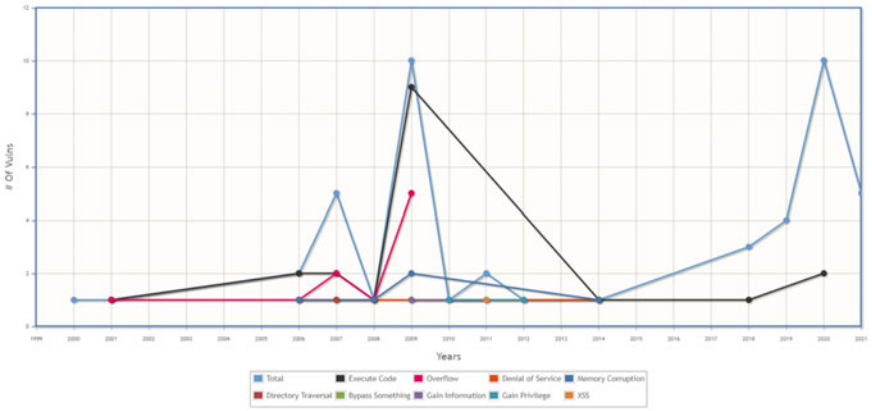


Fig. 8 Trend of vulnerabilities in Visual Studio over the years 2000–2021 [6]

4 Mitigation of the Vulnerabilities

Over the years, Microsoft has devised various methodologies to mitigate the vulnerabilities present in their software. Regular patches and updates are released for various software, including Visual Studio, which focus on mitigating the vulnerabilities that attackers rely on when attempting to develop an exploit for a vulnerability.

Microsoft has developed certain exploit mitigation techniques such as stack-buffer overrun detection, data execution prevention, address space layout randomization SAFESEH and SEHOP. These security practices ensure that all users experience a safe working environment and have protected applications to develop and manage their code.

5 Conclusion

The authors studied the CVE, CWE, and CVSS scores for different vulnerabilities from the National Vulnerability Database and CVE database for Visual Studio-related

vulnerabilities. The results and conclusions derived from the analysis are based on the three core parameters, namely confidentiality, integrity, and availability.

The results help the developers to identify the particular vulnerabilities, their impacts and mitigation strategies of the vulnerabilities in Visual Studio. They also help developers identify and ratify common mistakes made during the building and testing stages.

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Chapter 30
Global Outlook of Cyber Security

Tripti Lamba and Shivani Kandwal

1 Introduction

Cyber Security is the act of safeguarding information systems, programs, and digital information including networks from attacks. Normally, these cyberattacks target accessing, manipulating, or destroying susceptible information [1]. Significance of the field is growing due to increasing dependence on computer systems, the Internet, and wireless networks and because of the populous increase of "smart" devices. It is also one of the primary challenges of the modern world [2].

Safeguarding data and stopping cyberattacks now have risen besides trading with natural calamities as the most important threats asking the world's whole concentration. According to the president and CLO of Microsoft, Brad Smith, "Cyber Security is all regarding keeping the world secure. Also, Cyber Security has an essential and unique function in world politics" [3]. The world is dependent on digital infrastructures, and people are dependent on their digital devices [4], and it is found that the same digital devices face attacks every particular day.

2 Literature Review

The World Economic Forum (WEF) (an international NPO) releases the Global Risk Report (GRR) [5], an annual research based on the Worldwide Risk Network that

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portrays changes in the global risks environment from year to year and acknowledges global catastrophic threats [6]. The research also looks at risk correlations and how methods to global risk mitigation might be constructed. The Global Risks Report 2018 highlights four areas of concern: (1) chronic inequity and injustice, (2) domestic and international political conflicts, (3) environmental threats, and (4) cyber-vulnerabilities [7]. The United Nations' International Telecommunication Union (ITU) is a specialized institution for information and communication technology. ITU's initiative Global Cyber Security Index (GCI) is an index produced, analyzed, and published by the union itself, measures the engagement of countries to Cyber Security to raise Cyber Security consciousness.

In their survey, the UN finds Cyber Security gaps everywhere and negligible most committed countries [8]. Moreover, Cyber Security is all regarding keeping the world secure [9]. The world is dependent on digital infrastructures, and people are dependent on their digital devices, and it is found that the same digital devices face attacks every particular day. Hence, this report highlights the current scenario of the world in terms of Cyber Security considering GCI and GRR.

3 Cyber Security on a Global Scale

The GCI assesses country's commitment to Cyber Security in order to promote Cyber Security awareness. The evaluation of the country's commitment is based on five pillars. These are (i) legal, (ii) technical, (iii) organizational, (iv) capacity building, and (v) cooperation. The index has classified all the participating countries into three different groups based on their level of commitment to Cyber Security. These groups are as follows: high, medium, low. There are 175 countries that have participated in GCI 2018. GCI scores (normalized) were obtained using 99 percentiles which were calculated on the basis of five pillars as mentioned above. The ranges are as follow: **High commitment or leading stage**: Global rank 1–51 (score: 1.000–0.670), **Medium commitment or maturing stage**: Global rank 52–99 (score: 0.669–0.340), **Low commitment or initiating stage**: Global rank 100–175 (score: 0.339–0.000).

4 Global Security Index Countries Score

As previously stated, the five evaluation pillars are as follows: (i) Legal: Scaled depending on the presence of legal establishments and frameworks dealing with Cyber Security and cybercrime. (ii) Technical: Scaled according to the number of technical institutions and frameworks dealing with Cyber Security. (iii) Organizational: Scaled according to the presence of policy coordinating structures and Cyber Security development initiatives at the national level. (iv) Capacity Building: Scaled based on the presence of R&D, training, and education programmers; certified experts and public sector firms nurturing, capacity building. (v) Cooperation: Determined

on a scale of one to ten [10]. Out of the 175 (total = 194 but some countries have not participated) participating counties, the below figure illustrates the top 10 most committed, least 10 committed countries, and 10 medium-committed (in unordered level) countries toward Cyber Security [11]. The European countries have higher level of commitment to Cyber Security, and African countries have a lower level of preparedness to face cybercrime and cyberattacks supported by unfriendly external controls. There is a considerable difference in knowledge, awareness, capacity to deploy suitable solutions, and comprehension among countries.

5 GCI Ranking

There is a wide gap between the normalized score of nations. This section, with reference to Fig. 1, lists the possible reasons why such a gap exists between the scores of nations.

5.1 Most Committed Countries Toward Cyber Security

The General Data Protection Regulation (GDPR) of the European Union is being implemented in France, and similar policies are being discussed in the United States. Operation Tsunami, a cyber-war games training activity, was held by Australia's

Country	Score	Country	Score	Country	Score
United states	0.92	Ukraine	0.661	Somalia	0.07
France	0.92	Nigeria	0.65	Saint kitts and nevis	0.065
Lithuania	0.92	Serbia	0.643	Djibouti	0.063
Estonia	0.91	Iran	0.641	Haiti	0.046
Singapore	0.9	Mexico	0.629	Honduras	0.044
Spain	0.9	Kuwait	0.6	Central african republic	0.036
Malaysia	0.9	Tunisha	0.536	Equatorial guinea	0.031
Norway	0.9	Sri Lanka	0.466	Kiribati	0.028
Canada	0.9	Peru	0.401	Dominica	0.019
Australia	0.89	Ecuador	0.367	Comoros	0.015
Most Committed		Medium Committed		Least Committed	

Fig. 1 GCI's countries with different commitment (normalized score) 2018

Department of Human Services. Teams from government and industry collaborated in a simulated offensive on a cyber-range that served as the autonomous IT system for the fictional city of Shell Cove (replicated using Lego). The National Institute of Standards and Technology (NIST) in the United States has announced new risk assessment recommendations [12]. The NATO Cooperative Cyber Defense Center of Excellence (CCD COE) in Estonia focuses on both technical and non-technical aspects of cyber-defense research, development, training, and education [13]. The World Summit on Information Society Forum 2017 announced this award for cyber-excellence for a country that is considered as a leader in Internet-enabled government. Singapore is a safer cyberspace and the development of a vibrant Cyber Security ecosystem. The Cyber Security agency has been working on a law to improve the country's Cyber Security posture for around two years. The Strong infrastructure and nourished international relations are responsible for Malaysia's strong cyber space. The Country's Information Security Certification Body is credited with ensuring safe cyberspace in the country.

Spain's national strategy aims to generate an adequate capacity for prevention, defense, detection, response, and restoration in the issue of cyber-threats or attacks [14]. The National Crime Agency is in charge of leading and facilitating the fight against digital crime, along with other open bodies such as the National Cyber Security Center, which was established in 2016. According to the ITU, a coordinated effort with Europol's European Cybercrime Center and the Joint Cybercrime Task Force is underway. Action Taskforce has permitted UK specialists to distinguish and close down major digital wrongdoing activities, including a site connected to 4,000,000 DDoS assaults universally (counting against the biggest UK banks). Active Cyber Defense (ACD) ecosystem of assistance continues to accurately and measurably make the UK more secure from cyberattack [15]. Lithuania's initiative to lead seven countries to create a Cyber Security response team [16]. Canada and Norway's rules and laws for protecting citizens.

5.2 India With Respect to GCI 2018–2019

India has been ranked 47th out of 175 nations and has been listed under the high commitment group of the index (2018). The normalized score of India is 0.719 based on the five pillars of evaluation [10]. However, here lies the utmost concern as well: why India does not have a higher score (normalized) commitment toward Cyber Security? The answer to the question can be answered on the basis of the following four points: (i) Lack of awareness among the masses: Despite various efforts from the government, people are still unaware. (ii) National level architecture for Cyber Security: National level architecture that unifies the efforts of different sectors of the country. (iii) Separation: Boundaries in cyberspace that make activities vulnerable to cyberattacks. (iv) Lack of uniformity in devices used for internet access: Devices with higher security norms are used by a smaller percentage of the population.

5.2.1 Measures for Cyber Security in India

Legislative, technical, and institutional initiatives taken by the Indian government to address Cyber Security challenges. Introduction to the "Cyber Swachh Kendra" (Botnet Cleaning and Malware Analysis Center) [17], National Cyber Security Coordinator (NCSC) under the National Security Council Secretariat (NSCS) manages various agencies for Cyber Security-related concerns at the national level. The Information Technology Act of 2000 [18] provides provisions to cope up with cyber-risks and attacks. The national nodal agency for responding to computer security issues in India is the Indian Computer Emergency Response Team (CERT-In). This comprises data gathering, analysis, forecasting, alerting, coordination, and emergency response, among other things [19]; the National Critical Information Infrastructure Protection Center (NCIIPC) is accustomed to protecting the nation's critical information infrastructure, and the National Cyber Coordination Center (NCCC) was established to generate mandatory situational awareness of current and potential Cyber Security threats and to enable timely information sharing for proactive, preventive, and protective actions. THE PERSONAL DATA PROTECTION BILL, 2018 audits all new government Web sites and applications prior to hosting and on a regular basis after hosting.

5.3 Countries With Medium Commitment Toward Cyber Security

With reference to Fig. 1, this section discusses the maturing countries.

- Draft Law on Critical Infrastructure Protection in Ukraine has been developed, and it will help to reduce the vulnerabilities concerning the same [20]. Although a number of challenges and policy directions in terms of Cyber Security cannot be solved by a single law and requires some specialized measure [21].
- National Cybercrime Strategy formed under Serbia's Ministry of Interior (commonly named CERT) highlights its growing commitment toward Cyber Security. 'The Cyber Defense Command' which is operating under the supervision of Iran under the supervision of Iran's Passive Civil Defense Organizations is protecting it from cyber-wars [22, 23]. Being both an unfortunate victim and wager of cyberwarfare, Iran is viewed as a developing military force in the field of Cyber Security [24, 25].
- The National Cyber Security Strategy (2017) is the report that builds up the vision of the Mexican State in the issues including the requirement for a general Cyber Security culture [26, 27].
- The National Cyber Security Strategy for the State of Kuwait 2017–2020 promotes the culture of Cyber Security and plays a main role in safeguarding and maintaining the security of various assets in the State of Kuwait [28, 29].

- The National Agency for Computer Security (NACS, Tunisia) is securing the cyberspace simultaneously focusing on new challenges like Critical Infrastructure Information Protection (CIIP), deep Web, and big data [30, 31].
- TechCERT has been working with Sri Lanka CERT|CC for securing cyberspace [32].

5.4 Least Committed Countries Toward Cyber Security

With reference to Fig. 1, this section gives possible reasons why the ten listed countries are least committed to Cyber Security.

- Studies find that for maturing and leading stage/group, there is a necessity for further improvement in cooperation, but overall improvement is needed for these countries in initiating stage/group [33].
- No national strategy for Cyber Security to secure nation: 50% of the nations (mostly developing) does not have any strategy [34, 35].
- Despite various measures and efforts, people are still unaware [36].
- Lack of focus on the root problem of insecure systems by government and other organizations [37].
- Inadequate national and international organizational structures in terms of dealing with incidents [38].
- Economic resources and sector-specific R&D programs/projects are scant.

6 Conclusion

The world is dependent on digital infrastructures, and people are dependent on their digital devices; it is found that the same digital devices face attacks every particular day. Therefore, Cyber Security has a crucial role in terms of safeguarding information system. There is still a wide gap in Cyber Security commitment between European countries and African ones, with European governments being more prepared to handle cybercrime and cyberattacks supported by unfriendly external controls. According to the report, there is a gap between countries in terms of knowledge, awareness, capacity to deploy suitable tactics and understanding, as well as digital information, networks, and programmers that are vulnerable to digital attacks. Still, there is difference in between countries in terms of commitment to Cyber Security between European and African countries, with European governments being better prepared to deal with cybercrime and cyberattacks supported by hostile foreign controls.

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Chapter 31
Consensus Mechanism Using Sharding Approach in Consortium Blockchain

Shivani Wadhwa, Divya Gupta, and Lipakshi

1 Introduction

Blockchain is a series of distributed ledgers that can be configured to record and monitor value of anything [1]. Whenever an entity of the distributed system receives new data in blockchain, it shapes the data into the block. This block has a hash value which is generated by the corresponding data, the block index in the chain, the data reception timestamp and the hash value of the previous block of the chain. The node also mines the block with other chain blocks to construct the proof of work for that block so its hash fits a similar pattern with the others. The copy of the block is subsequently sent to other nodes for linking with their local blockchains. However, if any block's data is altered on a node, the block's hash would shift and mismatch in the next block with its saved hash. As a consequence, the later component of the chain becomes invalid. To make the chain valid again, it is important to recalculate the hash of the invalid blocks. In addition, proof of work of each block needs to be recalculated [2]. Both operations are time consuming and costly to determine. Therefore, this fraudulent exploitation of data in blockchain does not work unless 50% of its distributed copies are reformed individually by following the same collection of operations.

The paper is organised as follows: In Sect. 2, blockchain as a data structure is discussed. Then, the types of blockchain are mentioned in Sect. 3. Section 4 discusses

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the existing consensus mechanisms in consortium blockchain. Proposed framework using sharding approach is explained in Sect. 5, followed by performance evaluation in Sect. 6. Challenges are mentioned in Sect. 7. Section 8 discusses conclusion and future scope.

2 Blockchain as a Data Structure

Blockchain is basically a data structure that grows indefinitely using cryptographic hash links which are agreed by the nodes that are part of the blockchain network. The property satisfied by these nodes is the common prefix and the chain quality property [3]. Data organisation consists of three levels, i.e. secure transactions, the blocks and the ledger of the blocks.

- **Secure Transactions**: Data of the block may consists of list of transactions indicating the digitally transfer of data from senders to recipients [4]. Concept of cryptographic hashing and asymmetric keys is applied for security. Cryptographic hashing applies SHA-256 hash function because of the various favourable properties, i.e. it is one-way, deterministic, computationally faster and withstand collision [5].
- **The Blocks**: The data part of the block consists of events which must be stored securely. For providing security to it, fields like timestamp, nonce, previous hash and hash are added. On the basis of hash generated by the block, concatenation of blocks takes place in sequential manner.
- **The Ledger of the Blocks**: Blocks contains all the transactions which are linked sequentially. The ledger acts as the log for these transactions as these can be accessed in a linear fashion using cryptographic links [6]. Mining of the blocks is done by the miners to generate a block which then becomes the part of the ledger.

3 Types of Blockchain

There exists various variants of blockchains depending on the organisations contributing in its formation [7]. Basically, blockchain can be categorised into three types:

- **Public Blockchain**: In public blockchain, all participants can access the transaction and contribute in its verification. Here, participants also help in reaching consensus on the basis of resources they possess. Examples of public blockchain are bitcoin and ethereum [8].
- **Private Blockchain**: In private blockchain, participants are restricted to participate in the blockchain. Here, there is a strict management to supervise that who is contributing in reaching consensus. Examples of private blockchain is ripple [9].

– **Consortium Blockchain**: Consortium blockchain is also known as federated blockchain. Here, single organisation does not possess the power to contribute in reaching consensus. Instead, multiple organisations work together and ultimately reach consensus. Examples of consortium blockchain are Corda, Quorum and hyperledger [10].

4 Existing Consensus Mechanism in Consortium Blockchain

Most widely used consensus algorithms in blockchain are Proof of Work (PoW), Proof of Authentication (PoA), Proof of Stake (PoS), Practical Byzantine Fault Tolerance (PBFT), etc. Nowadays, concept of Directed Acyclic Graph (DAG) [11] and sharding is also used to reach the consensus in blockchain. Consensus mechanism in consortium blockchain plays very vital role as all nodes are from different organisations and their execution is in closed environment.

The consortium blockchain consist of highly trustworthy nodes in an organisation that are accountable for reaching the consensus by proper verification of nodes and then creation of the block. Consortium blockchains have different types of nodes for approving the final block, i.e. peer nodes, orderer nodes and endorsement nodes. Different types of nodes upgrades the effectiveness of reaching consensus. IBM's, Hyperledger Fabric is an open source project which integrates multiple highly reputed organisations to reach consensus. It uses Kafka or solo consensus algorithm which is not byzantine fault tolerant. Kafka is crash fault tolerant. Hyperledger composer is an open source consortium blockchain that provides framework for developing applications based on blockchain. It provides integration of already existing business with the blockchain that makes the deployment easier.

5 Proposed Framework: Sharding Approach for Consortium Blockchain

Our technique proposes a method to reach consensus using sharding approach for consortium blockchain. As different organisations collaborate together to give rise to consortium blockchain, so it is difficult to totally trust the organisations. In our proposed technique, sharding-based approach is used to provide the security to the data being produced by organisations. Various organisations assist each other in finalising the block. The computation power of the organisations is splitted into 'n' number of committees within an organisation. Nodes inside organisation are assigned random identity number. Every committee knows the nodes present in its own committee and nodes present in neighbouring committee. All nodes present in a committee knows the nodes which are trustworthy depending on the previous

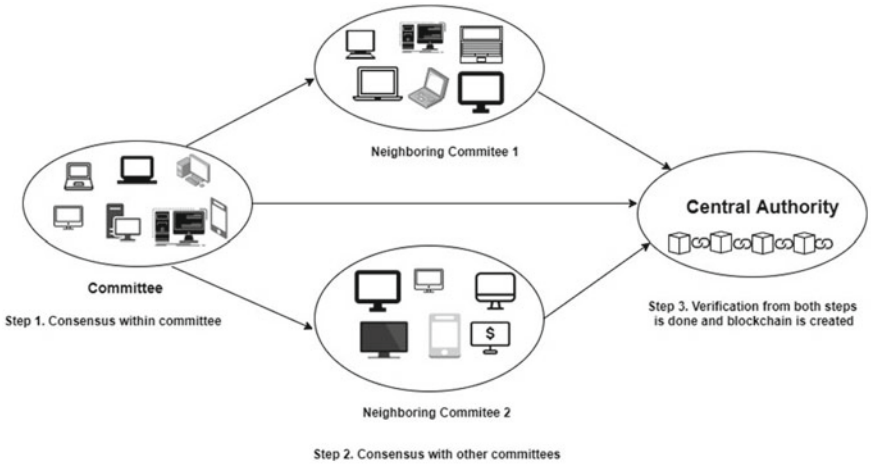

Fig. 1 Consensus mechanism using sharding approach

experience of the results produced by them during consensus. To finalise the block, consensus is reached in two steps (Fig. 1).

5.1 Consensus Within Committee

Nodes present inside committees work iteratively in round robin fashion to select the trustworthy nodes whose action will be taken into consideration. After considering nodes, their signatures are verified and threshold limit of signatures is finalised for all the committees. If the number of signatures of trustworthy nodes matches with the threshold value, then consensus within organisation (committee) is reached. This task is performed iteratively, so as to finally reach the consensus within the committee. The selection of value of *n,* i.e. number of iterations is very crucial as it ultimately affects the convergence rate of reaching consensus.

5.2 Consensus with Other Committees

Leaders from the committees pass on the decisions taken by them to the neighbouring committees. Neighbouring committees also verify the decision by matching the count of threshold signatures and the nodes who signed the decision. This result is then passed onto the central authority.

Central authority verifies both steps and then eliminates the nodes that do not help in generating the decision or nodes that are considered to be non-trustworthy. The

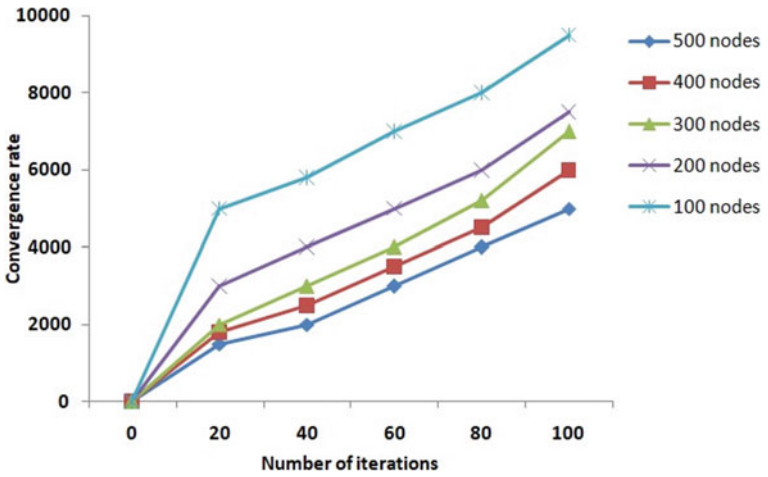

Fig. 2 Relation between number of iterations and convergence rate

final decision is then broadcasted to all the committees and blockchain is maintained at all the trustworthy nodes selected by the leader of the committee.

6 Results and Discussion

Experiment has been conducted by creating 40 committees using Python 3.6. The machines used in this experiment are i7-8565U CPU @ 1.80 GHz, 1992 MHz, 4 Core, 8 Logical Processors. Different number of iterations are conducted by fixing the number of nodes every time. Simulation of environment has been done using 100 nodes, 200 nodes, 300 nodes, 400 nodes and 500 nodes. Figure 2 shows the relation between number of iterations and convergence time. Number of iterations are varied from 0 to 100 for single committee. Convergence time increases almost linearly with the number of iterations and number of nodes.

7 Challenges

- **Security attack on committee**: The possibility of attack on security of committee exists only in that case, if majority of the nodes present in committee are malicious and leader is also malicious attacker. In this case majority of the nodes will do falsified signatures and leader will reach the agreement of signing the transaction or event.
- **Security attack on data**: When data is released by the parties, it is very important to check that data is not attacked when data is sent to committee. It will be treated

as data received from parties whereas the data will be false data that will be stored in blockchain
- **Appropriate implementation tool**: It is very important to decide appropriate tool for its implementation so that its computational task does not become very complex as the proposed framework includes excessive computation of node's signatures, verifying the signatures, keeping record of the neighbouring committees, etc.
- **Centralised control**: After reaching consensus within committees and with other committees, there is still dependency on central authority. Without involving, central authority assessment of real time attributes becomes very challenging.

8 Conclusion

Nowadays, blockchain is gaining importance because of keeping records in secure manner. There exists mainly three types of blockchain, i.e. public blockchain, private blockchain and consortium blockchain. Wide variety of consensus algorithms exist for these blockchains but they have their own pros and cons. Proof of Work consensus mechanism is elaborated along with the few consensus algorithms of consortium blockchain. Sharding-based approach is used in our framework for improving consensus mechanism of consortium blockchain. Committees of trustworthy members are formed. Consensus within committee and with other committees is reached which is further approved by central authority. Committees perform their tasks iteratively. It has been observed that convergence time increases almost linearly with the number of iterations and number of nodes. In future, extensive experiments need to be conducted for evaluating the robustness of our proposed framework.

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Chapter 32
Education Through NGOs: Challenges and Opportunities

Sandeep Mathur and Riya Saini

1 Introduction

Today, a large number of non-governmental organisations are working around the world to help the less fortunate in any way they can. Their role is significantly recognisable and highly appreciated in most parts of the world. Considering India, this sector is expanding day to day, with now having lakhs of such organisations in the country. In 2009, the Central Statistical Institute of India reported that India has 3.3 million registered NGOs or one for every 400 Indian inhabitants [1]. NGOs create employment for people as volunteers are essentially required for working in the NGOs; they might not pay a lot to the people working for them, but they develop a sense of humanity and unselfishness in the person which leads to success in life. The organisations work with a defined purpose and goals in order to fulfil the needs of the society or people it tends to help. Volunteers with an intent to help the people and work towards the upliftment of poor sections of the society, see children grow, mentally as well as physically and to see their faces and minds shine because of the knowledge they get every day. They think of various new and creative ideas every day because of the care and compassion which they have in their heart for the people who need them. Education has always been and continues to be one of the most important aspects of one's life. Providing quality education to the children of the marginalised and deprived sections of the society is one of the most important aspect to work upon as this will help the future generations in the best possible ways, be it career, employment, standard living, health, etc. and it also helps an individual in building up his/her self-confidence and enhance the overall personality. Many NGOs in our

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country and also in other countries are working towards educating the children of the country who are not able to get educated either because of poverty, unawareness, social biases or any other possible reason. Educational NGOs work together to make the parents, and the children realise the importance of education and make them aware about the benefits of being literate and educated in life. The main objective of such organisations is to increase the number of schools going children, inherit skills like communication skills, confidence and to bring an overall change in the mindset of the people who think that education is unnecessary; he or she doesn't need to have a purpose in life and can stay uneducated, such as in the case of the girls, especially. Empowerment of girl child has always been a need in our country and continues to do, so because there are still many of the people who feel that girls are not meant to get educated and do something other than household work in society, this mentality, of the narrow-minded ones need to change, and it will only be possible when education, knowledge and wisdom are a part of their life as then they will be able to fight for themselves in the society and know what is right and what is wrong for themselves.

2 Education Through the NGOs

Education becomes a key factor when it comes to bridging the gap between the children of the country. A child who is illiterate and doesn't know how to read and write will always feel morally down and lacked behind than the other children who know how to read and write and can access education through various means [2]. NGOs are capable of covering large areas of the society which makes them a really important part of the country. Children are an integral part of the country and that is why India has always taken the children very seriously. Providing education to the children belonging to economically backward class will help eradicate poverty in the country and enhance the development at various levels and here comes the educational NGOs which provide a platform for the children to get quality education and make their future better [3]. Otherwise, if a child stays uneducated, then he/she will not get a good job, and lack of job might make him/her get into unlawful activities and committing crimes, ultimately leading to hindrances in the development of society. Starting from the primary education to the secondary level education, many NGOs help children through it all [4]. Majority of them provide school fees, books, tuitions, and all other resources required by the students for studying properly. Volunteers are a key part of the NGOs as they are the ones to actually look onto the children and help them with their studies and problems related with it [5]. They are the ones to motivate, guide, emotionally and mentally support the children associated with the organisation (Table 1).

Table 1 Some NGOs and their role in educating children in India

Name of the NGO	No. of students enrolled	Impact
Teach for India	More than 33 million	Providing quality education to the children along with global exposure such as participations in model united nations (MUN), reaching in the top ten list of global design for change projects, etc. [6]
Pratham	About 4.5 million	Runs the teach at right level approach and has made about 0.8 million direct interventions with the children and youth and also has helped millions of dropouts (those who could not complete their education after class 10) in completing their studies [7]
Akanksha Foundation	About 10,000	Implemented their model of educating children across 27 Akanksha schools in Pune, Mumbai and Nagpur, providing good quality educations along with several other cocurricular aspects [8]
GavaKsh	About 100	Provides quality education through creative ideas to children living in slum areas, creating an environment for overall growth, be it mental or physical or children [9]
Aarti for girls	About 650	Andhra Pradesh-based orphanage, which supports abandoned girls, provides them shelter and education and new opportunities in life [10]

3 Challenges Faced by the NGOs

The first and foremost challenge faced by the NGOs trying to provide education to children is the social bias. It becomes very important and sometimes very difficult to tackle the mindset of the people living in the marginalised sections of the country; as sometimes, they are not aware about the importance of education, or they have hatred towards a particular religion or caste or the parents sometimes, don't want their child, especially, girls to gain education as they think that there is no benefit in educating their girl child. Such social biases create hindrance in the process of educating children. Secondly, fundraising becomes a serious issue when it comes to providing resources to children for education, as money plays an important role in every aspect (www.savethechildren.in). Thirdly, infrastructure challenges, in the past times, the only focus was on creating spaces and arranging hardware for the children, but now, virtual learning has become a very important part of the education system, and the technology has a vital role to play when it comes to the overall development of an individual. On the basis of a survey conducted by the Global Governance Initiative, only, 6 out of the top 32 NGOs have put in their efforts towards girl empowerment [11] (Fig. 1).

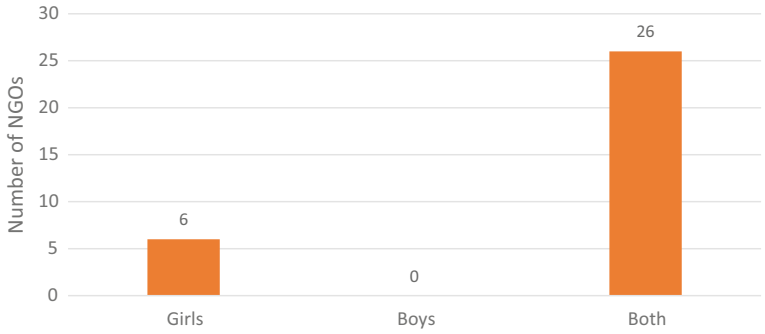

Fig. 1 Social biases against girl child

4 Effect of COVID on the NGOs Providing Education

After the pandemic hit, the country and the world as a whole, it became very difficult for the underprivileged children to gain education as they many of them did not have smart phones or laptops because of poverty, and also, many of the people, who are also parents, lost their jobs due to the pandemic and did not have money to fulfil their basic needs, so it was next to impossible for those parents to get a new mobile phone for their kids to study, and if some children had a smartphone, the Internet recharge for every month again became an issue for them because of the similar financial problems, and the network connectivity in such areas was also poor which posed hindrances in learning. Also, many of the children lost their parents or one of their parents which made them very unstable. Both the children and the organisations took a lot of time in adapting to the new mode of learning which was the virtual mode, and everyone has to go through a lot of problems whilst shifting to the online mode of teaching and learning.

5 Opportunities Provided by the NGOs in the Field of Education

Firstly, NGOs provide a platform for the children from the weaker sections of the country to get quality education free of cost. Secondly, they identify the vulnerable children from the poor sections and help those children go to school who are missing out on schools due to poverty or inaccessibility [12]. Thirdly, many NGOs help children complete their education who had to drop out or leave their studies in between because of various possible reasons. Fourthly, NGOs help girls get access to education who are not able to do so because of social stigma or other reasons and help them do good in their future by getting educated. Many NGOs equally focus on the cocurricular activities like art and craft, debate and help the children build

self-confidence in themselves so that they can freely and confidently speak amongst the people; various kinds of workshops related to science, communication skills, mathematical activities are conducted by the organisations in order to enhance the skill development in children. Other than just academics, many NGOs also provide mid-day meals and adequate food to the children so that they don't miss out on their studies due to hunger issues. Also, in the view of this pandemic, several NGOs have provided smart phones, Internet recharge amount, and other required resources to the children and are continuing to do so. For example, GavaKsh is an NGO which was initially started in Delhi for providing quality education to the children living in slums, poorer sections, but now, after the pandemic has hit the country, GavaKsh has been operating virtually for all the needy children who want to gain knowledge, and for this, they also provided resources required such as the Internet recharge amount every month and continue to do so in order to help and do good for the kids as much as possible. GavaKshars (volunteers associated with GavaKsh) keeps a track of growth by continuous assessments, interaction with the parents, etc. and there are several activities and workshops organised throughout the session for inculcating skills in the students (Figs. 2, 3 and 4).

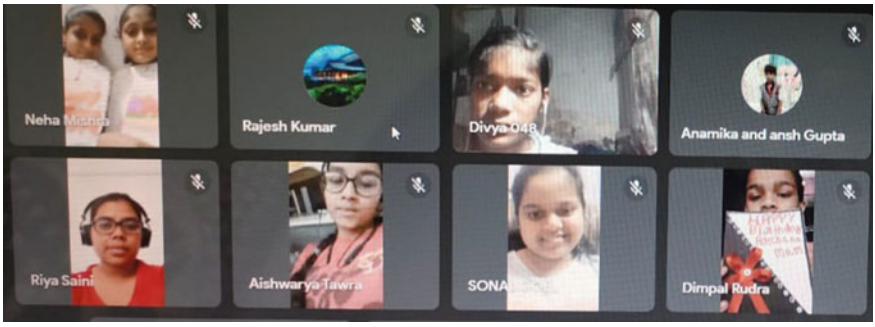

Fig. 2 GavaKsh digital Paathshala

Fig. 3 GavaKsh online class

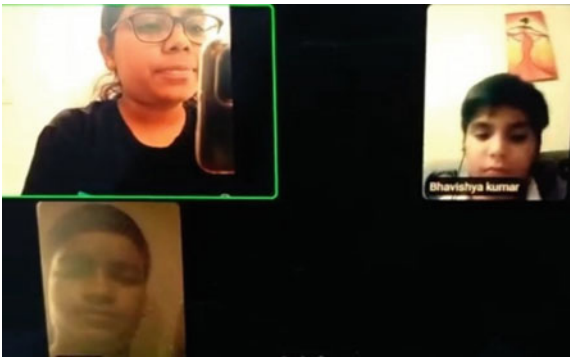

Fig. 4 Gavaksh online activity class

6 Conclusion

NGOs are the ones who genuinely care and are concerned about the underprivileged sections of the society. India, as a developing country, appreciates and needs more people and organisations like these for the betterment of the people and the country as a whole. The youth of the country should think about and work for such people who need them and should help the needy in solving their problems and do as much as possible for them. If everyone works together with compassion towards the people, then we will surely be able to solve the issues faced by underprivileged sections at grassroot levels and see them live a better life.

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Chapter 33
Delay Efficient Caching in Fog Computing

Divya Gupta, Shivani Wadhwa, Shalli Rani, and Parth Sharma

1 Introduction

Today, the majority of services are provided by the IoT devices through the data captured from the surrounding environment. This captured data after extensive analysis are essential for improving end user's quality of life [1]. The end user always demands reliable, real-time delivery of the requested content. However, these IoT devices are not enough capable with processing, storage, and computing resources to meet real-time requirements. The integration of cloud computing has been encouraged to support storage and processing requirement at the network core. The centralized access and remote storage of the content make cloud computing an infeasible solution for the time-sensitive applications. The fog computing has been emerged as the layer between cloud and IoT devices for providing computation and storage facilities near the proximity of end user [2] (refer Fig. 1). The request for any service is first processed by fog nodes to support timely response and is ultimately transferred to cloud in case of non-availability of requested content at fog layer. The various techniques had been proposed in past by various researchers to support delay-sensitive content delivery in fog environment [3]. The caching of frequently requested content at the fog nodes serves great help in minimizing the offered delay. The caching of frequent content at fog network nodes may not work well if the node selected for caching the content is not suitable. This work proposes efficient caching at capable nodes based on filtration mechanism for storing content inside fog network nodes.

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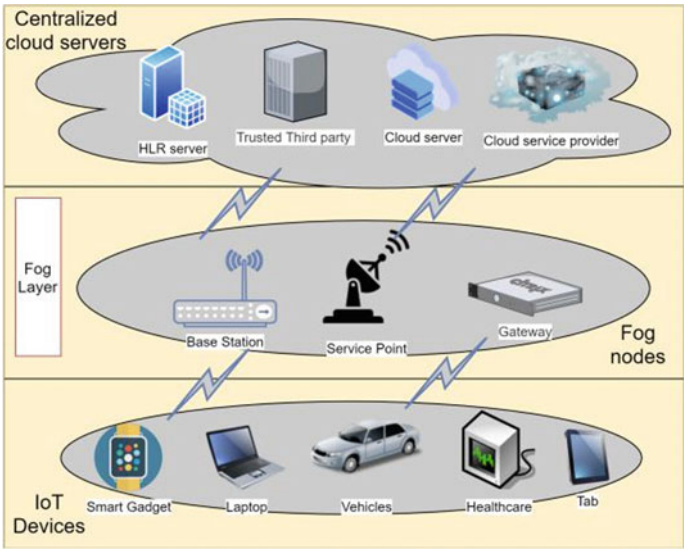


Fig. 1 Network model

1.1 Motivation

Fog computing is a decentralized emerging paradigm to enable various future technologies. The fog layer in the network architecture offers real-time services and is best suited for energy efficient communication as it is positioned near the end user. This research mainly focuses on the minimizing the content response delay for real-time application requirements with the use of fog computing as it is an emerging future technology. The real-time delivery of the requested content with the reduced delay will increase the overall system performance. The study in the fog computing has listed various research gaps such as task scheduling, energy efficiency, load balancing, security, real-time delivery [4], and many more will be explored in the future during study in the same domain. To make fog computing a standardized solution for future paradigms, these research gaps need to be addressed. Out of listed gaps, this study relates to address the delay-sensitive requirement for the efficient content delivery.

The remaining of the paper is organized as follows: Sect. 2 discusses the related work in fog computing environment for efficient communication. The design of the proposed scheme for delay-sensitive content delivery has been presented in Sect. 3. Section 4 demonstrates the results obtained after evaluating the proposed scheme under different simulation environments. Finally, Sect. 5 concludes the research work conducted in this study.

2 Related Work

The work in [5] focuses on energy consumption of clusters. This work proposed fog computing-based energy efficient load balancing scheme. The optimization in their proposed approach is achieved through practical swarm optimization technique. Similarly, the work in [3] proposed scheme for balancing the delay and energy efficiency for content communication inside homogeneous fog networks. They applied Lyapunov optimization for reducing energy consumption. The research in [6] is based on study of fog networks and fog data centers. They proposed holistic fog architecture to manage the excessive traffic in the network. The main goal of this work is to offer real-time delivery with use of fog layer. The work in [7] proposed game theory-based energy efficient task scheduling. The popular contents as a service were utilized to offer high scalability and reliability in fog network architectures. The work in [8] used named data centers as the servers for providing content based on user requests. The P2P-based communication and caching was even introduced in this approach to offer reduced delay. To perform computation offloading, resources are provided at the network edge through fog computing. Non-orthogonal multiple access (NOMA) was used for performing computation offloading, and multiple tasks were executed at same time.

The work in [9] discussed challenges faced by the fog nodes. The fog nodes are not as much capable as cloud servers to perform computation and storage. Therefore, data processing balance needs to be maintained between fog and cloud for efficient communication. To support energy efficient communication at fog, this work proposed dual-power source at fog layer to process the requests. They also used Lyapunov optimization technique on time and energy to process requests on time.

The work in [10] proposed a caching technique for optimizing the fog networks overall performance. The work suggested caching of popular contents on top level nodes. The criteria for selection of top level nodes is based on the maximum degree associated with each node. The node with highest degree in the cluster is selected as active node in the cluster and will be responsible for caching the content.

3 Proposed Scheme

Based on the study carried for real-time content caching, some research gaps were found in the paper [10], where caching of content inside fog network nodes is based on the content popularity.

Algorithm 1: Caching with Filtration

1. Computation of content popularity based on Zipf distribution.
2. Categorization of content popularity as highly popular, medium popular, and less popular contents.
3. Compute the degree centrality of each fog node
4. Sort the nodes in descending order of their computed degree centrality
5. Choose the node with highest centrality as active node and select content with highest popularity
6. If active node has enough computation resources
7. Cache the content on active node
8. Float the information packet inside entire network containing information of active node.
9. Else
10. Choose the immediate next node from the sorted node list and go to step 6.
11. Repeat the step after every 20 min.
12. End

The content popularity has been categorized in to three classes such as highly popular, medium, and less popular contents, and the caching of content according to classes is performed on active nodes. The node with maximum degree centrality in fog layer is selected as the active node for content caching. The reason behind caching based on node degree is that such node is highly accessible by all other nodes. However, selection of an active node based on degree centrality has some issues such as popular content may get cached on node which does not have enough processing and computation capacity. The caching of content on a node which has been selected based on weak approach will lead to poor system performance. To address this issue, this paper proposes filtration method before caching content on active nodes. In this approach, before caching content on active nodes, a filter will be applied to ensure caching of popular contents only at edge nodes which have enough computation and processing capabilities. To proceed with the filtration mechanism, an extra layer is added after calculating the popularity of the content. This extra layer called filtration layer ensures caching of calculated popular content only on active nodes with enough computation. The caching process is repeated every 20 min, and an information packet is floated in entire network which contains information of the selected active node. Algorithm 1 describes the complete caching process inside fog nodes based on filtration mechanism.

4 Evaluation and Experiment

The detailed knowledge about the experiments and results obtained by the proposed scheme has been discussed in this section.

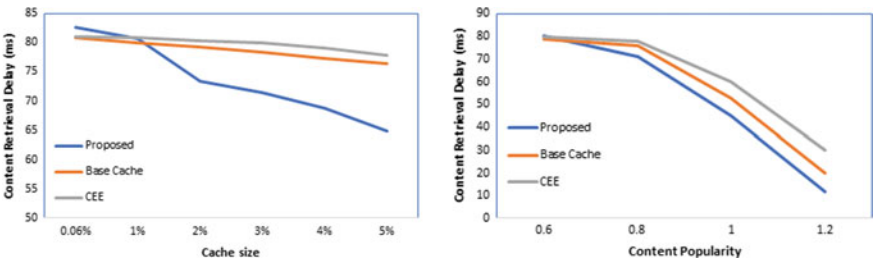
4.1 Experimental Setup

To evaluate the performance of the proposed algorithm, experiments have been conducted using Icarus simulator. This is Python-based simulator mainly designed for measuring performance of caching strategies in ICN environment.

The experiments have been carried using Tree topology. Out of 43 available nodes in Tree topology, 13 nodes are selected as fog nodes and 5 nodes as original content provider. Rest all nodes are used as clients requesting the content. The network is initially warmed up with default 3 * 10 * 5 requests, and performance is measured for 6 * 10 * 5 requests. The Zipf distribution has been applied to determine the popularity of the content. The simulator works in such a way that each and every request is first scanned to check popularity of requested content, and then, node based on highest degree centrality among available fog nodes is selected for content caching. To provide simplicity during evaluation, all the fog nodes have been provided with the uniform cache space, and all the contents are assumed to have same size. The experiments have been conducted to examine the content retrieval delay offered by the proposed algorithm, and the performance has been compared with base caching conducted in paper [10] and caching everywhere policies.

4.2 Results and Discussions

The results obtained from the experiments have been compared with different benchmark schemes. The content retrieval delay offered by the different policies under varying cache size and varying content popularity distribution has been shown in Fig. 2a and b. The graph plotted from the results proves better performance of the proposed approach for both varying cache size and content distribution. In the initial stage, high delay can be observed because of the calculations performed for determining popularity, degree centrality, and sorting. However, the average delay offered by the proposed scheme is far better than the delay offered by other benchmark strategies.



(a) Different Cache Size (b) Different Content popularity

Fig. 2 Content retrieval delay. **a** Different cache size, **b** Different content popularity

5 Conclusion

Fog computing is an emerging future technology to support QoS for end users. The introduction of fog layer inside cloud network infrastructure offers efficient communication for time-sensitive information processing to support real-time application requirements. Although a lot of research has already been conducted to meet these application requirements inside fog networks, still, design of an optimized delay-sensitive technique is an active research topic. In this paper, a filtration-based caching mechanism has been presented to cache popular content on best suitable nodes, also called active nodes. The suitability of fog node for caching the content has been decided based on the degree centrality of the node. The active nodes for caching the content are then filtered to allow caching only by node with enough computation resources. The evaluation results obtained after simulation show significant improvement for real-time content delivery by our proposed scheme in comparison to existing benchmark strategies.

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Chapter 34
Optimization and Pursuance Analysis of RDBMS for Relational Algebraic Operations—MySQL

Arpana Chaturvedi and Deepti Khanna

1 Introduction

Web-based application or Internet is required in our day-to-day life, so we need to check application performance optimization in any Web-based applications. It is very important to normalize DB so that it is used on the records (DB and Web site) according to requirements. Research paper always prepares according to research society's needs and requirements and its goal. We need to think about research analysis and data we selected for work. For the Web site, we always select a simple database of research applications. Perfect definition can't be explained for analysis, but we can specify requirements of Database (DB) and its specifications. To make Web-based applications more interactive and user-friendly, we need Database (DB) will be properly being normalized and useful for future forecasting and optimized any DB. For the selection of data, we need to concentrate a few facts they are as follows:

Data Selection based on facts and figure, it all depends on the DB we selected and how we analyze.

Web-Based application, we should keep in mind that DB should be simple, normalized, and optimized.

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Type of query performed, there are varieties of styles in which each query can be performed. A researcher needs to understand which parameters he/she select.

Quality Factors, for any research analysis, quality is an important factor that includes correctness, consistency, accuracy, robustness, user-friendly, user interface, verification and validation, and reusable.

For perfect DB, we need to understand research analysis for better performs selection, and designing of data should be kept in mind.

2 The Objective of Research Work

To understand the basic need of tuning any DB, i.e., to check the performance of any DB, we require RDBMS DB so that we can find applications, for instance, SQL statement tuning [2]. The next step is how CPU can be utilized properly with perfect response time and better memory usage. The second objective of our research work is to define the cost of any query for that we need to measure proper parameters like time required by each query and memory usage.

3 Problems Facing in Tuning MySQL DB and Its Solution's

We create DB named as research_work in MYSQL which consists of employee records of ABC Corp. These employee records are dummy record, department table which includes the entire department and its description. For evaluating the query based on the part of my research work and the preferred Database is MYSQL (DB) because it is open source and platform-independent. We can create the analysis so that to find out how much response time [3] perform by the server if we create any query and how good or bad MYSQL performs as a back end [4]. Various problems encounter are given below:

- Huge database.
- Least usage of index
- Avoid using a wildcard (*) character
- Avoid using MVD
- Redefine schema
- Avoid unnecessary column
- Remove duplicate column
- Write more precise query
- Reaction time.

To resolve the query, we need to perform technical tools and operations; they are given below in the Proposed Work.

4 Proposed Work

In any relational DB, we need to perform performance monitoring and data synchronization, so DB needs to be tuned, and popular tools are in use to provide optimized data [4]. There is a variety of DB available like relational DB, object DB, hierarchical database, network DB, and object-oriented DB; in our case, we select relational DB because we need to join two queries, perform normalization (3NF), and find the results according to that. In the market, various DBs are available like oracle, Sybase, MYSQL, SQL server, and IBM DB2, but we select open-source DB because it is easily available and more suitable and requires less memory space and better user-friendly, so we select MYSQL using XAMPP. Various advantages of using Database MySQL are platform-independent, great storage, allowing the query to perform all operations, perform cardinality, and multiple operations with multiple users. There are some disadvantage of using paid software is that it required programming skills, require good design tools. MYSQL is the best solution for selected as a back end, and we select PHP and HTML as a front-end tool.

4.1 Tools and Techniques

For research work, we require tools and techniques to fulfill the analysis and tuning of DB. We required various software and Internet facility. The hardware and software program necessities for my thesis presented are.

Hardware Requirements:

- Processor: P3
- RAM: 4 GB or higher
- Hard Disk: 320 GB or higher.

Software Requirements:

- Platform: Windows 10 pro
- MYSQL 10.1
- PHP.

4.2 Scope of Work

This study is based on the basis of the dummy database, i.e., research_work. In the research_work done for the employee database, we have considered employee records, and we have done the performance monitoring of different records. The employee schema includes various attributes; they are employee_id, name, and address. The research_work DB is a small database which consists of employee

and its department. For the analysis purpose, queries are primarily based on wild-card characters and with or without multi-value dependency; we perform all practical work in MYSQL as a back end and PHP as a front end. I execute the query to find out how optimized queries and improve overall performance analysis of the front end and back end. The various queries can be performed to calculate how performance can be monitor and tuning of MYSQL queries. I analyze query performance with or without performance monitoring techniques and reaction or response time for each query [5].

4.3 Solutions for Optimization of MYSQL DB

There are various problems related with any DB, but it is important to resolve problems and use optimization technique through which DB can be tuned and summarized easily. Each DB has different problems; these problems are related memory allocation, response time, and processing speed. DB may be freeware or paid. Space required to install any DB may be vary. MySQL is freely available [6, 7].

4.3.1 Huge DB

It is necessary for every DB to decompose and recombine to check working of any DB. It is important that if DB is decompose and recombine and provide lossless data. Figure 1 shows employee registration, but when we divide data or table into subparts, then we get decompose data, i.e., in the form of e1 and e2 table shown in Figs. 2 and 3, respectively [8, 9].

Fig. 1 Employee table

+ Options

Field	Type	Null	Key	Default	Extra
id	int(5)	NO		*NULL*	
name	varchar(230)	YES		*NULL*	
address	varchar(224)	YES		*NULL*	

Your SQL query has been executed successfully.

```
desc e1
```

+ Options

Field	Type	Null	Key	Default	Extra
id	int(5)	NO		*NULL*	
name	varchar(230)	YES		*NULL*	

Fig. 2 e1 table

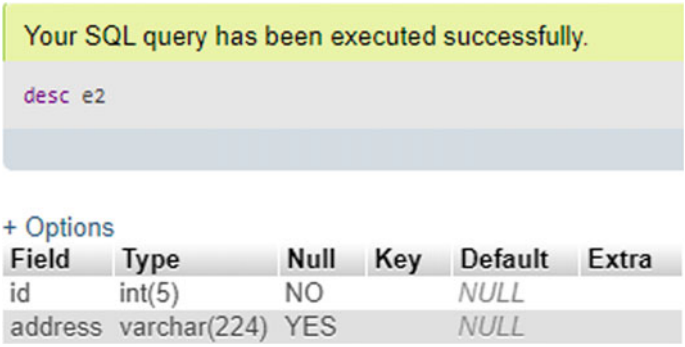

Fig. 3 e2 table

When we want to perform any query in employee table where we have 100 records, then time required by each query is huge, and same query we need to perform in e1 or e2 table then its less, shown in Figs. 4 and 5, respectively.

The diagram show time required to response in Fig. 4 shows 0.1121 s, and Fig. 5 shows 0.0023 s when we find all the records of employee whose name start with *s*. And we do same with e1 table and find the time required by each query to perform.

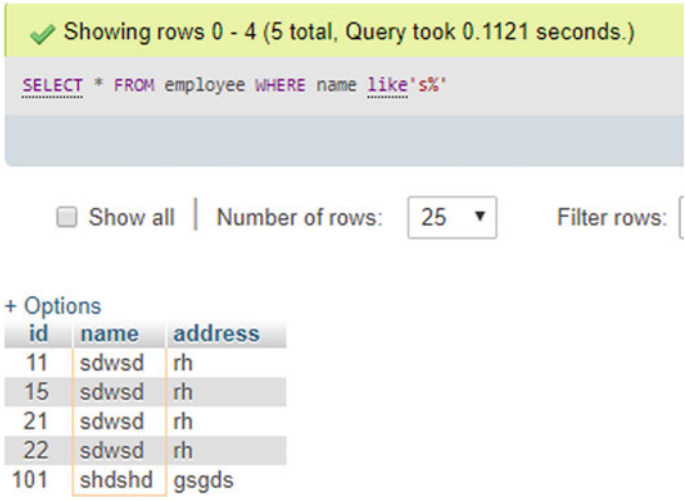

Fig. 4 Fetch record from employee table

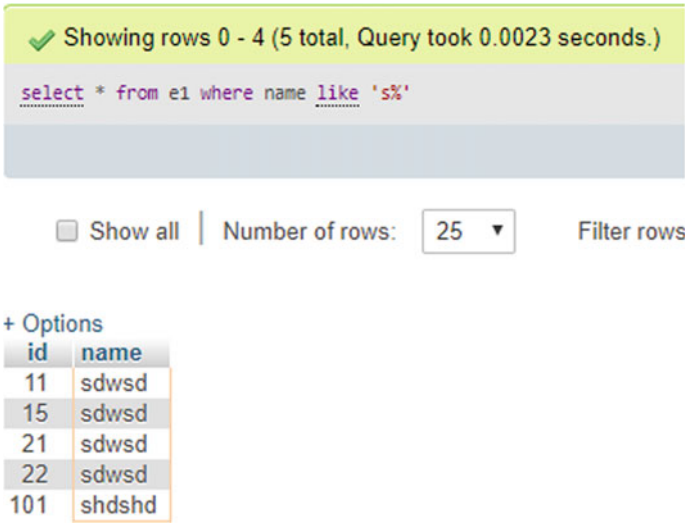

Fig. 5 Fetch records from e1 table

4.3.2 Least Usage of Index

Basic purpose of using indexing is that it save time, speed up for selection, and find large string, but in case of DML operations, it slows as we can see in MYSQL if we set index on e1 table on name field then time required to response is lesser (Fig. 6).

Earlier, it was 0.0023 s, and after indexing, it is 0.0019 s. But, when we add index, it required less time (Fig. 7).

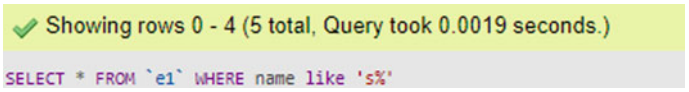

Fig. 6 With indexing on e1 table

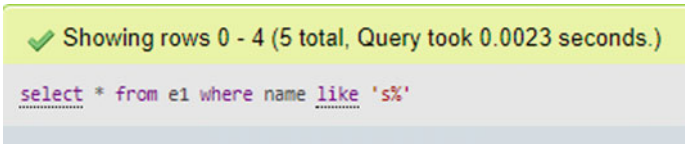

Fig. 7 Without indexing on e1 table

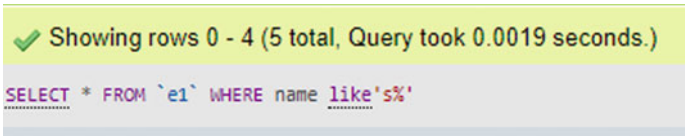

Fig. 8 With wildcard character

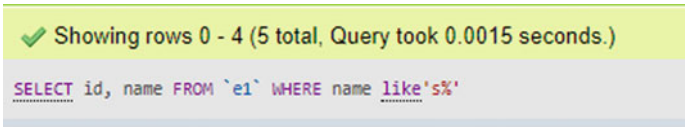

Fig. 9 Without wildcard character

4.3.3 Avoid Wild (*) Card Character

When we are using SQL statement, it is required that we need to avoid using wildcard character such as like with *, %, _ [10].

As shown in Figs. 8 and 9, when we use wildcard character (*), memory usage is high then other, i.e., 0.0015 s and 0.0019 s, respectively.

4.3.4 Don't Use or Avoid MVD

Best part of MYSQL DB is that it doesn't allow DBA to create multivalued object. If we want to create, we can create using manual method.

As shown in Figs. 10 and 11, we analyze that when we use multiple values, we get more value or more time to process [11].

Fig. 10 Without multiple value

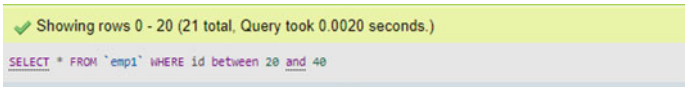

Fig. 11 With multiple value

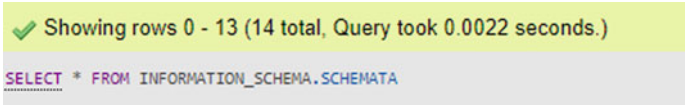

Fig. 12 MySQL schema which call object

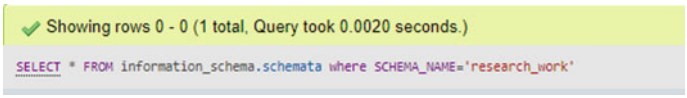

Fig. 13 Schema of research_work DB

4.3.5 Redefine Your Schema

It is required that you must analyze the column first then you select schema. In MYSQL, information_schema.schemata will check and refine schema created by the system (Fig. 12).

It contains memory stored in MySQL schema. It includes all the schema; we create schema for individual DB (Fig. 13).

When we collect information from entire schema or individual schema, result would be different.

4.3.6 Avoid Unnecessary Columns

It is necessary to delete unnecessary column from the tuple, and we get appropriate record and find the query very quickly (Figs. 14 and 15).

In case of emp1_1 table where fields or attributes are id, fname, mname, and lname, where as in case emp1_1_1, table attributes are id, fname, and lname. When we perform query 'select * from < table-name >', response time for both of the queries is different as 0.0021 and 0.0018 s, respectively.

Fig. 14 Query of emp1_1

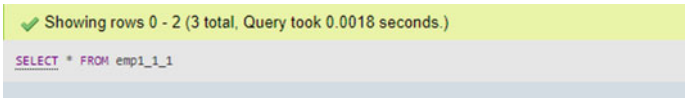

Fig. 15 Query of emp1_1_1

Fig. 16 emp1_1

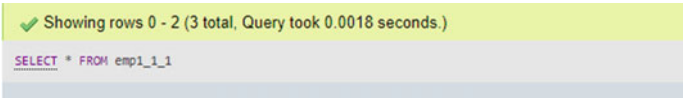

Fig. 17 Query of emp1_1_1

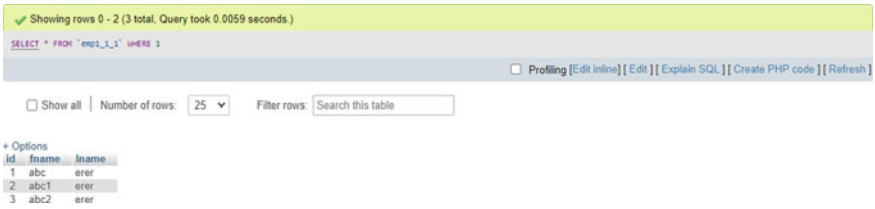

Fig. 18 Before using all fields record in employee

4.3.7 Remove Duplicate Columns

In case of emp1_1 table where fields or attributes are id, fname, mname and lname, where as in case emp1_1_1, table attributes are id, fname, and lname. When we perform query 'select * from < table-name >', response time for both of the queries is different as 0.0021 and 0.0018 s, respectively (Figs. 16 and 17) [12].

4.3.8 Write More Precise Query

Whenever we are writing any query, we need to write query according to requirements and specifications. It includes never use (*), avoid subquery, work on response time, as given below:

Never Use (*)

See Fig. 18.

```
SELECT * FROM 'emp1_1_1' WHERE 1
```

See Fig. 19.

```
SELECT id, fname, lname FROM 'emp1_1_1' WHERE 1
```

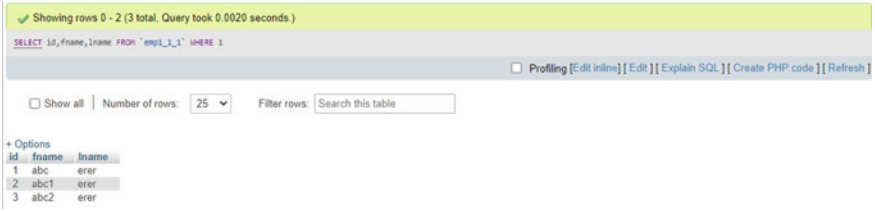

Fig. 19 After using all fields record in employee

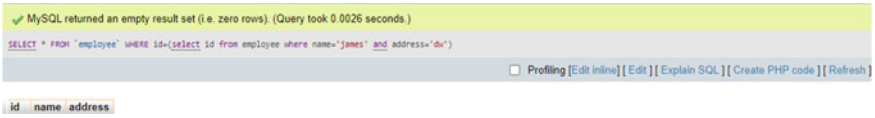

Fig. 20 Adding subquery

Fig. 21 Avoiding subquery when we are writing any query

Avoid Subquery

```
SELECT * FROM 'employee' WHERE id = (select id from employee where
name='james' and address='dw')
```

See Figs. 20 and 21.

4.3.9 Reaction or Response Times

We need to set timings of profile as 1. By default value of profiling is 15 and maximum, it is 100; it shows the usage of resources (Fig. 22).

5 Future Work

In future work, we implement more efficient and effective techniques to perform performance tuning by optimizing SQL queries. Few points which we will take care of is to not execute queries in loops as it slows down the complete sequence of a code, to use temp table in case of processing large volume of databases as it helps

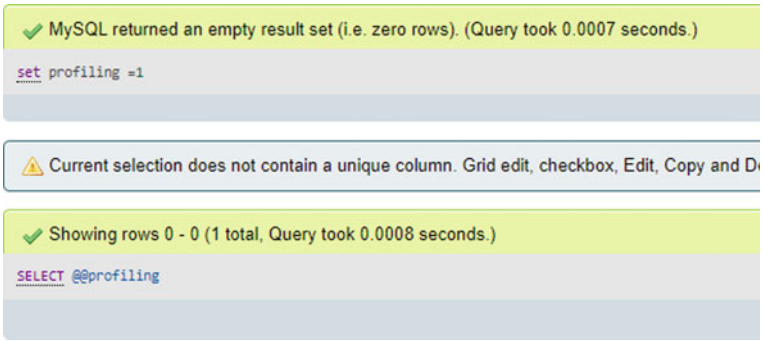

Fig. 22 Set profiling as 1

in reducing computing power, in spite of using linked queries suggested to use join to optimize time by reducing average cycle speed, to use where clause in place of having clause as it is much quicker and faster to execute queries, to filter maximum dataset at the server end as the less data retrieved, the faster the query will run, hence, it is better to limit the working dataset size. It is also suggested to use exists in place of count to find out existence of records as it is more effective and efficient. In case of large-scaled database and while doing indexing, use clustered and non-clustered indexes to reduce the execution time and to manage memory space. A clustered index requires no additional space, whereas non-clustered required additional disk space. It is also proposed to avoid use of distinct in select query. It is better to use select fields in place of select *. To define the optimal requirements before starting any query so that fetching the records from the database consumes less time.

6 Conclusion

Queries are to be executed in such a way that while working with large-scaled databases, it should take optimal time, and in a situation, when a small change has been made in the database, the preformation should not get effected drastically. The queries should be able to handle such situations.

We have created a three-tier architecture in this paper to optimize SQL queries. We have used various optimization techniques and performed performance analysis. The query processing time after every query along with its response time is checked during the performance analysis. It has been concluded that after applying various optimization and query processing tools, SQL statements are converted into executable code. The efficiency and performance are increased by removing indexes are removed; after adding a column in the table, it has been checked that yet it is accessible, and data can be manipulated efficiently without changing the program code. Various assessments are done using Show Profile and Show Status to check the status of each and every query along with its execution and response time. We have

also tried to perform optimized queries so that the memory utilization can be saved. We have also checked the multi-valued dependencies. These all processing are done using MY_SQL, HTML, and PHP [8–10].

In the future work, [11, 12]all mentioned tools and techniques will help in optimizing SQL queries and in performance tuning.

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Chapter 35
Chatbot Farming System

Tripti Lamba and Ritika Keshri

1 Introduction

The contribution to agriculture to Indian economy is manifold. It is the very promising field of growth potential. As we India is in 2nd rank in agriculture output, still, farmers of our country are finding difficulties to produce more because of lack of knowledge about plants disease; because of this, they can't choose right method to resolve the problem of plant disease. The consumer is also didn't get right quality of food as lack of knowledge about plant disease. They can't take correct measure to solve the issue, and because of this, the quality of crops becomes down.

In present-day, there are many popular algorithms in machine learning that have been applied in the agriculture sector, such as decision tree, KNN, and SVM. In this paper, decision tree is used to decide on the agriculture sector using Python language. Experiments on agriculture data with results.

1.1 Decision Tree

The decision tree is a non-parametric supervised learning method used for classification and regression. The main aim of to create this model is that to calculate the confidence value whether the particular disease is present or not. A decision tree is very simple to understand. It also requires too little dataset for the demonstration. In this type of algorithm, it can perform both the numerical values and categorical

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values. Decision tree classifier is capable of performing multiclass classification on a dataset.

Decision tree classifier takes two inputs an array of sparse matrix, and another is holding the *n* samples.

1.2 Machine Learning

Machine learning is one of the most exciting technologies that give computer to learn themselves. The ability to learn is the key feature of machine learning. Machine learning is actively being used today, and because this, it helps to find more feasible solution for our problems. Machine learning is one of the most interesting fields in information technology (IT) and computer science (CS).

1.3 Python

Python is a programming language that is used to create Web applications. It is general purpose interpreted, object oriented, high-level programming language. Python programming language widely used in machine learning and artificial intelligence as it consists of almost all libraries that is needed to perform jobs/tasks in these languages. It is very simple to implement the algorithm of machine learning in Python language, and because of this, python is now became very exciting programming language in market.

2 Problem Statement

INDIA as it is the second-largest agriculture country. The suicide rate of the farmer has been the major problem in agriculture; as the plants are not grow effectively, they didn't get proper amount of the plant, and because of this, they faces many problems.

Awareness regarding the plant disease [1] needs to be notified at the right time so that they can cure the plant disease. So, there is a a need for single mobile that simultaneously takes the feedback of the farmers about the symptoms of the crops. This need is not only to increase the profit but also to make a better life of the farmers and people who are consuming the product. Such devices are a basic need in our country INDIA.

2.1 *Various Plants Disease with Symptoms*

See Table 1.

3 Methodology

The data are collected from various sources that are present on the Internet. The dataset is generated manually by scraping the data from various Web sites such as agrifarming.in, britannica.com, krishisewa.com, agric.wa.giv.au, and biologydiscussion.com. This application is used to predict the plant disease in relation to the symptoms of the plants. The decision tree is used in this technique; this technique is used for small or moderately large dataset. This type of models is widely used in regression and classification task. The dataset learns the hierarchy of if–else question, to make the decision (Fig. 1).

Table 1 Plants disease

Plants disease	Description
Leaf rust	It is caused by pathogenic fungi. Rusts affect many economically important plant species and usually appears as yellow, orange, red brown, or black powdery on leaves, young shoots, and fruits [2]
Stem rust	It is same as leaf rust and also caused by pathogenic fungi
Sclerotinia	It is also known as watery soft rot, stem rot. It produces black resting structures known as sclerotia and white fuzzy growth of mycelium on plant it infects
Powdery mildew	As its name suggests, powdery mildew is visible as a light gray or white dusty coating on leaves, stems, flowers, or fruits [3]
Canker [4]	This type of disease mostly occurs on ornamental woody plants. It reduces the growth of the tree. It asks sometimes kill the entire tree
Bacterial speck [5–7]	It is similar with bacterial spot in appearance. The small black spot appears on plant leaves
Discoloration [8]	It is caused by when the soil is too wet. The extreme hot and cold weather will slow the growth of the plant
Mosaic	Mosaic plant is part of the **Fittonia** genus. Its scientific name is ***Fittonia albivenis***. Fittonia is an attractive foliage plant with leaves which bear a network of white, red, or pink veins. Unfortunately, the standard large-leaved types of Fittonia are very difficult to grow under ordinary room conditions—they demand constant warmth and abundant moisture around the leaves [9]
Spots [10]	Spots may have a range of colors but are frequently brown or slate gray. In severe cases, these spots merge, sometimes obscuring most of the leaf surface. Premature leaf drop may occur, but in some instances, there is little damage or effect on the overall vigor of the plant

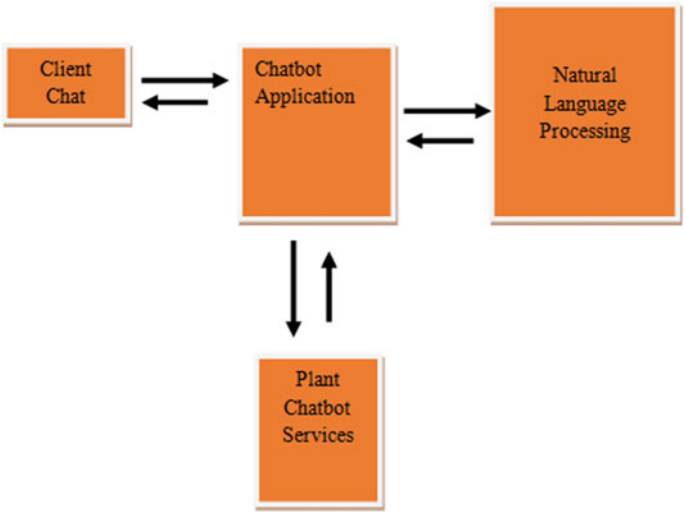

Fig. 1 Block diagram of the chatbot system

3.1 Research Method

The data are collected by scraping manually from various articles present on the Internet. The various data are present in the browser which helps in collecting the data. As these methods take time to get the details of the accurate data, it gives deep and complete knowledge of the data. They take time according to the depth of the data.

If the depth of the data is small, then it will take less time, and if not, it will take time to give the result. This method is used to generate or makes the dataset of the disease; dataset works like a backbone of this project.

Without any dataset, we can't predict or do anything. As each and everything is based on the dataset, everything is present in dataset and because of the task is performed.

4 Proposed Solution

The author has proposed a chatbot application which will help the farmer to ask his queries regarding the plant disease. This application not only helps the farmers to produce better products but also the consumer who consumes that product. The farmer oversees the activities of the farm and can immediately ask for the disease present in crop or plant and get the name of the solution and consultant of the specialist of the particular crop scientist. This application will make the better life of the farmer who doesn't have much knowledge about the disease of the plant.

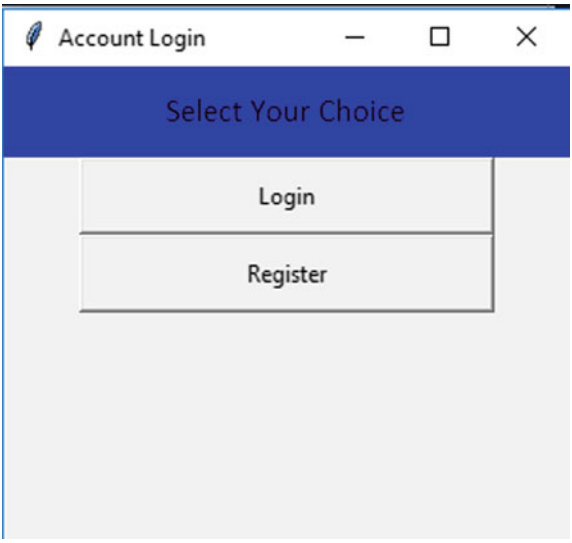

Fig. 2 Login and register window

5 Experiment and Results

The user will first login to the system by entering their username and password by clicking on login button. If the user is not registered in the chatbot system, then the user will first register to the chatbot system by entering username and password as seen in Fig. 2.

After login to the chatbot system, the user will click on the start button so that system can ask the various plants diseases to the user; after this, system will ask the question, and user will answer to the question by clicking to yes or no button as seen in Fig. 3.

According to the answer of the user, the system will display the disease and also the confidence level of disease present in the plant as seen in Fig. 4.

6 Conclusion

This application would help the farmer to find out whether the plants disease could be cured or not. The application would tell the percentage of disease affected in a plant. If the plant disease is less than 15%, then it is curable.

This application is only for the plant health purpose which checks the disease of the plants by asking the few questions from the user. It will help the farmer to take the action as soon as possible if they notice any unwanted things in the plants. It will make a better life of the farmer to grow healthy crops and also for the consumers who are going to consume the products.

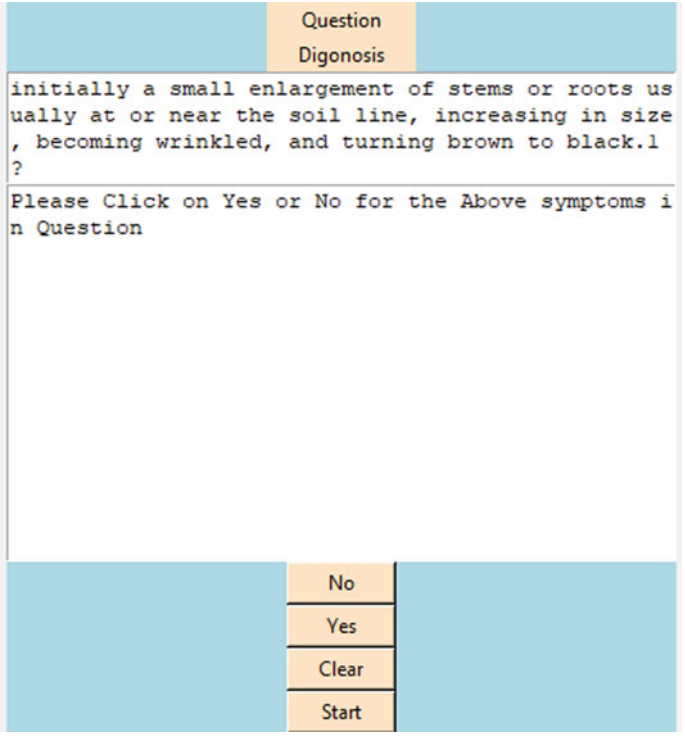

Fig. 3 Chatbot window

It makes the life of the farmer easy, and using such kind of technology, it is easy to grow anything effectively with the least number of problems.

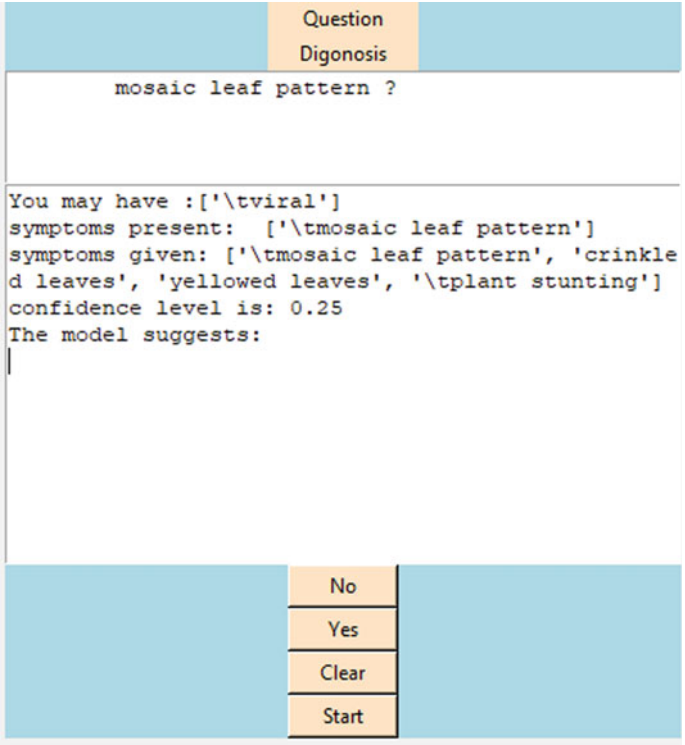

Fig. 4 Result

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Chapter 36
Smart Cities in Emerging Economies: Opportunities, Challenges and Policy Implications

Roli Raghuvanshi and Tanushree Sharma

1 Introduction

Professor John McCarthy in 1956 gave his views that Artificial Intelligence (AI) delegates "the science and engineering of making machines intelligent, especially intelligent computer programs". Stanford University's panel-AI 100 designated Artificial Intelligence as "that quality that enables an entity to function appropriately and with foresight in its environment". More definitions regarding AI reiterates that AI acts as a computerised system that acts and thinks like mankind. It is something that stimulates perception, spatial processing, reasoning, environmental scanning and many more things. AI creates an environment where continuous scanning of the environment goes on, experience is gained from the same and measures in lieu of what they feel or sense are taken. Depending upon the cognitive abilities that are simulated, we observe three categories of AI that are applied.

Basic Artificial Intelligence drives cognitive potential such as language, memory and attention, along with some executive functions like expectation and decision-making. It enhances the performance of business analytics solutions and improves the functioning of digital platforms. Examples include online matching, chatbots, credit scoring and smart speakers. **Advanced Artificial Intelligence** explores further in the simulation of human cognitive abilities such as perception, sight and spatial processing. It imitates the human mind and delegates the anatomization of unstructured data such as images, audio data and texts. Instantaneous applications include recognition of speech, health diagnoses, transport, urban planning, logistics, safety

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and transportation. **Autonomous Artificial Intelligence** is expected to be self-driven, with the capability to interconnect with mankind and acquire skill independently.

Today when we look at the cities, we find them to be sitting on a plethora of data, which are produced through usage of IoT, sensors, smart metres, telecommunication devices, traffic management systems, installed cameras, etc., (Fig. 1). Already the archives for many years are available to the government and agencies, and on the other hand, these smart devices are an icing on the cake which is playing a very crucial role the city management. The urbanization process and migration of labourers from rural areas at a fast pace is making the application of Artificial Intelligence inevitable for the economies, especially the emerging economies. We can certainly look forward towards an exponential growth using the available data and smart technologies. Artificial Intelligence has the prospective to make usage of the ample data and ameliorate the performance of cities, resulting into optimization of operational resources and operational cost. The role played by ICT in smart city development widely covers the areas [2, 3, 17]. AI has helped the local bodies, decision-making entities and government regarding many important issues [1]. Smart Cities have espoused the Internet of Things as a mode to inspire orderliness and performance in urban affairs. Artificial Intelligence paved the way for a platform that assists in gathering, analysing and distributing the data which plays a very prominent role in different spheres of life. In Bhadani [10] and Batty [9] case study of London, it was observed that Artificial Intelligence was smart enough to capture the location which had a problem of contaminated water and proper measures were taken to avoid any further mishappening to deal with high mortality rate cause of the contaminated water [11].

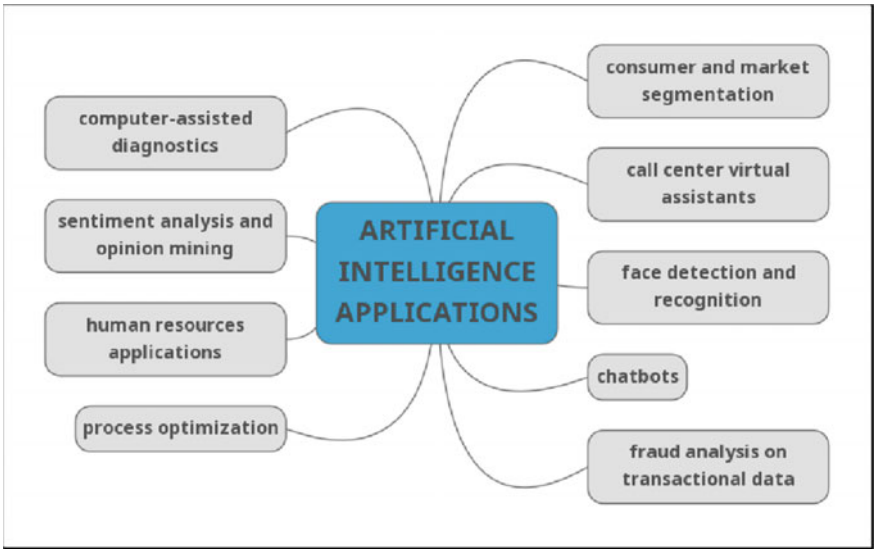

Fig. 1 Applications of artificial intelligence

Big Data from Artificial Intelligence also supports the attainment of economic goals with higher returns. Due to the implementation of AI in the process of developing smart cities, we see the availability of better supply chains, advanced infrastructure, good connectivity, real-time settlements, and high computing capabilities making it possible to have a competitive edge over others [12, 15]. The collaboration between mankind, Machines and big data enables enhanced governance, and Blockchain technology here plays a very significant role, contributing to management of the cities Voto [23]. The generation of big data related to the stakeholders of the city will help the agencies and governments to reach out to the citizens to get their view on city governance, and this will contribute towards inclusive decision-making [16]. The cities are witnessing vast transformations which in turn is gearing the demand for resources and land [6]. Artificial Intelligence is creating vast opportunities for the humans as it is ensuring safety, quality education, and better job opportunities [4, 5, 20].

Figure 2 depicts various advantages that come out of application of Artificial Intelligence in smart city development and the cities witness innovative products and effective business models including remarkable solutions, to business, household, government leading to tremendous results in the field of affordable cost, development of human resource and Innovative services rendered by government agencies.

The AI is most suited to the urban affairs as it enables personalised delivery of services, improves city planning, improves financial management of the city, improves coordination between the stakeholders, manages resource constraints,

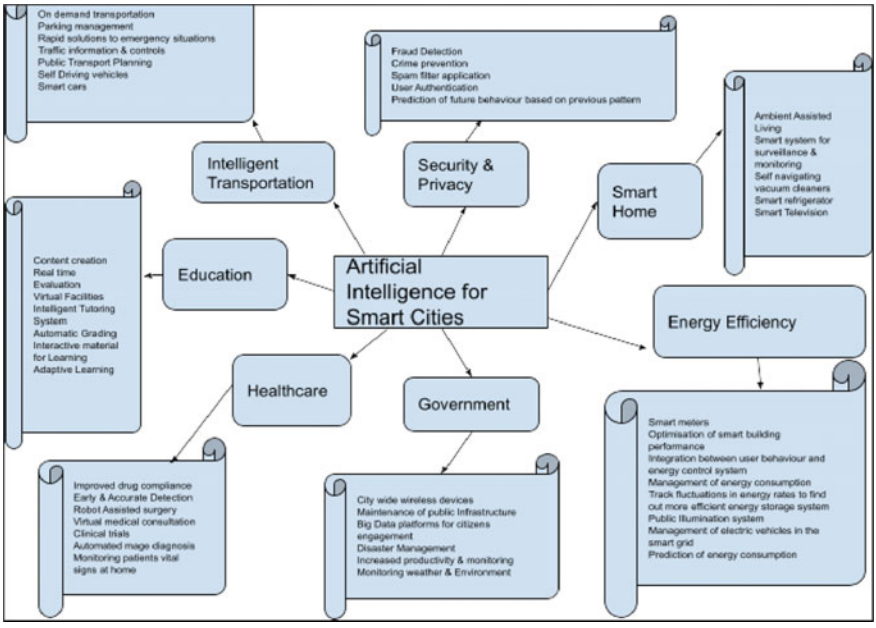

Fig. 2 Artificial intelligence applications for smart cities

increases the utility of existing services and platforms, improves access to city infrastructure and foremost helps in planning for the economic uplift of the city. Direct and indirect benefits could be generated through the application of AI in the cities of emerging economies. The betterment of cities could be experienced through quick, smooth and scalable solutions, and the citizens would experience a better lifestyle.

Though the implementation of AI in smart city development reaps a plethora of benefits, it is observed that the Artificial Intelligence poses certain threats also and this needs to be addressed. Autonomous AI is still nor very widely applicable due to its certain limitations.

For instance, challenges which occur due to large-scale automation like the problem of unemployment which is bound to happen with the implementation of artificial intelligence (AI) and machine learning, everyday increasing digital divide and technological divide, time lag in adaptation of new job requirements, privacy of stakeholders, trust issues and security matter. As we depend on big data, complexity cannot be overruled [7, 8, 22]. Storage problems, spanning and scaling are big challenges of Big Data. As big data is related to big sample sizes, therefore the problem of incidental endogeneity, accumulation of noise, factitious correlation and errors in measurements can be responsible for delayed results [25]. The ability to disseminate, investigate and gather information, using various devices in real time appends to the problems, and the issue of privacy and psychological comfort occurs to the urban people [13]. Due to technological reasons, the possibility of accessing private data is a major cause of concern as it hinders the privacy of urban dwellers. In Hildebrandt and Gutwirth [14], the social platforms make the private data public, thus posing a threat to one's privacy [26].

Absence of homogeneity among various devices, collection of large data and proper analysis enormous information and data security concerns, system failures, proper waste management, cost of operation, performance, connectivity issues and sustainability are some of the major provocations. The development of smart city faces the challenge of maintenance and design. Managing operational as well as design cost is a big deal especially with the emerging economies. To gain cost optimization in handling smart cities is a major cause of concern. The cities use the sensors, communication devices and appliances through a variety of vendors and for a variety of purposes. Therefore, integrating the diversified portfolio of the stakeholders becomes a challenging task, posing a threat to proper implementation of Artificial Intelligence in smart city development. The application is always better when homogeneity exists. Undoubtedly, the advancements in technology in all spheres of life have made it convenient for all; on the contrary, the malevolent threats have caused enormous worries about securing smart cities and rescuing them from possible pounce. Any dysfunctionality of a city management system poses a threat on a range of services offered to smart city residents. For example, if an automated water supply system gets disrupted because of some or the other reason, the supply of water will suffer and so will the residents as is witnessed at many times. Large information is gathered in the urban areas through smart city networks, and there is always a vulnerability regarding sensitive data of citizens. Data leakage and cross scripting is often experienced in AI-based smart cities [18, 24]. Day by day, this

issue is becoming challenging to manage. Big data generation and management is a tedious task as the storage and transfer of data, recalling the data and analysis of big data due to ever-increasing datasets. Due to its importance, it is a challenge in front of big cities to unleash new avenues to manage the big data management systems. A major key concern is about the environment and its protection. The decline in the carbon footprint has become inevitable for smart cities; therefore, managing things accordingly is a genuine concern of smart cities. The usage of renewable energy is important for overcoming the concern of carbon footprint, so the smart cities are expected to do it for the sustainable development. Energy utilisation and reduction in the carbon footprint has become the utmost priority of the city development authorities. Another challenge is managing the waste of the city, and it becomes more challenging when the physical structure of the countries is not uniform. On one side, the countries have plains, and on the other, the coastal area exists. Apart from this, we find the hot and cold desert along with less rain-prone and more rain-prone areas, as in the case of India. Lack of uniformity in the physical structure of the countries makes it a very challenging affair in case of waste management. Also, the collection of waste and the segregation of the same is a challenge. Huge population, unexpected natural calamities and scarcity of resources specifically in the emerging economies are a big hurdle in attaining the main purpose of smart cities. These disasters have a negative impact on the system functioning, and we see breakdown in the systems and failed management. Therefore, we see that the application of AI in smart city development comes with certain challenges and opportunities. The need is to identify and implement appropriate strategies to manage these challenges and get optimal outcomes as far as the positive side of AI in smart cities is concerned. The countries need to work upon recovery strategies to manage the failures in the system and attain maximum output with minimum cost, i.e. optimization.

In lieu of the same, we will focus upon understanding the opportunities and challenges faced by the BRICS Economies in implementing Artificial Intelligence for development of smart cities.

Kazan (Russia) organised and hosted a two-day discussion forum on October 19–20, 2020, "BRICS Friendship Cities and Local Government Cooperation Forum".

The discussion focussed upon the strategies in order to strengthen assistance and cooperation between the development authorities and municipalities which would induce the improvement in quality of life and prosperity of city residents. Representatives from 15 countries, 56 cities and 10 major municipalities and local governments participated in the forum. Final declaration was adopted at the finale of the forum where emphasis was on Sustainable Development Goals 2030 implementation which would inevitably bring improvement in the quality of life of people and welfare of the stakeholders (Economic Times, October 20, 2020).

The trend of urbanisation where the rural population is moving to urban areas as could be seen specifically in case of Asian and Latin American economies; it is inevitable to understand the dynamics of Smart Cities.

Long and complicated process is involved in constructing a smart city. The emerging economies have to see environmental sustainability and conducive technologies while implementing AI in development. If we consider the example of India,

we see that many cities are starting from scratch and the one already using AI has many more things to implement. Same is the case with other BRICS economies. The Prime Minister of India stated that in earlier times the cities used to be situated near by the bank of rivers but presently the setting up of smart cities will look forward to places where the access to fibre optic networks, roads, highways and all new generation infrastructure will be facilitated.

Beijing, Shanghai, Shenzhen, Hangzhou, Chongqing, Chengdu, Wuhan, Guiyang in China, Surat, Indore, Ahmedabad, Pune, Vijayawada, Rajkot, Visakhapatnam, Pimpri-Chinchwad and Vadodara in India, Obninsk. Moscow, Sholokhov, Yekaterinburg, Kaluga, Samara in Russia, Johannesburg, Durban, Cape Town, Port Elizabeth, Panseria, Mooikloof in South Africa, and Rio De Janeiro, São-Paulo, Belo Horizonte, Vitoria, and Curitiba in Brazil have adopted the AI at various level thriving to be best smart cities. We observe different levels of implementation of Artificial Intelligence in the cities of Emerging Economies, and also, it was supported in a recent report published by UNCTAD—"Technology and Innovation Report"—2021 which considered 158 countries.

A "country readiness index" (Table 1) is considered in the report which investigates the readiness and progress of various economies in using frontier technologies. Frontier technology includes nanotechnology, IOT, gene editing, blockchain, solar photovoltaic, Artificial Intelligence, 5G, robotics, big data, etc. The nations are assessed based on their capabilities in terms of human resource, investment capacity, technological endeavour like deployment of Information and Communication Technologies (ICT), financial status, industrial activities and Research and Development.

Further, in the report the index throws some light on the performance of some over performing countries. This section of over performing countries primarily considers the performance of the developing nations (Table 2). The over performance of these

Table 1 Readiness for frontier technology index, index score ranking

Country name	Total score	Total ranking	Score group	ICT ranking	Skills ranking	R&D ranking	Industry ranking	Finance ranking
USA	1.00	1	High	14	17	2	20	2
Switzerland	0.97	2	High	7	13	13	3	3
UK	0.96	3	High	17	12	6	11	14
Sweden	0.96	4	High	1	7	16	15	16
Singapore	0.95	5	High	4	9	18	4	18
China	0.76	25	High	99	96	1	7	6
Russian Federation	0.75	27	High	49	28	11	66	45
Brazil	0.65	41	Upper–middle	73	53	17	42	60
India	0.62	43	Upper–middle	93	108	4	28	76
South America	0.55	54	Upper–middle	69	84	39	71	13

Table 2 Overperforming countries relative to their per capita GDP

S. No.	Countries	Over performance positions
1	India	65
2	Philippines	57
3	Ukraine	47
4	Vietnam	45
5	China	40
6	Jordan	34
7	Brazil	33
8	Republic of Moldova	33
9	South Africa	29
10	Tunisia	29
11	Morocco	29
12	Kenya	28
13	Nepal	28
14	Serbia	25
15	Republic of Korea	24
16	Russian Federation	24
17	Lebanon	24
18	Togo	23
19	UK	21
20	Ghana	20

Source UNCTAD technology and innovation report 2021

countries considers the deviation of estimated index ranking from the actual index ranking based on per capita income of these economies. So the crux is that as per capita Gross Domestic Product of these countries, they are doing beyond expectation. An investigation of the Index in terms of outstanding performance revealed that despite comparatively low per capita GDPs they are doing great. With special reference to BRICS nations, four out of five countries make it to the top ten as depicted in the figure.

The index highlights the countries who are outshining in terms of frontier technologies with respect to their per capita income levels. Despite low per capita income, these emerging nations are doing more than expected. The deviation of the estimated index rankings based on their PCI from the actual index rankings is measuring the overall performance of these economies.

The performance of India is best in this category as the estimated rank was 108 as per capita income, but the actual rank holding stood to be 43 so the difference between them stands to be 65 giving India an edge of overperformance by 65 ranks. With 57 Philippines was the second to make it in this category. Next stands China with 40 and Brazil with 33 ranking positions. South Africa among the BRICS overperformed by 29 ranking positions and finally the Russian Federation by 24 ranking

positions was able to make it into the top 20. Amongst the top 10, 4 of the 5 BRICS nations outperformed, which is a matter of great indulgence in using appropriate techniques to transform their economies.

Analysing the rankings on five parameters of ICT, Skill, R&D, Industry and Finance in term of the BRICS nations, we observe that China is best among them in Finance, R&D and Industry bagging 6th, 1st and 7th rank overall, respectively. In R&D and Industry, the second position is captured by India with 4th and 28th rank overall, respectively. In ICT, Russian Federation and South Africa followed by Brazil stands out to be 1st, 2nd and 3rd among the BRICS, and in skill rankings, Russia, Brazil and South Africa surpass China and India.

The positions of India and China in R&D and Industry are attributed to their skilled workforce available at reasonable cost. The demand generated from a large market presence also contributes to this achievement. FDI inflows are another important aspect, and the Chinese government infusing two per cent of GDP in R&D does make a huge difference. China and India are the countries which supply abundant labour who are also highly qualified and skilled. This is substantiated by the presence of huge markets promising huge demand for products and services, therefore grabbing the attention of multinational giants. In China, two per cent of the Gross Domestic Product is invested in R&D and the reflection of this phenomenon could be observed everywhere. However, in ICT connectivity the BRICS do not show very impressive results and comparing amongst them it is observed that China and India lag behind Russia, South America and Brazil. In the same manner, they lag behind in ICT skills, especially South America, China and India. The potential of emerging countries of BRICS is immense, and it is of utmost importance to understand the opportunities and challenges faced by these economies on various fronts.

2 AI: Challenges and Policy Implications for Emerging Economies

Demographic changes, low economic diversification, existing technological gaps, weak financing mechanism, issues related to intellectual property rights, automation taking jobs in large scale, job polarisation, less citizens engagements, security and privacy concerns, inequalities driven by Artificial Intelligence and widening technological gaps are few major issues that needs to be addressed immediately. The need of the hour is effective policies and guidance in terms of usage of technology, strengthening the framework and most importantly citizens activism.

In cultural and societal aspects, the challenges of maintaining human interconnection and a sense of belonging are of utmost importance. The GPS-based tracking data, associated with data on consumers regarding preferences, location, and personal interests, based on the Internet of Things poses security and privacy concerns. Reinforcement of existing social inequalities could be observed in the country rather than observations on the positive side where inclusiveness is witnessed. There are

populations which do not wish to interact with the digital infrastructure of smart cities because of privacy concerns. Also risk in terms of unequal growth is inevitable when the affluent society segment has a dominant role to play in comparison with the peripheral segment. Massive development that has been brought up by smart cities have also posed a threat to the environment. Migration from rural to urban areas is causing ecological stress and pollution problems. Unplanned settlements in the urban area are responsible for congestion, and also, groundwater levels are suffering due to this massive development.

Lack of citizen participation is also considered to be a major challenge in smart city development in Brazil. Majority of the ongoing projects have no participation from the public, and therefore, the representation is almost negligible from the locals who actually face challenges on a day-to-day basis. Monolithic policy formulation induces ambiguity, and better views could not be placed for smart city development.

According to UNCTAD's 2021 "technology and Innovation Report", job, wages and profits are impacted by technological changes, therefore the countries need to be responsible for bringing changes in the policies so that proper use, adequate adoption and adaptation can be done country wise. Whatever technological changes are taking place in these economies they must be guided by societal needs and social framework. Convergence between Science, Technology and Innovation and other policies, like education, urban planning, fiscal and monetary, industrial and transport is inevitable for proper implementation of Artificial Intelligence in Smart Cities. Adoption and adaptation of technologies in an effective manner need the upliftment of digital skills among the citizens.

The nations should also think of open data initiatives. It will ensure deeper and active participation of citizens, and the local authorities would be able to implement it in a better manner. The agenda of inclusive development will also be taken care of.

Also, coordination and integration of civil society organisations, educational institutions, research institutions, private public partnerships and other stakeholders will help in implementing AI in a much better way.

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Chapter 37
AMSS: A Novel Take on Web Page Ranking

Yash Matta, Dheeraj Malhotra, and Neha Verma

1 Introduction

Web-based business is one of the segments in a portion of the nations that are developing quickest over the past specific years, particularly in a country like India, thickly populated because the quantity of web clients is expanding much of the time step by step [1]. In this day and age, individuals are more dependent on web-based business sites because of the enormous number of pulling in highlights they are giving [2]. In this way, with the expanding prevalence and request of such sites among individuals, there is a need to fulfill these requests effectively. Because of this, presently organizations are laying increasingly more accentuation to give clients the best experience and are thinking of the increasingly more new number of highlights in their sites and are putting more challenging work increasingly to keep up a pace in the present market and to keep up their notoriety in the market which can thus bring enormous incomes and sentiment of altruism to their venture. Because of such a massive number of Internet business sites, it has gotten hard for individuals to pick the best optimized site among all the sites present, giving the best understanding and the one on which individuals can depend for their essential everyday needs. This should be possible by positioning the website pages as indicated by a portion of the highlights like time, multifaceted nature, trust factor, the number of references, and input. There is a critical prerequisite to creating productive calculation which can work on the outcomes

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given by the various web crawlers like Google, Yahoo, and so forth [3]. The objective of this research paper is to talk about a portion of the prior proposed calculations and models and set up the best one, which can improve the idea of positioning the web pages all the more proficiently, which can create more exact outcomes in less time. Therefore, this paper will present a site positioning framework called "*Advance Meta Search Syste*m-Advanced", means which will rank the sites dependent on references recorded, time unpredictability, criticism/trust factor mining, and so on. This will not help favoritism between the online business sites and give reasonable outcomes since this framework deals with human ward factors, for example, recording how much time the client spent on a site, getting input by doing surveys, and registering references. The framework will improve its outcomes each time on account of the significant data analytics calculations are utilized. The rest of the paper is categorized as follows. Section. 2, highlights the writing audit of different accounts dependent on suggestion arrangement of online business site or positioning of Internet business site. Section 3 comprehends why we need this framework for positioning and gives its model of working. Sections 4, 5 and 6 discuss about the working of the framework, which offers the calculation of time recording, its utilization for positioning and visualizes the outcomes separately. Section 7, highlights the conclusion and the future work followed by references.

2 Literature Review

Web Mining is used for mining information strategies to find information from the Web. Anyway, all the old Web mining methods are not productive enough to fulfill the constantly developing needs of the present-day client. Consequently, the research is ceaselessly emerging. Poonkuzhali et al. in their paper illustrates about "recognition and removal of redundant web content through rectangular and signed approach", proposed a redundancy computation algorithm utilizing $n \times m$ Matrix age and marked methodology [1]. The goal is to improve the query item as far as accuracy and review through correlation among positive and negative tally of different expressions of a client search string [4]. Bhanipriya et al. in their paper "*Web Content Mining Tools: a near report*," clarified Web content mining and its related procedures and examination of different instruments for Web content mining, are incorporated, which serves to comprehend the usefulness of different accessible devices for Web content mining [1]. Hillol Kargupta [5] in their book "*Information Mining—Next Generation Challenges and Future Directions*", clarified rudiments of Web mining, and it depicts applications identified with the Web Technologies just as up and coming examination bearings [6]. Gupta highlights various case studies using "*Information Mining with Case Studies*", and clarified different contextual analyses identified with information mining, for example, affiliation mining, web crawler, and so on. This writing assists with understanding the fundamental looking through strategy and its engineering. He additionally clarified the page positioning calculation utilized by

Google. This book further clarified the wording of Web mining and different components to decide the accuracy of exploration [7]. Han et al. in their book "*Information Mining: Concepts and Techniques* ", clarified different fundamental ideas on information mining, and it incorporates different zone of usage of information mining methods [8]. Cooley et al., in their paper "*Web Mining: Information and Pattern revelation on the World Wide Web*", clarified the scientific categorization of Web Mining. A portion of the methodologies for Web content mining are Agent-based methodology, Database Approach, and so forth [1]. Web Miner, design disclosure apparatus naturally finds affiliation rules and consecutive examples from worker get to logs. After example disclosure, design investigation is required, which might be practiced by Web Viz. Framework, OLAP strategies, or SQL-like question system as proposed by Web Miner. The paper further clarified the design of web usage mining, which can be partitioned into two sections, for example, subordinate area procedures which incorporate preprocessing, exchange distinguishing proof, and information reconciliation parts. At the same time, another division is a space-free application [1]. Cooley et al. [9] in their paper "*Finding information from hypertext information*", they recommended the methodology of finding information from hypertext information through essential looking of information. Learning models are proposed as managed and solo learning [10].

3 Research Problem

1. Gigantic development of the Web is generally treated as colossal development of data, yet it is likewise going with the number of challenges in separating helpful and significant information [7]. The unoptimized nature of the Web is answerable for making the circumstances far more atrocious because of the nonattendance of an idea, for example, list in Web.
2. Subsequently, the User is subject to look at motors and search indexes. So forth, yet a portion of the everyday issues related with web indexes are abundance or shortage problem: User typically ends up with thousands or even more connections if the pursuit point is well known and at times not indeed, even a solitary relationship [1].
3. How to pass judgment on the unwavering quality of positioning of Web pages gave via Internet searcher [7].

4 Research Methodology

Web business has become a piece of many individuals' lives in this technological world and has developed quickly in the past specific years. As per e-Marketer, Asia–Pacific will remain the world's most significant retail web-based business advertise all through the gauge time frame, with deals expected to top $1 trillion out of 2016

and more than twofold to $2.725 trillion by 2020. Likewise, the locale will observe the quickest ascent in retail web-based business deals, climbing 31.5% this year [11]. In any case, this has brought about an increment in the no. of web-based business sites, with which the clients are having issues in contrasting the internet business sites. Subsequently, this paper is proposing a Meta search system—Advanced Tool (AMSS) and (PPA). This area will discuss the vital realities of the proposed model and calculations utilized in this paper, for providing optimized web-based business site positioning. The proposed framework likewise challenges the virus start by the other web indexes just because of clients. The proposed framework can handle this issue of cold beginning with the assistance of information mining procedures with which the framework gives the outcomes to new clients by mining the information of old clients having same sources of info/inquiry and by giving them semantic outcomes as positioned internet business sites. This framework is best from the client perspective since it is verifiably subject to the client activity and develops itself by utilizing information mining calculations dependent on client activities.

5 Advance Meta Search System—Advanced Tool

Advance meta search system—advanced tool is an incredible framework, which can rank the sites more precisely and exactly when contrasted with a portion of the prior proposed frameworks for site positioning. Along these lines, it is essential to have a client account on the framework through which the above-proposed framework will keep up a database record for every client, for example, the number of snaps on a specific connection, time spent by the client in that particular connection or site and so forth which thus will give better outcomes by information mining with the assistance of AI calculations utilized in the above-proposed framework. Therefore, the proposed AMSS tool will give many precise outcomes to the clients.

5.1 The Proposed Model: AMSS

The proposed model implements various steps as follows:

5.1.1 Input from User

Initially, the client approached to enter his/her quest inquiry for a specific item. For instance, if the client inputs “Samsung phones” to look. The framework will accept the contribution of the client’s worth and send it to a database. From here, the watchwords are additionally handled to the Data Cleaning step, which has been talked about as beneath.

5.1.2 Data Cleaning

The framework has acknowledged the catchphrases from the client, in the type of search input from the above explanation. Presently, in this progression, two procedures will occur:

1. Input mining
   Input mining alludes to the evacuation of stem words or undesirable words from the hunt question entered by the client in the initial step. Presently, the outcomes from the database are acquired on the premise of mined input and before evaluations done by the arrangement of sites on drilling the record of snaps on the connections.
2. Semantic watchwords extraction
   After the procedure of Input Mining, we move to the subsequent stage in which the client will additionally be given the decision of quest for hypernym or hyponym, which alludes to the specialized significance of the input question entered by the client and hyponym which alludes to some particular importance of the pursuit question if no hypernym exists for the hunt inquiry lastly it will search for equivalent which indicates to the general significance of that specific question if both hypernym and hyponym do not exist. This additional component is beneficial for the clients when the client does not realize that 'For what he/she is searching after the fulfillment of this progression, the framework further moves to the time spent mining process.

5.1.3 Time Spent

Time spent alludes to the chronicle of time finished every second by the client on a specific Internet business site in the wake of tapping on the connection of places by the client. More noteworthy the time spent on site more noteworthy the need in positioning framework. In the given graph, the time work is called recursively and dispatches the information recorded to the database consistently until the client shuts the program (Fig. 1).

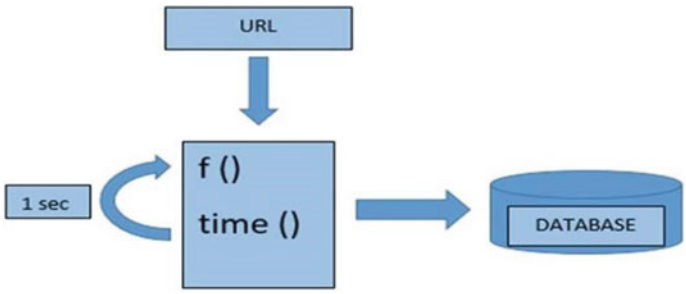

Fig. 1 Time spent calculation model

5.1.4 Customer Response Mining

In the fourth step, an Feedback Mining Tool (FMT) is being utilized, The instrument will acknowledge the input from clients and afterward measure them to mastermind that criticism's likewise. AMSS will evaluate the E-trade sites with important information on the top, and areas having the most noticeably terrible complaint will be appraised in the last. Moreover, this apparatus will direct ordinary studies and solicit the clients to give input from the sites for the positioning reason. The device will be computing a standard rating, and after figuring the average rating from the criticisms performed by the previously mentioned instrument, it will rank the sites likewise. At last, from here, the outcomes are sent to the last advance (Fig. 2).

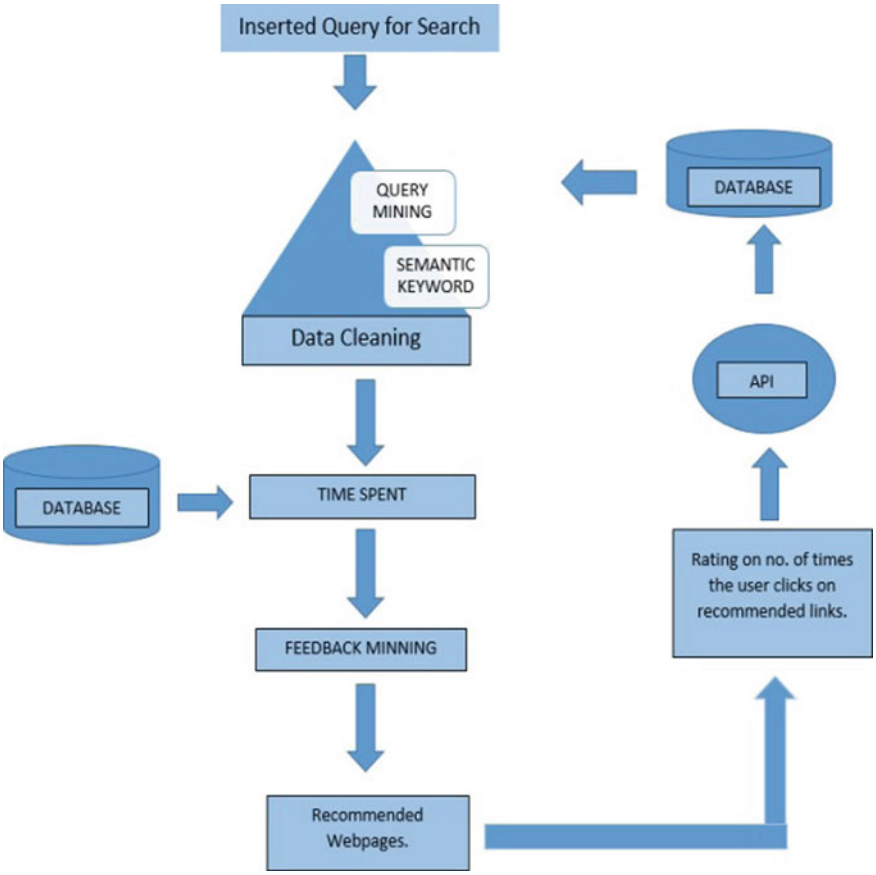

Fig. 2 Model of AMSS

AMSS Tool			
Sign		Log-In	
User Id- abc12832@.....			
Password- **********			
Enter Search Query: -			
Search		Reset	
Hypernym	Hyponym		Synonym
Rank	Web Links	Feedback (ratings)	Time Spent (in seconds)
1. 2.	www.apple.co.in www.worldfoot.com	201 169	1107 1690

Fig. 3 The interface of the E-commerce page ranking tool

5.1.5 Suggested Website Page and Their Rating

Lastly, the positioning of suggested Internet business sites appears as yield. At whatever point the positioned joins are clicked, the particular name of the specific site having some number worth is expanded by 1.

6 Page Positioning Algorithm

The steps for proposed algorithm are as follows:

Step 1: Accept query string from the User.
Step 2: Remove stem words from a string.
Step 3: Determine minimum and maximum length.
Step 4: Check for hypernym, hyponym, and synonym if available in the database.
Step 5: Create a web document.
Step 6: Retrieve time spent by the User on each website from a database.

TIME ( )
IF database -> username, site name

Time = Time+1
Else Create tuple -> username, site name
Set, Time = 1

Step 7: Arrange web documents according to time in descending order.
Step 8: Retrieve feedback rating from a database.

Feedback ( )
Get feedback string from user Remove stem words Compare ()
If words in favor Counter ( )
Feedback = Feedback + 1
Else Return zero

Step 9: Arrange web document according to feedback rating in descending order.
Step 10: Display ranked web pages.
Step 11: Record no. of clicks on the recommended links.

Link (username, site name)
Click = True, $A = A + 1$.
Store A in the database.

7 Experimental and Graphical Analysis

To test the general productivity and the viability of the proposed framework, the model appointed 123 volunteers, of which 63 were males, and 60 were females. All the volunteers were experienced who do an exchange on web-based business sites usually. They were approached to introduce this proposed framework and first complete the joining cycle. The volunteers were come to look at the AMSS an Ingenious Approach for E-Commerce website ranking 1479 execution of ~~our~~ proposed framework concerning AMSS apparatus [3], rehashing the accompanying strides for in any event 3–4 preliminaries on every one of advanced and AMSS tool [3].

1. The volunteers were told to look through an item inquiry; for instance, *Reebok buy*s rather than *Reebok shoes buy*.
2. Also, the framework will evacuate stem words like an, an, and so on, if any in the search question and will look for hypernym, hyponym, and equivalent for the same search question.
3. Thirdly, the proposed system will ascertain the time spent by every one of the volunteers on a specific site. More prominent time spent will give higher needs in our framework.
4. In the fourth step, proposed system will request that the volunteer evaluate the information available on site.
5. In this progression, the positioning of various sites is delivered as yield, and the proposed framework gives correct ranking. On the off chance that any of those connections are clicked, at that point, their qualities were incremented by 1 (Fig. 3).

Fig. 4 Comparison between IAMSS and AMSS

The website page's pertinence for a given pursuit question relies fundamentally on its position among the list items. Here, we have analyzed our proposed AMSS tool with the IAMSS tool [12], where we have thought about accuracy at *A* metric, signified by $P(A)$. $P(A)$ reports the small portion of named results as pertinent, accounted for in top an outcome. What's more critical is viewed as that a site page positioned higher is more relevant. The correlation of accuracy between the proposed AMSS tool and IAMSS has appeared in the diagram underneath. The plotted diagram that appeared in Fig. 4 analyzes the accuracy of the vertical hub and the number of preliminary attempts, which is on the flat pivot for a similar pursuit inquiry. As demonstrated by the diagram, the results created are vastly improved so that the above-proposed tool can be utilized for development in the page positioning interaction.

8 Conclusion and Future Work

In the research work, the proposed model introduced a system of ranking websites called the AMSS tool. The system works and gives results based on various factors such as feedback mining, time spent mining, query mining entered by a user for searching. The proposed ranking system includes a 3-stage ranking combined to give the orders based on feedback ratings. This research work also discusses the other research papers based on a hierarchy of websites. The article also proposed the PPA algorithm used for recording the time spent by the User on a particular website. The system worked accurately, as shown by the experimental evaluation in the form of graphical analysis. The result of the experiment shows that the algorithm worked properly and gave accurate results. Machine learning and data mining algorithms are also adopted to provide better results to each User every time.

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Chapter 38
Impact of COVID-19 Vaccination: A Machine Learning Approach

Ekata Gupta, Mukta Goyal, Abhishek Srivastava, and Anchal Pathak

1 Introduction

At the point when coronavirus hits our nation, in the same way, as other different nations of the world were totally ill-equipped. We had clinics facilities, no one had considered treatment for coronavirus, and no one had committed communities for it. Not very many individuals made veils, no one had PPE units. By doing an early lockdown, we got an opportunity to set up a well-being reaction for something which was uncommon. The outcome is, "we have one of the most minimal case-casualty rates on the planet, we have one of the most noteworthy recuperation rates on the planet", says EAM Dr S. Jaishankar, in Vijayawada. We are amidst a worldwide general well-being crisis with the spread of the novel serious intense respiratory disorder COVID 2 (SARS-CoV-2), which causes COVID infection 2019 (COVID-19). A protected, powerful, open, and worthy antibody is fundamentally expected to forestall the spread of COVID-19. Despite the fact that sex unmistakably assumes a part in this infection, numerous states in the United States do not report or break down contrasts in results among people.

Previously, immunizations have been created through a progression of steps that can require numerous years. Presently, given the critical requirement for COVID-19 immunizations, remarkable monetary ventures and logical joint efforts are changing

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how antibodies are created. This implies that a portion of the means in the innovative work measure has been going on in equal, while as yet keeping up severe clinical and security principles. For instance, some clinical preliminaries are assessing different immunizations simultaneously. Notwithstanding, this does not make the examinations any less thorough.

Last year our country, India, executed a cross country lockdown to be of assistance to control the unknown COVID-19 deadly disease. India, alongside numerous nations, has conceded crisis use approval for COVID-19 antibodies and has begun the way toward inoculating medical services laborers and high-hazard gatherings. India's controller has allowed limited crisis use support for two vaccinations—Covishield and Covaxin.

Notwithstanding, we likewise know, from the preliminaries and early involvement in COVID-19 antibody organization, that the immunizations have high paces of impermanent and terrible—yet not perilous—results. The antibodies since sore arms at high rates, and they can cause expanding, mellow fevers, weariness, and throbs. Preliminary members in Bhopal say that they could not peruse assent frames and have not had the option to report unfriendly occasions. A reporter from a city of Madhya Pradesh narrates the real-life time story of nearing to old citizen. He was an old occupant of city of India, who normally spends his days by occupying a seat on a broken bench in a tea shop. The disease had slow downed the entire economy of the country resulting in scavenging inside a filthy sack of folded clinical archives. He is seeking for a record from a nearby private emergency facility, where he took part in a COVID-19 antibody clinical trial in the country. He at long last discovers it. It shows that he got his first infusion on December 7. The 34-year-old's passing from the infection on February 7 prompted an overflowing of public grieving and uncommon articulations of outrage on the web.

2 Literature Review

1. COVID-19 is caused by the coronavirus 2 that attacks the lungs and lead to severe respiratory illness. Coronaviruses cause disease in humans as well as animals, in birds, the infection is caused by the virus called infectious bronchitis virus (IBV) and porcine coronavirus-induced gastroenteritis in pigs [1]. Bats are thought to be a natural reservoir for the disease and it spreads to other living beings say humans or animals through genetic mutations. Human coronaviruses are known to exist, including the novel SARS-CoV-2.
2. Local and systemic responses, using a memory assist, were reported 7 days after each vaccine. Participants were not advised to regularly use acetaminophen or other analgesics or antipyretics before or during vaccination, but were asked to report all new medicines obtained. Adverse events were rated on a typical toxicity scale [2].
3. The disease spreads swiftly over the world at first, leading to an increase in mortality. Countries rushed to test their populations for the virus after it was

discovered that many infected carriers show no symptoms. This suggests that there are three major risk factors to be aware of: The initial risk of transmission caused by a variety of factors such as population density and international travel, the risk of mortality caused by aging populations and underlying health issues, and the risk of citizens not being properly tested [3, 4].

4. World Health Organization has been fighting the epidemic with a variety of tools, including timely and accurate technical guidance, scientific briefs and situation reports, regular press conferences, educational videos and trainings, "mythbusters," active social engagement, and personalized advice for important industries like health care, food and agriculture, as well as travel and tourism, are just a few examples [5, 6].
5. As the disease advances, a slew of complications emerges, particularly in critically ill patients. Acute respiratory distress syndrome (ARDS) with multiple organ involvement was discovered in the pathological findings. There is no specific treatment for COVID-19 other than supportive care. Clinical trials are currently underway to see if several promising antivirals, convalescent plasma transfusion, and tocilizumab are effective [7, 8].
6. The heart of our challenge since the beginning of the global epidemic, to continue our critical work in sexual and reproductive health at a time when COVID-19 has complicated almost every decision [9, 10].
7. "The last thing we want in a pandemic is for vaccines to be available only to countries that make them," says Mariana Mazzucato, an economist who directs the University College London Institute for innovation and public purpose. Supply constraints, both physical and political, are a "major concern" according to Seth Berkley, the CEO of GAVI, the Vaccine Alliance, a public–private nonprofit organization based in Geneva, Switzerland, that aims to improve global access to immunizations [11, 12].
8. Coronaviruses infect humans and a variety of other vertebrates, severe breathing, digestive, liver, and neurophysiological diseases. In 2003, the severe acute respiratory syndrome coronavirus (SARS-CoV) and the Middle East respiratory syndrome coronavirus (MERS-CoV) produced human outbreaks. There are some noticeable distinctions and similarities when compared to the present virus. Both MERS-CoV and SARS-CoV have significant case fatality rates (40% and 10%, respectively). Despite sharing, 79% of its genome with SARS-CoV, SARS-CoV-2 looks to be far more contagious [13, 14].
9. There is a positive indication of potential convergence between the allopathic and AYUSH systems. Many ayurvedic preparations are considered to have immunomodulation properties, such as Amalaki (Emblicaofficinalis), Ashwagandha (Withaniasomnifera), and Guduchi (Tinosporacordifoloia), and all of these preparations are being examined in these trials [15].
10. Several Bhopal study participants told India spend that they assumed that the actual vaccine was being administered and They had no idea they'd signed up for a medical study. Others have similar tales recounted [16, 17].
11. Clinical trials have an enormous potential to benefit patients, improve therapeutic regimens and ensure evidence-based advancement in medical practice.

Unfortunately, it is also difficult to locate the data and documentation of the different trials and, in some cases, they do not even exist because several trials have been discontinued or are not released due to "negative" or misleading findings. This propensity, however, to only have limited data available from a multitude of clinical trials.

12. "Adverse events following immunization is a critical issue. When we launch a universal immunization program that has been in place for decades, some adverse effects are seen in children and pregnant women after vaccination," Bhushan said [18].
13. The infection is spreadable from person to person and has resulted in a global pandemic. Vaccines against coronavirus vaccines are a critical global intervention for containing the present pandemic and several vaccines have been developed in a relatively short time to try to control the situation, but they have also resulted in adverse reactions.
14. One of the most recent applications of artificial intelligence for COVID-19 is virtual screening of both repurposed drug candidates and novel chemical entities. The goal of repurposed medications has been to foresee and exploit interconnected biological pathways or off-target biology of existing medicines that have been proved to be safe and hence can be promptly explored in new clinical trials [19, 20, 21].
15. The study showed that the vaccine, with less side effects, is best tolerated in older people than in younger adults. Pfizer also argues that across age groups, its mRNA has consistent efficacy. Older adults appeared, as with AstraZeneca, to record less and milder adverse effects requested.
16. In the past, relevant research on female-specific vaccinations has been done, and women's concerns have been considered in these trial. Effective vaccine strategies for women should also be recommended by national policies. This will increase understanding and increase the immunization experience of women [22].
17. Coronavirus outbreaks have an exponential growth pattern, making it difficult to control with a small number of clinical personnel to handle a outgrowing number of patients in a reasonable amount of time. As a result, after clinical doctors' decisions, it is necessary to develop an automated model based on machine learning for corrective measures. For front-line clinical doctors, it could be a promising supporting authorization technique [23].
18. Growing claims are raising public concern as the authorities draw up lists for healthcare employees, senior citizens, and hospital staff to inoculate the first dose over the coming week [24].
19. In comparison with what is presumed, as stated by health authorities, individuals will not be given the option to choose between the two vaccines. Countries which have already approved more than one vaccine have also adopted the same. Both have acceptable rates of efficacy. They have historically been developed and will work to increase the body's antibody response to keep SARS-COV-2 from infecting people in the future [25].

20. However, it ignores the position that social contexts, systems, and norms play and obscures the steps that can be taken to resolve these drivers by attributing gender disparities in COVID-19 findings solely to biology. There is no simple trend globally as to who is most likely to become COVID-19 infected. A strong mortality trend has, however, developed across the vast majority of countries. This trend varies by nation and may alter over time [26, 27].
21. Data from April 6 showed that, relative to other nations, a large proportion of men tested positive for COVID-19 in India. Since then, data on gender has not been available for PAN-India. The gap has narrowed, and the pattern is still high in May [12].
22. Coronaviruses are enclosed, positive-sense, single-stranded RNA viruses that have a diverse set of properties. They produce disorders that impact the respiratory, gastrointestinal, hepatic, and neurological systems in humans and animals. Human CoV infections are used to account for only a small percentage of annual respiratory illnesses. In the last two decades, two novel CoVs, the severe acute respiratory syndrome CoV (SARS-CoV) and the Middle East respiratory syndrome CoV (MERS-CoV), have appeared and are responsible for severe viral infections [28].
23. With an accuracy rate of more than 85%, machine learning classifiers using medical history were also able to identify which patients were most likely to have a complication-free vaccination. Our research uses classification methods to identify profiles of people who may need more monitoring and care (e.g., immunization at a place with complete clinical assistance) to avoid bad effects. The incidence of heart disease or type-2 diabetes, as well as allergy susceptibility, was crucial classifiers in achieving these reactions.
24. Budget 2021–22, introduced after the COVID-19 pandemic, sought to look at the health system differently by incorporating multiple policy headings to set out a health blueprint. The investment for' health and well-being' amounted to Rs. 223,846 crore ($30.6 billion), which Sitharaman said represented a 137% rise over the previous year's budget of Rs. 94,452 crore ($13 billion). An outlay of Rs. 64,180 crore ($8.7 billion) over six years has been declared for Pradhan Mantri Atmanirbhar Swasth Bharat Yojana [28].
25. As of February 6, 2021 at 6 p.m., the cumulative vaccination is 5,636,868, of whom 5,266,175 are health employees that have been vaccinated, which is 54.7% of the total cohort of health workers enrolled with CoWIN. Since we began to vaccinate front-line employees on 2 February, a total of 370,693 front-line workers have already been covered, which is 4.5% of the existing database of front-line workers. Top 13 countries that have protected more than 60% of healthcare workers are Bihar, Tripura, Uttarakhand, and Mizoram [25].
26. Psychotherapy can offer a way of finding what is at the center of a need for contact. It can also encourage you to explore other ways of related feeling without digital stimulation. At times, behavioral addiction, such as the Internet and social media, can mask underlying problems that increase anxiety. Exploring your feelings can be a positive way to travel through a private and discreet environment for emotional addictions [21].

3 Objectives of the Study

This study is conducted on various group of people over the globe who have got themselves vaccinated and thus analyzing their age groups, sex, symptoms, and demographic location over the impact of vaccination.

3.1 Primary Objective

Age, gender, demographic location, brand of vaccine, and symptoms-based analysis over impact of recovery level of vaccination.

4 Research Design

In this study, open source dataset has been used to investigate the relationship between age, demographic location, sex, symptoms, and brand of vaccine to predict the recovery with the help of machine learning approach. Role of laboratory was also explored to see the impact over prediction.

4.1 Participants

The population of this study is made up of people of various ages, demographic locations, and sexes. The participants were chosen using a purposeful sampling strategy. Total 1450 candidates across the globe had participated in this study.

5 An Approach of Machine Learning

A machine learning system is similar to a human brain in that it learns from prior historical data, constructs output models called prediction models, and predicts the output for incoming data in the trained format.

Here, we define three main key types of algorithms for machine learning: supervised or trained from data algorithms, the next is algorithms is for unsupervised learning, and the third or final one reinforcement learning. Past data or labeled examples are used by supervised machine learning algorithms to make some predictions or classify trends in new test data. Existing data or labeled examples are primarily categorized as training sets and another one is the test set which is composed of new data from which predictions or labeled output are to be made. Unsupervised

Table 1 Decision variables

Decision variables
Age
Sex
Symptoms
Vaccination date
Brand of vaccination
State

machine learning or untrained algorithms, on the other hand, are used to train on fresh data or existing instances that are neither categorized nor classified. A supervised or trained learning algorithm tries to produce an inferred function that provides the closest or best predictions possible on any forthcoming data. The system does not calculate the proper output; instead, it studies the dataset and derives inferences from it to identify hidden structures or patterns, as well as unlabeled data trends. Reinforcement machine learning algorithms communicate with their environment by producing actions and detecting flaws or incentives.

Linear regression, logistic regression, and decision tree are some of the common ML models. Vector machine help, Naive Bayes, neural networks, *K*-means, random forest, and so on. We used supervised machine learning techniques in this paper to predict the impact candidate taking the vaccine based on certain variables. The supervised learning models work by taking a set of labeled or classified examples (training set) and deriving a function *f* that predicts the class for which a new example was defined (test set). The implementations of these models are written in Python.

5.1 Decision Variables

Some of the variables used in the study are given below. The study followed a quantitative research methodology using the questionnaire method to gather data from the target population, after which 500 candidates were randomly chosen from different sexes, ages, and symptoms (Table 1).

5.2 Data Normalization

The dataset was skewed to check for normalization, and it was found that the data is moderately skewed.

- **Dimension Reduction**

  In a given dataset, the number of input features, variables, or columns present is known as dimensionality, and the method of reducing these features is called reduction of dimensionality.

  In different instances, a dataset includes a large number of input attributes, which makes the predictive modeling task more complicated. Since it is very difficult to imagine or predict the training dataset with a large number of characteristics, dimensionality reduction techniques are required for such cases to be used.
- **Backward Elimination**

  In designing the model of linear regression or logistic regression, the backward feature exclusion technique is primarily used. In this procedure, the following steps are performed to minimize the dimensionality or in the collection of functions:
- To train the model, all the n variables in the given dataset are taken
- Model performance is tested.
- Each time, we will now remove one function and train the model on *n*-1 functions for *n* times, and will measure the model's output.
- The measures above are repeated until no element can be removed.

5.3 Data Scaling

We have been using decision tree classifiers for a while now. Scalar vector machine, linear regression classifier, and many more are used as our model for prediction and its input as well as output is only on numeric data. So, we used the pre-defined module—label encoder to scale out dataset.

5.4 Supervised Machine Learning Algorithms

Binary Logistic Regression

BLR is an algorithm for classification that estimates a dependent categorical or numerical variable. Here, the answer or output variable has 2 responses such as, yes or no, 1 or 0 clear or unclear, defective or non-defective which is classified as 0 or 1. The binary or continuous variables can each be independent variables. If Y be a output variable which holds a binary value and X be a set of explanatory or input variables $\times$ 1, $\times$ 2, $\times$ 3…, which can be discrete, continuous, or a combination.

Decision Tree
It is one of the common ML algorithms that are supervised. For problems of classification and regression, they have been commonly used [29]. Decision trees can be used to anticipate and respond to both categorical and continuous data. Classification decision trees are used when the goal response variable is categorical or discrete, but regression decision trees are used when the response variable is continuous. Decision trees work in a similar way to how the human brain thinks by breaking down a problem into smaller chunks that are easier to comprehend. They work in a recursive manner until the final output is reached by dividing the dataset into smaller datasets based on a condition or feature values. The goal is to partition the set in the best possible way at every step, i.e., that produces the maximum amount of information and tries to minimize the level of uncertainty. The classification and regression trees (CART) approach is used to build the decision tree model by recursively partitioning the dataset around a function that reduces the answer variable's heterogeneity the most. At each phase, the Gini index is used to calculate a node's heterogeneity.

$$\text{Gini} = 1 - (x/n)2 - \left(y/n\right)2 \tag{1}$$

where x is the calculated values of responses giving a positive result ("YES"), n is the number which defines the sample, and the variable y is the calculated value of number of negative responses ("NO").

Scalar vector Machine
Another machine learning algorithm that learns from data can be used for problems of classification as well as regression. In classification issues, however, it is mostly used. A support vector machine takes data points and generates the hyper plane (which is simply a line in two dimensions) that best separates the tags. In order to minimize the error, the hyper plane will be generated by SVM in an iterative manner. RBF kernel, often used in SVM classification, maps input space in infinite dimensional space.

Naïve Bayes
Naïve Bayes algorithms are a method of classification based on the implementation of the Bayes theorem with a clear assumption that all predictors are independent of each other. Out of the available model, we have used Gaussian Naïve Bayes. It is a probabilistic classifier, which means it predicts on the basis of the probability of an object.

5.5 Model Evaluation

Estimating the precision of the classifier's predictions is the most important aspect of a classification analysis. Model accuracy and sensitivity are assessed in order to determine the efficiency of the models used (1.2).

Table 2 Confusion matrix

	Predicted: POSITIVE	Predicted: NEGATIVE
Actual: YES/POSITIVE	Positives values which are true	Negatives values which are false
Actual: NO/NEGATIVE	Positives values which are not true	Negatives values which are not false

$$\text{Accuracy} = \frac{\text{No. of correct predictions}}{\text{Total no. of predictions made}} \tag{2}$$

As shown in Table 2, four cases are included in the uncertainty matrix:

- True Positives: It is the calculation of number of cases that are accurately predicted and ultimately positive as positive cases.
- True Negative: The count of number of cases correctly predicted as negative cases is actually negative.
- False positives: The calculation of number of cases incorrectly predicted as positive and actually negative is the number of cases.
- False Negatives: The number of cases wrongly identified as negative is the number of cases. And are positive in fact.

Sensitivity is also recognized as the real-positive rate (TPR). This calculation informs us the percentage of variables that are correctly defined. As given below, the formula for calculating sensitivity is

$$\text{Sensitivity} = \frac{\text{No. of true positives}}{\text{No. of true positives} + \text{No. of false negatives}} \tag{3}$$

5.6 Results and Conclusion

The model was initially trained using K-fold classifier with five supervised machine learning algorithm at level 0 and level 1. Based on the performance, the best three algorithms were selected and prediction was performed.

Figure 1 clearly shows that LR outperforms the entire algorithm. Based on the Fig. 1, top 3 algorithms were chosen for prediction.

The dataset was run over LR, CART and SVM algorithms. Initially, the data was split into training and test data in the ratio 70:30. The test data was used to do the predictions and it was observed that most of the candidates were recovered after taking the vaccine in spite of having pre-defined symptoms. It can be clearly seen from Fig. 2 that by LR algorithm we did not have any not recovered case (Figs. 3 and 4).

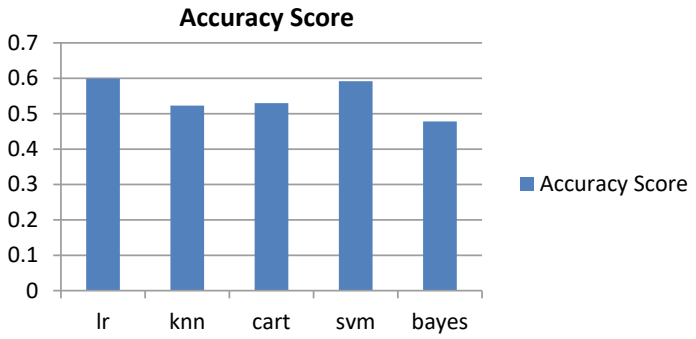

Fig. 1 Accuracy score of various algorithms

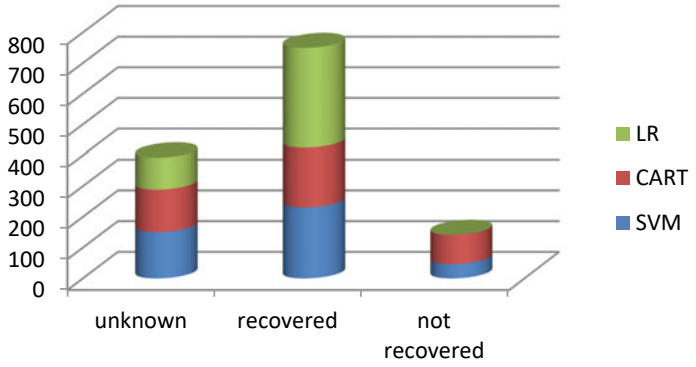

Fig. 2 Prediction based on various algorithms

The $f1$ score was calculated on the SVM, CART, and LR machine learning algorithm. Decision tree classifier had got a good $f1$ score. It shows the balance between precision and recall.

6 Findings and Recommendations

In this study, it has been observed that age, demographics location, brand of vaccine, and gender play a significant role for the candidate in predicting the outcome of the vaccine. In the analysis, we can easily conclude that recover rate is high as compared to the not recovered rate.

The study took into consideration some major factor that do affect the probability of the outcome like the demographic region in contrast to the brand of vaccine along with preexisting symptom. It was likely that in spite of preexisting symptoms, the recovery rate if good and each and every candidate can predict their outcome before

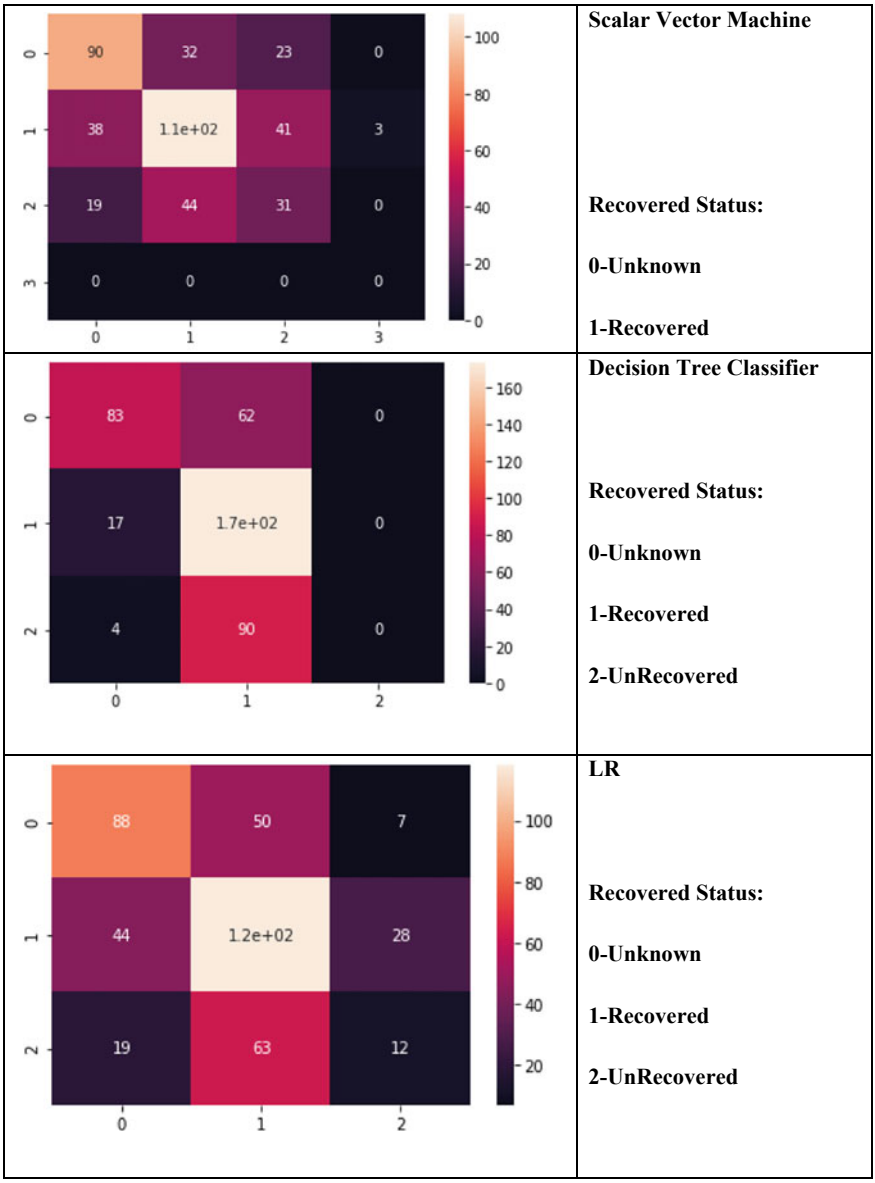

Fig. 3 Confusion matrix shown on heat map

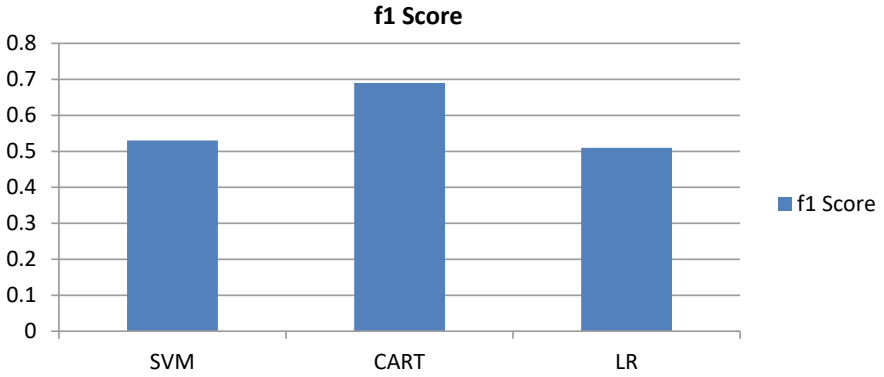

Fig. 4 *F*1 score of prediction using various machine learning algorithm

getting vaccinated. The accuracy rate is quite good for the all the algorithms used and most probably will reduce the not recovered case with due prediction.

7 Conclusion

The research mainly focuses on developing prediction models for finding the impact of vaccination on various factors. The impact of the vaccination has played a significant role in connection with a candidate getting vaccinated based on his age, sex, any pre-defined symptom, location, and the brand of vaccine. The candidate has a choice to be himself vaccinated based on the prediction done by model. The pandemic is not over and people are scared to get themselves vaccinated so this model is quite helpful in predicting the outcome and helps the candidate to take a decision. It is possible that by the time, a vaccine is developed, and the new coronavirus will have infected much of the world. Even so, many people may benefit from vaccinations to increase their immunity.

A good amount of training data was given to train the model and later on test data was used to do the prediction.

The model used a variety of supervised machine learning algorithms, and the accuracy was approximately 60%. The model was iteratively tested using the CART model.

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Chapter 39
Task Allocation in IoT: A Systematic Review of Techniques and Issues

Malvinder Singh Bali and Kamali Gupta

1 Introduction

Due to rapid expansion of IoT devices, huge data traffic is being generated and lot of data is bogus and utilizes unnecessary bandwidth [1], causing congestion [2] and leading to performance issues [3]. To avoid unnecessary data traffic and bandwidth consumption, data offloading concept came into existence where only relevant data can be offloaded to the servers [4]. This concept helps to overcome data traffic, avoids congestion, and proper bandwidth consumption is maintained. Further, offloading data to the cloud servers requires task allocation protocols which help to allocate the resources to the offloaded data like server allocation using different optimization techniques. Since task allocation is an NP-hard problem, we need innovative task allocation protocols which can help to optimize the problem of allocating servers to the offloaded data to avoid performance issues like response delay and latency [5].

1.1 Motivation

In IoT-based scenario, allocating resources to the sensor-based devices which are deficit in resources like battery, storage, and processing power using nearby fog or edge nodes is the most optimal choice for the vendors. But allocating resources to the fog/edge devices by selecting the optimal method are challenging in terms of heterogeneity of devices, interoperability of different fog devices, routing-related issues,

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incentive-based policies, and security issues. These major issues have prompted a slew of job allocation research, all while promoting energy-efficient IoT.

1.2 Contribution

The following are the review's significant contributions:

- The primary difficulties and challenges related with the task allocation technique in IoT are outlined.
- Examining the various task allocation techniques that are currently in use in IoT.
- Finally, a smart task allocation architecture is proposed for distributing resources to offloaded data in the Internet of Things, which tackles challenges such as data traffic, bandwidth utilization, and heterogeneity.

1.3 Paper Organization

The below is how the rest of the paper is structured: Sect. 2 provides the relevant literature review on different task allocation techniques. The approach for selecting research subjects is given in Sect. 3. Section 4 contains a comparison and explanation of the strategies that have been discussed Sect. 5 contains a proposed smart architecture for task allocation. Finally, in Sect. 6, we give our conclusions.

2 Literature Study

The process of selecting, segregating, coordinating, and assigning relevant tasks to the appropriate entities is known as task allocation. Minimizing energy usage while maximizing job allocation dependability is one of the key goals of task allocation algorithms. Several considerations, including as network structure, energy restrictions, and network entity processing capabilities, are usually taken into account. However, in terms of extending resources for network-assigned applications, most present approaches have a broad and limited scope. Furthermore, while the topic of job allocation in wireless sensor networks (WSNs) has received a lot of attention, the task allocation problem in IoT networks is still a hot topic. This section covers the core terminology and concepts related to task allocation in IoT networks and related studies [9]. Present a task allocation mechanism that allows users to start and stop services according on their needs and rules [7]. Introduced the "cross test" data processing application characterization framework, which looks at future resource requirements of heterogeneous devices in the IoT ecosystem. The problem of task allocation among mobile objects that aspire to participate in the execution of IoT is addressed in [10]. A 3GPP-introduced Prosec-Proximity service performs two

purposes in this case. One is network-assisted discovery of nearby users, and the other is network-assisted facilitation of direct contact between such users, with or without network oversight. The purpose of [10] is to let network organizations to collaborate and make their resources available in order to complete the task. One of the paper's main goals is to reduce energy consumption in the task allocation process. ETAP1, 2 and SETAP1, 2 are compared to the CBATA protocol, which is already in use [14]. Investigates data-aware task allocation, in which task and network flows are cooperatively scheduled with the goal of reducing application completion time. In a brief, the previous review publications had the following flaws (Table 1):

- The studies lack a systematic heuristic approach for task allocation in IoT, particularly between the years 2017 and 2020.
- In certain articles, there has been no clear categorization of task allocation techniques in IoT.
- Many articles did not cover all facets of the Internet of Things task allocation scope.
- The available works are not organized in a systematic fashion for selecting papers.
- To address all of these shortcomings, we prepared a survey study on task allocation techniques in the Internet of Things.

3 Research Methodology

Subheadings may be used to split this section. It should give a clear and simple summary of the experimental findings, their interpretation, and the possible experimental inferences. In this section, for current research, we present a method for doing a systematic literature review (SLR), for identifying task allocation methodologies used in the IoT. To discover important synonyms and keywords for the techniques, the following string terms were studied:

- ("Task" OR "task allocation" OR "allocation" OR "fog computing" OR "IoT")
- We use the SLR method to create a set of technical questions (TQ) depending on the scope of IoT task allocation techniques.
- TQ1: What are the most important factors to consider when allocating tasks in the Internet of Things?
- TQ2: What types of simulations are used to evaluate task allocation methods?
- TQ3: What are the most popular methods of assessing task allocation strategies?
- TQ4: What strategies are employed for task allocation?

In our research, selection and rejection of papers is done to acquire quality and highly peer-reviewed papers for better results. Research articles that are indexed in highly qualitative databases like Scopus, Web of Science, and ISI proceedings with the peer-reviewed process are considered for task allocation problems in IoT due to the huge potential of these journals. The following are some of the paper's flaws: (1) The SLR approach does not apply to non-English research publications and (2) The SLR method excludes low-quality conferences with fewer than four pages. Finally,

Table 1 Comparison of different technique in task allocation

Ref/ Year	Technique used	Parameter	Evaluation tool	Advantage	Weakness
[6]/ 2014	Particle swarm optimization	Task execution time, energy consumption, balance of network, and network lifetime	N/A	The proposed mechanism is fault tolerant	Communication overhead not addressed
[7]/ 2017	Bankers algorithm	Execution time and fairness with the algorithm	N/A	The proposed method is assessed for fairness and execution time. It outperforms the FCFS brute force technique	Scalability and heterogeneity issue not addressed
[8]/ 2017	MDP-based TSECS algorithm	Power consumption, reward value, and execution time	N/A	Paper studies the performance and energy issues on edge cloud IoT system	
[9]/ 2017	Heuristic algorithm	Power, duration, and energy consumption	Atmega 1261microcontroller, Rasberry Pi with Raspbian *O/S* for M2M gateway	The proposed algorithm discovers the optimum task mapping to nodes and a protocol that allows control messages to be exchanged	Mechanism is ineffective for apps that must be operational at all times
[7]/ 2017	KNN (Classification algo) and BIRCH (Clustering algo)	Execution time and network bandwidth	Raspberry Pi and Intel Server	Proposed cross-test framework examines future resource requirements of heterogenous devices for IoT ecosystem	Scalability issues not addressed
[10]/ 2017	Game theory	Cell radius, No. of active users, D2D separation distance, and noise	MATLAB	Prosec: a 3GPP service provides synchronization and communication among local UE	Reliability of the technique 7 scalability issue not addressed

(continued)

Table 1 (continued)

Ref/ Year	Technique used	Parameter	Evaluation tool	Advantage	Weakness
[11]/ 2018	GAACO (Genetic algo and ant colony optimization)	Makespan, average processor utilization	N/A	Algorithm is competent in heterogenous environments	Scalability issue not addressed
[12]/ 2018	Reinforcement learning algos (RLMT and RLRA)	Time	Java-based simulator	Approach was able to obtain optimal solution	
[13]/ 2018	Matching algorithm SPA-(S, P)	Service latency and system cost performance	N/A	Proposed framework provides distribution close to optimal performance from both users and systems view	Communication overhead not discussed
[10]/ 2018	ETAP (1, 2) and SETAP (1, 2)	Population size and average dissipated energy	MATLAB	Existing work addresses heterogeneity issue	
[14]/ 2018	Multistage greedy adjustment algo (MSGA)	Completion time and running time	MATLAB	27% improvement in completion Time	The proposed solution takes longer to run than benchmark solutions
[15]/ 2019	Game theory	Average residual energy	MATLAB	The overall algorithm improves the optimization of task allocation	
[16]/ 2019	Steady task allocation protocol (STAP)	Average dissipated energy and No. of rounds	MATLAB & OMNET + +	To solve the problem, task groups and virtual objects are used	Scalability issues remains a challenge
[17]/ 2019	Reinforcement learning algorithm	Average latency and energy consumption	MATLAB	Online complete information performs very close to the optimal solution	Heterogeneity of devices is an issue
[18]/ 2019	Ant colony optimization (Meta-Heuristic)	Path distance and error rate	MATLAB R2015a	Distribution of task allocation to the best corresponding node is done using ACO	Reliability and scalability overhead may reduce algorithm efficiency

(continued)

Table 1 (continued)

Ref/ Year	Technique used	Parameter	Evaluation tool	Advantage	Weakness
[19]/ 2020	Particle Swarm optimization (PSO) and SA (Simulated annealing)	Minimum time, cost, and minimum energy	MATLAB	Hybrid approach used performance better than PSO and SA algorithm	
[20]/ 2020	Genetic algorithm (GATA and mGATA)	No. of systems, No. of tasks, no of objects, and population size	N/A	Problem aware operators' importance is the key of the paper	Multi-objective genetic algorithm is better than proposed single objective algorithm
[21]/ 2020	Non-deterministic genetic algorithm (NSGA-II)	Overall delay and overall energy consumption	MATLAB	The proposed solution can lower both the delay and the power consumption of edge devices at the same time	Communication overhead not addressed
[22]/ 2020	Fuzzy based allocation algorithm	Load, cost, and unprocessed data	DISSECT-CF-Fog Simulator	The results reveal that the Pliant system shortens the development time of IoT applications while increasing operational costs to a minimum	Applicability of the proposed solution is not generalized
[23]/ 2020	Task allocation protocol (ToP)	Throughput and traffic rate	CVX Toolbox of MATLAB	Algorithm improves the network throughput	Scalability issue not addressed
[24]/ 2020	*Q*-Learning techniques	Job completed, offload job completed, and efficiency	N/A	Proposed job management framework has better efficiency for predicting the machines and efficiently completes allocated and offloaded jobs in time	Not able to address scalability issue overhead

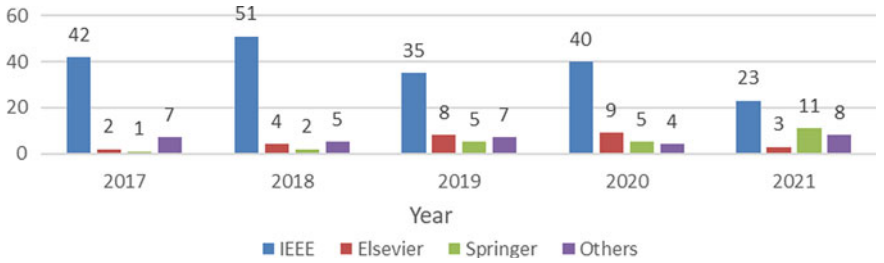

Fig. 1 Year wise research paper publications by publishers

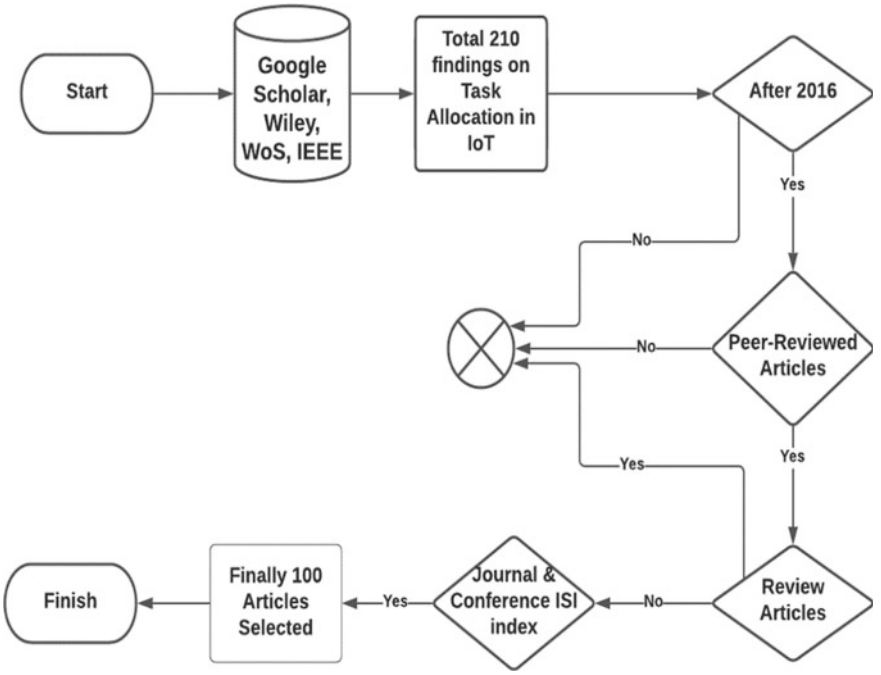

Fig. 2 Procedure for selecting papers

100 articles were chosen to respond to our technical questions. As seen in Fig. 1, every year, scientific publications including google scholar, IEEE, Elsevier, Springer, ACM, and Wiley publish a wide range of research papers. Figure 2 shows the final selection flowchart with addition and rejection.

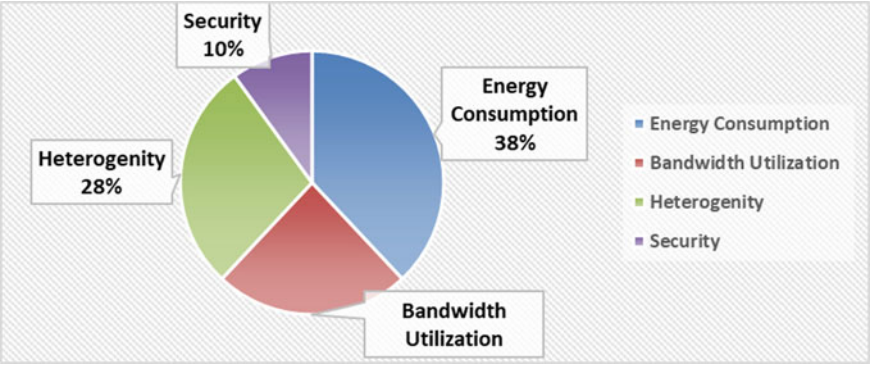

Fig. 3 Issues presented in task allocation

4 Discussion and Comparison

This section analyzes and discusses existing Internet of Things task allocation research. The existing TQs in Sect. 3 are the basis for the analytical evaluation and reports:

- TQ1: What are the most important factors to consider when allocating tasks in the Internet of Things?

A statistical comparison of several problems related to task allocation is shown in Fig. 3. We look at four main topics in this article that include energy consumption, bandwidth utilization, heterogeneity of devices, and security approach. Energy consumption issue has the highest percentage due to low processing capabilities of sensor devices. Followed by heterogeneity with 28%, bandwidth utilization with 24%, and security with 10%.

- TQ2: What types of simulations are used to evaluate task allocation methods?

According to Fig. 4, MATLAB is used in 38% of the research publications. Furthermore, the iFogSim toolkit is employed by 26% of research articles, led by Cloudsim at 22%. A simulation tool was not given in a few of the research publications for testing their methodologies.

- TQ3: What are the most popular methods of assessing task allocation strategies?

As per the Fig. 5, the QoS parameters used in task allocation depict that energy parameter is used 33% in task allocation followed by time with 24%, cost with 17% and delay with 13%

- TQ4: What strategies are employed for task allocation? (Fig. 6)

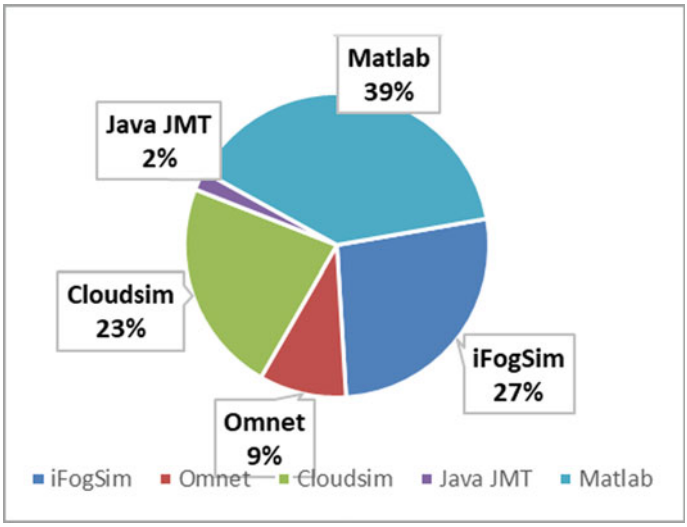

Fig. 4 Simulators used in the research study

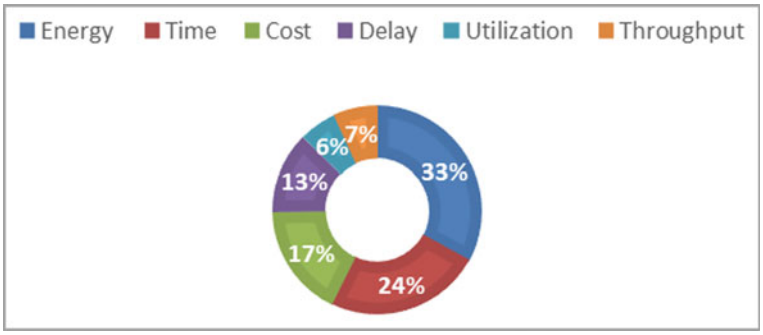

Fig. 5 Percentage of various parameters for evaluating task allocation

5 Proposed Architecture

In the proposed task allocation framework, sensor will sense the data and if sensed data is found above threshold value, then flag of thread 1 will be activated and data will be offloaded to the edge node device embedded with real-time operating system (RTOS). Thread 2 will perform task allocation at the edge node by allocating a server to the offloaded data based on the server with the lowest ping value. This framework helps to avoid data loss and initial traffic is curtailed (Fig. 7).

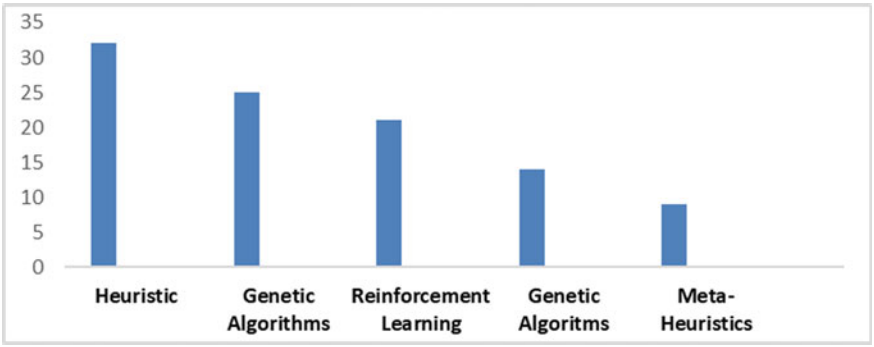

Fig. 6 Techniques used for task allocation

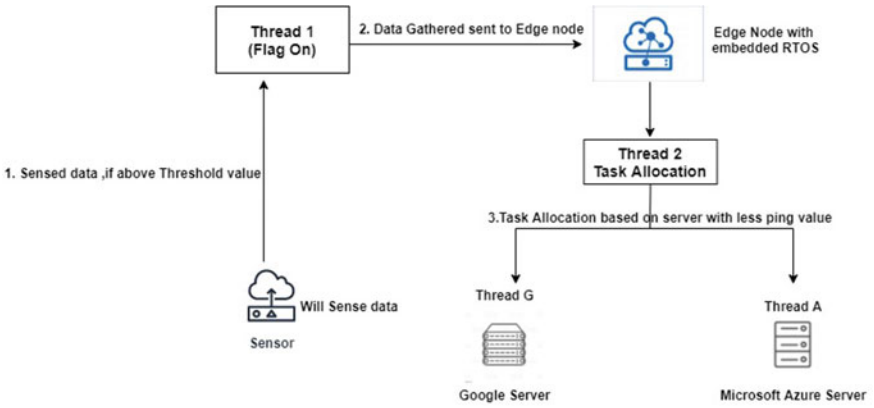

Fig. 7 Architecture for task allocation

6 Conclusion

A systematic literature review of task allocation techniques utilized in IoT is presented in this research. We reviewed on various task allocation approaches used. Some important issues related to task allocation were highlighted and proposed smart architecture for task allocation was also presented. According to the findings of the literature research, the main difficulty in task allocation is energy consumption. As per the tools used for execution, MATLAB was utilized in 38% of the studies, followed by iFogSim in 26%. In most task allocation articles, the suggested model's performance is evaluated using energy as a QoS metric. Lastly, a statistical study of the approaches used reveals that 30 studies used heuristic techniques. In the future, we will implement and validate our proposed task allocation architecture.

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Chapter 40
Healthcare BPM's Rebirth: A Case of Digital Disruption Post COVID-19

Pallavi Kudal, Sunny Dawar, Abhishek Sharma, and Prince Dawar

1 Introduction

In health care, efficiency and productivity are critical to survival and growth. Business process management (BPM) is the foundation that enables you to do more with less and adapt to change quickly. It provides the visibility, accountability, and scalability required to navigate today's operational challenges and secure a brighter future. BPM platform enables one to design, control, and monitor the organization through standardized processes, automated hand-offs, alerts and escalations, and business analytics. BPM firms had been helping healthcare organizations in redesigning their go-to-market strategy, deploying virtual-care processes, and improving, medication and vaccination adherence.

The COVID-19 pandemic has increased digital healthcare adoption, transforming each interaction into a personalized health experience. Increased demand for back-office services is also being driven by healthcare organizations' shift to telehealth systems powered by data, virtual platforms, and artificial intelligence tools. However,

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prior to the outbreak of the pandemic, the BPM industry in health care was on the decline.

Death of BPM
Business process management, a technology platform which once was at the heart of most enterprise transformation projects found itself on slippery turf in 2018–19 and that was a good decade ago when process re-engineering, optimization, and transformation was high on the priority list for most organizations. But just a year before BPM was not as much spoken about in enterprise circles. Some even claimed that the BPM game is over.

BPM Is Back (Again!)
The death and rebirth of the business process management market has been announced numerous times over the last 12–15 years. But BPM is more relevant now than ever and thanks to the digital boom brought in by COVID-19.

With the rise of cloud-based technology, BPM is easier to use and much cheaper. COVID proved that fast, powerful process automation is crucial for organizations to keep people connected to each other and to enterprise data amid sudden and massive change. The power of BPM is that it enables you to effectively coordinate work spanning departments and teams, or throughout the entire supply chain and when you consider all of the current automation-related technologies, BPM plays an essential role as the orchestrator of them all.

"From a digital standpoint", Ward Dutton explains, "you need some kind of backbone into which a variety of various capabilities can be plugged and adjusted over time". BPM is the ideal option from a strategic standpoint [1].

2 Literature Review

Business process management is different from the conventional outcome approach which are utilized in health care. Effects management as a consideration of technology designed for patient experience is aimed at supporting the patients, bill payers and supporters to make rational medical decisions created on clearer insights with the effects of various choices of patient's life [2].

Business process management (BPM) is making a big difference. BPM arises as a way to connect several management disciplines directly to the operation of processes. In healthcare industry, utilization of business process management (BPM) has become essential for ensuring the organizational competitive edge by adding values in different ways of modified processes [3].

In this light of BPR, according to [4] has emerged as a critical feature accomplished of allowing the establishment of an evolutionary structure which enables valuable organizational transformations. BPM was first defined as "a process management strategy focusing on the continual improvement of business processes employing

information technology (ITs) as one of the essential principles for the realization of processes" [5].

The BPR's core premise is an advanced methodology to shift management that leads to best procedures [6]. In comparison with other industries, the healthcare industry has demonstrated that it has a comparatively immature information approach structure. The significance of lowering healthcare costs and optimizing systems, processes, and support routes is becoming increasingly apparent in this setting. Even though the significance of process management, there are few international recommendations for implementing healthcare practice management in hospitals [7].

Though business process management has numerous potential benefits, most applications in the healthcare division focus on well-specified managerial processes such as the large master pursuing process, occurrence reporting process, and support process [8, 9].

Identifying every source of possible development and utilizing any instrument, methodology, methodologies, and technologies to expand healthcare provision and services is thus a global challenge. Even though well-recognized evidence of substantial cost savings and reasonable advantage as a result of supply chain management strategies, the healthcare business has been sluggish to adopt these systems [10].

One of the most important aspects of BPM is the study of risks associated with a business process, as well as the process' compliance with norms, regulations, and laws [11]. Ref. [12] used BPM for the implementation in organizational resource planning in UK-based enterprise in the energy sector and they applied principles of BPM for the benchmarking project management disciplines. In the context of change management, this frequently compels firms to restructure business processes [13].

3 Indian Healthcare Sector

Till 2020, the health division of India is anticipated to be a value of US$ 193.83 billion. The key aspects to development would be increasing level of income, augmented awareness of health, advanced priority of life diseases, and also higher admittance for insurance. In Indian market, healthcare insurance is rising acceptance. Gross premium of health insurance income amplified 17.16% year on year to US$ 7.39 billion in financial year 2020. In India, there had been around 393 government-known Ayurveda institutions and 221 government-documented homoeopathic institutions. The sub centers numbers mounted to 169,031 in month of April 2020, although number of main centers of health enhanced to 33,987.

Till 2020, hospital segment is predictable of value US$ 193.83 billion, and also US$ 372 billion by 2022. Since its start in November 2010, national telemedicine services has performed 8 lakhs teleconsultations, empowering patient-to-doctor, and doctor-to-doctor consultations from the comfort of their own homes.

In Indian healthcare sector, the private segment has grown like a vibrant power, providing it domestic and world-wide standing. Its justifications around 74% of all

healthcare expenditure in India. In India, telemedicine is a rapidly growing trend. Telemedicine facilities are accepted by key hospitals (Apollo, Narayana Hrudayalaya, and AIIMS), and formed various public–private partnerships. Besides, India's rank as a desirable target for medical tourism is bolstered by the existence of many facilities and skilled medical experts.

The Union Budget of 2020–21 allocated US$ 919.87 million to Ayushman PMJAY, the leading government-financed healthcare plan with over 500 million enrollees. PMJAY provided free treatment to roughly 63.7 lakh individuals as of November 2019. The Union Budget of 2020–21 incorporated sum of Rs. 3,000 crore grants to Pradhan Mantri Swasthya Suraksha Yojana. From Dec. 2019–Mar. 2020, the health and family welfare Ministry launched Intensified Mission Indradhanush 2.0.

The Union Budget 2020–21 provided Rs 65,012 crore to health and family welfare ministry and Rs 2,100 crore to department of health research, respectively. Health care spending by the federal government climbed to 1.6% of GDP in financial year 2020, up from 1.3% in financial year 2016.

The administration wants to increase public health expenditure to 2.5% of GDP by 2025. The percentage of GDP spent on health care is projected to rise to 19.7% till 2027. From April 2000–March 2020, FDI into the sectors of drugs and pharmaceuticals totaled US dollar 16.50 billion.

Healthcare Sector of India and BPM

In 2016, India's healthcare segment was worth more than 140 billion dollars, with projections of 372 billion dollars in 2022. The country's healthcare market had grown to develop one of the country's largest in terms of income and jobs, and the industry was rapidly expanding. The business process management market is projected to increase at a CAGR of 6.65% from US$ 3,339.13 million in 2019 to US$ 4,915.86 million till the end of 2025. The incorporation of artificial intelligence (AI) and machine learning (ML) tools along with BPM software, as well as the demand for automated business processes to eliminate physical errors, is all major reasons driving the growth of the business process management industry [14].

Trends Affecting the BPM Market Size

India has begun to institutionalize health technology assessment (HTA) in order to contribute evidence to strengthen policymaking in the areas of universal health coverage (UHC), usual treatment procedures, and creating evidence on worth for money for a diversity of health intrusions and technology choices. In India, the Government was spending just about 1% of its GDP on health care (Gupta and Mondal 2014) which has been now budgeted to 1.8% in 2020–21 (highest since 2014) (source is economic survey of India 2020–21); the obvious reason been the pandemic outburst. COVID-19 revealed the significance of investing and strengthening public health system. Pradhan Mantri Jan Arogya Yojana (PMJAY) is one such step toward attainment of the goal of UHC.

Pradhan Mantri Jan Arogya Yojana (PMJAY)

PMJAY, which was inaugurated in September 2018 as part of the Ayushman Bharat initiative, seeks to give a cover of Rs. 5 lakh/family per year to 10.7 crore poor and vulnerable households (with no limit on family size or age). The scheme merged the Rashtriya Swasthya Bima Yojana (RSBY) and scheme of Senior Citizen Health Insurance, which were both supported by the government.

Benefits: Secondary and Tertiary Health care are Included Under the Scheme

There are currently 1,393 processes covered through several areas such as general medicine, cancer, orthopedics, and cardiology. In extra, the plan covers pre- and post-hospitalization costs. PMJAY has given Rs 6,400 crore for 2020–21, which is a 100 percent increase over the modified estimates for 2019–20. The program was budgeted for Rs 6,400 crore in 2019–20; however, this was reduced to Rs 3,200 crore.

The order and expenses on the PMJAY for the next five years were estimated in research published by the 15th Finance Commission. According to the report, PMJAY's total expenses (center and states) for 2019 could range from Rs 28,000 crore to Rs 74,000 crore. This valuation considers (i) the notion that all targeted users (about 50 crore people) will be covered, (ii) hospitalization rates over time, and (iii) average hospitalization expenditure. In 2023, these expenditures might rise to between Rs. 66,000 crores to Rs. 1,60,089 crores, according to the report (accounting for inflation).

It should be mentioned that the standing committee on health (2018) and the 15th finance commission's research report (2019) both said that PMJAY is simply an expansion of the Rashtriya Swasthya Beema Yojana (RSBY), which required reporting of up to Rs 30,000 per household per year.

As a result, an investigation of RSBY's faults and inadequacies should be conducted in order to assure proper execution of the system. This would examine if (i) the RSBY covered all prospective beneficiaries, (ii) hospitalization rates increased as a result of the scheme, and (iii) insurance firms made money as a result of the plan.

While the PMJAY covers secondary and tertiary health care, the majority of customers' out-of-pocket spending is on pharmaceuticals (52%) and public hospitals (22%). Individual payments made immediately at the time of service when the total health cost treatment is not included by any financial protection plan are referred to as out-of-pocket expenditure.

While the primary responsibility of healthcare providers is to treat patients, it is critical that services for PMJAY beneficiaries are provided in accordance with the scheme's guidelines. Compliance with PM-fundamental JAY's principles, both in policy and in practice, is a critical metric for determining the scheme's success. For the scheme's effective implementation, empaneled hospitals are encouraged to streamline certain processes and establish standard operating procedures. BPM is the effective solution to make schemes like PMJAY reach a large number of people.

BPM provides professionals with strong software that allows them to quickly design business rules based on project needs. Numerous benefits, such as enhanced

worker efficiency, speedier time to market, process dexterity, efficient implementation and regulatory management, and business process liability, are likely to drive the business process management market size.

Customers can benefit from the benefits of BPM technologies at a lower cost, thanks to cloud computing technology. In this industry, the steady shift from straight management to universal management and monitoring represents a significant technological achievement. This, in point, is likely to propel the BPM marketplace's expansion.

During the projected period, the growing number of SMEs approving BPM to improve operational productivity is projected to boost the BPM marketplace size. SMEs are implementing BPM techniques to realign business operations and manage massive amounts of data from many sources, such as blogs, emails, and Intranet portals.

These solutions are easier to implement in SMEs than in huge corporations. The BPM strategy minimizes the demand for micromanagement at the top managing level, that is, expected to be main reasons for its widespread acceptance across large enterprises. The healthcare business has changed dramatically since the affordable care act (ACA) was passed in 2010. The affordable care act's reforms have made the healthcare industry more complex and competitive, from the patient's bill of rights to electronic health records to health insurance and also Medicaid.

With so many new requirements to comply with, as well as more data to collect, analyze, and exchange, healthcare companies may encounter significant obstacles in not only incorporating new systems, but also progressing to provide high-quality patient care. Crisis to achieve these needs might result in significant economic losses as well as discontent among patients. There is, however, a solution to meet the challenge.

4 Why Is BPM a Good Fit for the Healthcare Industry?

Process driven healthcare firms are better able to take use of data, respond to industry changes, decrease errors, enhance the bottom line, and provide better patient care. Furthermore, they may be more likely to adhere to central and state standards and mandates, like data formats and real-time addition. Health brokers and suppliers can use BPM to assist shape how information, technology, and people cooperate. BPM can also assist workers in meeting critical targets, earning incentive expenditures, and working on continual efficiency improvement [15].

Inefficiency in Health Care Has a Long History

Historically, health care has been a labor-intensive industry, with patient admissions, paperwork, billing, and care all being done by hand. Furthermore, a change away from primary care and to a growing range of choices for providing patient care has led in an increase in recommendations, research, practices, and conclusions. Expenditure

on health care has soared, while efficiencies have dropped. There was also a lot of waste, with billions of dollars thrown away every year all around the world.

To avoid the expense of health care from growing out of control, healthcare providers have been under pressure to convert their business models toward a patient-centric, data-driven approach, as well as to minimize inefficiencies and remove waste. Investing in more reliable information systems cleared the path for streamlining operations and coordinating the interchange of data necessary to deliver high-quality patient care.

Three ways business process management (BPM) can help improve health care requires technologies that can keep up with the industry's rapid evolution. Here are three ways that BPM can help you enhance critical processes [16].

i. **Claims Processing**
   Claims processing is a complicated operation that includes compliance and reporting tasks and necessitates a constant flow of data. By streamlining each connected operation, by streamlining each connected operation, BPM technology can help to streamline these procedures. To make it easier to track and prioritize claims, claims and patient appeals can be handled more swiftly and monitored at every step.
ii. **Big Data**
   Big data indicates to the huge volumes of data that have become available to enterprises as a result of the Internet's development. Volume, velocity, and diversity are used to define it. A rapidly rising amount of healthcare information is now available and shareable thanks to electronic health records. BPM technology enables businesses to better manage their data and makes better use of it. Monitoring regional illness trends, for example, can aid in determining the efficacy of a treatment.
iii. **Software Programs**
   When several software applications are employed to accomplish typical healthcare activities, BPM can help fill in the gaps. It creates links that capture data that is not covered by existing apps and delivers information more swiftly to help patients get better care faster. BPM also fills in gaps left by manual processes like face-to-face or email patient exchanges, which can drive up expenses and put a company at risk of non-compliance.

BPM Can Improve Healthcare Consistency

The healthcare business has not always been known for its consistency, which has resulted in a lot of waste and poor patient care. When business process management is at the heart of a healthcare business's strategy, people, systems, and data can interact more consistently. BPM has the potential to radically alter the way healthcare is conducted, resulting in less waste, cost savings, streamlined processes, enhanced compliance, and better patient care.

5 Conclusion

Universal health coverage in India is a long-held dream. Ayushman Bharat with its twin pillars of health and wellness centers with provision for comprehensive primary health care and Pradhan mantra Jan Aarogya Yojana is a very ambitious program aiming at making the primary health care affordable and sustainable. COWIN platform has been a successful platform for achieving the historical vaccination drive. COVID-19 has brought in this digital disruption in India in healthcare sector and BPM industry is an inseparable part of this initiative. The healthcare business has not always been known for its consistency, which has resulted in a lot of waste and poor patient care. BPM can surely improve healthcare consistency. When business process management is at the heart of a healthcare business's strategy, people, systems, and data can interact more consistently. BPM has the potential to radically alter the way health care is conducted, resulting in less waste, cost savings, streamlined processes, enhanced compliance, and better patient care.

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Chapter 41
Recurrent Neural Network: A Flexible Tool of Computational Neuroscience Research

Akanksha Kaushik, Jyotsna Singh, and Shilpa Mahajan

1 Introduction

The hunt for understanding human brain includes searching for neuronal features related to behaviour and trying to correlate them. In computational neuroscience, establishing a correlation means to model a link between activity and behaviour. The selection of accurate model, from a class of models, depends on the researcher's preference. In this paper, we have focussed upon recurrent neural networks and discussed how it can be useful as collaborator between complex system of brain and interpretable hypothesis.

RNNs are amongst a group of computational models, used for exploring neurological phenomena and as a mechanism for solving machine learning problems [1–3]. These are such types of networks in which a neuron receives signal/input from many other neurons in its network, without the consideration of crust or trough of the signal. As a result, the functionality of neurons is not only affected by stimulus current but due to the current state of the network also. Such features make these networks more suitable to use for computations that can reveal the crucial properties of brain like holding items in memory or recalling patterns towards a problem and what can be the mechanisms leading to memory failure.

The logic for studying RNNs as model in our work originates from the fact that human brain is a complex structure of tremendous number of distinct neurons, connected with each other to perform some activities like memory building, recalling and recognition, moods and behaviour, movement and motor system. Our work

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is concerned with memory building and how an RNN can represent a network of connected neurons, responsible for memory building. Here, we have presented a review of how RNNs can be used to explain the dynamical system along with techniques which can be incorporated to improve the performance of the network.

A detailed overview of RNNs and the techniques incorporated with RNNs to study problems related to cognition and memory is given below.

Martens et al. [4] proposed a novel damping approach for training RNN with Hessian Free (HF) optimisation for a set of two challenging issues. First, the pathological data set could not be used for optimization, due to its very long-term dependencies such as gradient descent, and second is real-world sequential data set dependent on long short-term memories. Experimental results established a solution to the problem related to long-term dependencies. The HF optimisation approach is capable of training RNNs more effectively. However, the total computation time required by the proposed approach was considerably higher than the expected. Therefore, some other mechanisms can be incorporated to reduce the training time.

Bitzer et al. [5] proposed a fusion of RNN with Bayesian inference approach to explore nonlinear dynamical system. In this strategy, RNN is used as a production model of dynamic process caused by the stimulus, and Bayesian equations are derived to decode its resultant. This combination of RNN with Bayesian equation is called as recognising RNNs. Experimental results show that these updates not only improved the efficiency of conventional RNN but also computes prediction with fast decoding and robustness. However, to explain coordinated movements, multistable dynamics may also be incorporated, which is an important phenomenon for explaining coordinated movements. For this purpose, rRNN can be upgraded to gRNN, which shows required multistable dynamics.

Brian et al. [6] proposed an approach of using firing-rate dynamics to train RNN of spiking neurons model. They proposed it for purposes like producing dynamical patterns and generating structural and temporal outputs, based in network input. The proposed methodology proved to be a success in constructing spiking networks. With few minor changes in the number of neurons, continuous variable network mimics the original spiking model. However, when it comes to explain the nonlinearity and connectivity of different populations of neurons, it could not work effectively.

Ingmar et al. [7] proposed a neural solution to simultaneous location and mapping (SLAM) problem. The proposed model of recurrent LSTM network performs a class of two-dimensional navigation. The experimental results prove the worth of training recurrent neural network and proposes to extend its work to be incorporated in robotics. But, this favour comes with a price. Since this approach only considered movement, it does not include memorisation. It would be interesting to see if constraints like non-negative neural activations, dale's law or architecture of hippocampus circuit can be incorporated with brain's navigation system.

Peter et al. [8] presented a train-and-constrain approach that portraits the results of artificial neurons with spiking neurons. Firstly, the training process includes RNN with back-propagation with respect to time; then, weights are discretised, and then,

finally, the results are converted to spiking RNN. Experimental results show that artificial neurons mimic the responses of spiking neurons. To prove the accuracy of the proposed approach, the mapping of NLP, i.e. question classification is done. This device used for demonstration is TrueNorth, and IBM's Neurosynaptic system. TrueNorth puts some restrictions on synaptic connectivity and its parameters. The hardware-restricted model generated 74% accuracy in NLP question classification task. However, there is a performance drop due to synaptic weights taken in the model are taken in the form of discrete. This discretisation leads to performance decrease and hence can be expected to be the topic of further research.

Rajan et al. [9] proposed a partial in-network training algorithm and used it to modify small portions of connections, starting from random connections, to show that distorted RNN can generate sequences and working memory effectively. The proposed algorithm proved to be efficient when the sequences generated by the collaboration of recurrent synaptic interconnections and external inputs were successfully propagated. However, neuronal sequences may also arise through largely connected unstructured network.

Alexander et al. [10] proposed trained recurrent neural networks to study task-related neural dynamics. In this, a mean-field theory was created to get multiple fixed-point attractors. Experimental results show that dynamics connected to network's output, in the boundaries of attractors, are determined by low-order linear differential equation. Using the equations, network can be accessed, and prediction of success and failure can also be made. However, the network generates failure when a nonlinear sigmoid activation function was used with rectified linear units. The proposed methodology forecasts a state-dependent recurrent selectivity in the network response.

Omri Barak [11] suggested to methodologies for designing and training RNNs, the first one includes implementation of low-D intuition, and second one incorporates reverse engineering in place of low-D structures. The low-D intuition methodology assumes that the activity of the neurons is not affected by the input current only, but also by the state of the network. But, this assumption is quite expensive because training an RNN is a difficult process. Here, the connectivity in the network was trained repeatedly with many example trials by recasting connectivity according to certain learning rule. Reverse engineering, on the other hand, does not include low-D intuition. It assumed that saddle points, line attractors, and other areas of phase space could be the main describing points of computation, which may provide some insights to the process existing in blackbox.

Umut et al. [12] proposed a recurrent neural network model for modelling the dynamics and activities of human brain. The authors claim that there has been substantial work on creating a better feature model; a very limited work has been performed on response model. Here, in this work, they have investigated that RNN models can be used to predict the sequences based on feature-invoked responses, depending on their internal storage for nonlinear processing of arbitrary sequences. Experimental results show that the RNN model proposed in this work can outstrip the existing response model by correctly evaluating long-term dependencies.

Hupkes et al. [13] proposed a methodology to explain how neural network can process and learn language with hierarchical structure. For this purpose, an artificial task of processing nested arithmetic expression was given to each type of neural network and computed their results. Surprisingly, it was RNN, which came out with a generalised solution to the arithmetic expression. It was seen that RNN stored the results of sub-expressions in the form of stacks and used those to solve the entire expression. However, this methodology worked well with limited size of arithmetic expression. It did not work well when the length of the expression was increased.

Table 1 Succinct review of the related work is presented in this table including different techniques used to study RNNs

Paper	Year	Author(s)	Technique used	Result/conclusion	Research gaps
[4]	2011	Martens et al.	RNN with Hessian Free optimisation for solving gradient descent problems and long short-term memories problem	Experimental results proves that HF optimisation holds a capability to train the RNN model more effectively	The computation time was unexpectedly higher due to its property of gating neurons which falls in the category of 3-way neuronal connection
[5]	2012	Bitzer et al.	RNN fused with Bayesian inference system to make it computationally more powerful	Experimental results show that fusion of RNN with Bayesian inference framework proved to be better for nonlinear dynamical system	In this approach, multistable dynamics are not incorporated, which can be an important component related to coordinated movements
[6]	2016	Brian et al.	Training of recurrent network of spiking model neurons using firing-rate dynamics	Experimental results prove that by introducing continuous variable, the neuron model mimics the original spiking networks with faster speed and computationally effective	The spiking model constructed using continuous variable was not developed by a logical design process. It could not explain the connectivity and nonlinearity at population level

(continued)

Table 1 (continued)

Paper	Year	Author(s)	Technique used	Result/conclusion	Research gaps
[7]	2016	Ingmar et al.	Training of recurrent neural network to demonstrate how brain solves problems related to hard navigation	The proposed methodology is first neural solution to SLAM problem. The experimental results prove the idea of end-to-end learning using RNN and also demonstrates, how this can be advantageous to solve robotics SLAM problem	Since the model repatriates the behaviour of movement only, it does not include memorisation. It would be interesting to see if constraints like non-negative neural activations, dale's law or architecture of hippocampus circuit can be incorporated with brain's navigation system
[8]	2016	Peter et al.	Conversion of artificial recurrent neural network to spiking neural network	A train-and-constrain approach is presented that portraits the results of artificial neurons with spiking neurons	Since synaptic weights taken in the form of discrete. This discretisation leads to performance decrease and hence can be expected to be the topic of further research. If discretisation can be improved then the accuracy of the model can also be improved
[9]	2016	Rajan et al.	Partial in-network training to train RNNs for sequence generation	The proposed algorithm proved to be efficient when the sequences generated by the collaboration of recurrent synaptic interconnections and external inputs were successfully propagated	However, it can be seen that neuronal sequences may also arise through largely connected unstructured network

(continued)

Table 1 (continued)

Paper	Year	Author(s)	Technique used	Result/conclusion	Research gaps
[10]	2017	Alexander et al.	Trained recurrent neural networks to study task-related neural dynamics	Experimental results show that dynamics connected to network's output, in the boundaries of attractors are determined by low-order linear differential equation. Using the equations, network can be accessed, and prediction of success and failure can be also be made	However, the network generates failure when a nonlinear sigmoid activation function was used with rectified linear units
[11]	2017	Barak et al.	Low-D intuition and reverse engineering methodologies for training RNN	The low-D intuition methodology assumes that the activity of the neurons is not affected by the input current only but also by the state of the network. Reverse engineering assumed that saddle points, line attractors and other areas of phase space could be the main describing points of computation, which may provide some insights to the process existing in blackbox	However, it was not suggested, which methodology, low-D intuition or reverse engineering can best explain network dynamical system
[12]	2017	Umut et al.	Recurrent neural network model for modelling the dynamics and activities of human brain	Experimental results show that the RNN model proposed in this work can outstrip the existing response model by correctly evaluating long-term dependencies	The work proposed here could not explain the dynamics of human brain with response to sensory stimuli

(continued)

Table 1 (continued)

Paper	Year	Author(s)	Technique used	Result/conclusion	Research gaps
[13]	2018	Hupkes et al.	Visualisation and diagnostic classifiers to check the performance of RNNs over hierarchical structures	Experimental results show that RNN performed well in solving the arithmetic expression, amongst other artificial neural networks	However, the network did not perform well, when the length of the expression was increased

2 Conclusion

Recurrent neural networks (RNNs) are useful tool for computational and theoretical neuroscience research. Designing and training such networks has unfolded alternative schema to develop neural systems. In addition to providing ample set of sub-networks to specific task, this type of network can give insights to new scientific questions. Like, does it provide correct measure of naturalism whilst modelling the brain? What would be the extent of solution for a given problem? What would be the behaviour of the network towards biological constraints? Will we be able to understand the learning process happening in the black box? In order to gather all these benefits, a robust theoretical foundation is required and is expected to be developed in near future. For understanding the dynamical system of human brain, it is quite important to train and design the network, the same way human brain is doing. In biological neural network, training takes place on a framework of physiological and anatomical constraints. These constraints can be thought of as elements in a network. My assumption is that if the network is able to represent the dynamical system of human brain, with all constraints satisfied, it may be able to solve the scientific questions.

This review targets recurrent neural network as an overall framework to understand the dynamical system of biological network, the connectivity and communication amongst a population of different connected neurons.

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Chapter 42
Data Protection and Security in Affordable Home/Remote Monitoring (MCPS) of Patients

Sumit Saini, Shilpa Mahajan, and Mehak Khurana

1 Introduction

Healthcare is vast and complex industry which has faced many challenges from time to time. Since today in this era of digital technology, Healthcare is facing one of the biggest challenge and that is data protection. Today, digitization of healthcare services is very essential to make it more effective and simply we cannot avoid it. And if the healthcare system is connected in an insecure manner, it could betray the patient safety which can force them to pay unaffordable personal cost. Since the healthcare has transformed with adoption of various technology like electronic medical records (EMR), Digital PAC System, Radiology Information system and Digital Laboratory Information System excreta, it is attack surface has been grown to a very high range but the risks are totally been ignored. Having said that the medical device industry is going through huge transformation with embedded AI and network connectivity. So the combination of embedded medical software of medical devices and networking capabilities turn to be a Medical Cyber Physical System (MCPS). So MCPS is basically an interconnected, intelligent system of medical devices. Below you can see a basic model of MCPS where medical device data is provided to the caregiver passing through various smart tools using the connectivity. Definitely adopting the technology ease our life but it brings numerous security and privacy challenges (Fig. 1).

Especially today when the CORONA Pandemic has brought new challenges and risks to our political, economic, social and health system. There is one more threat which is alarming at high peak is related to cyberspace or digital space. The COVID-19 pandemic has significantly caused the digital transformation which led us to more dependency on digital services in every possible ways. Every single industry has

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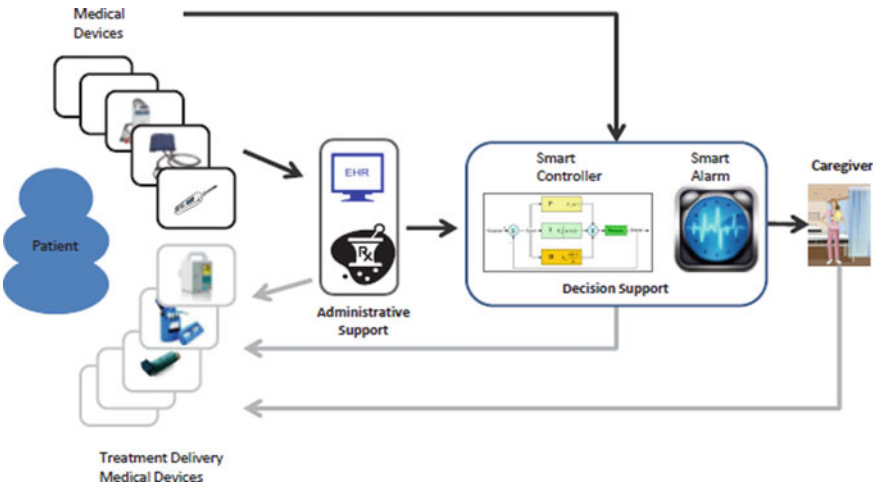

Fig. 1 Basic cyber physical system design

adopted the digital transformation like IT industry moved to work from home initiative and education industry completely moved to online classes similarly Healthcare industry has also adopted various Tele services for patient care like Tele Consultancy, Tele-ICU and Home Monitoring, etc. It was really necessary for them to adopt to these model to decrease the patient's foot step into the hospital and ultimately to limit the virus spread. In last one year of this pandemic, the world has seen millions of patients which need to be admitted to hospital for their survival but even the first world countries were seems like incapable of fulfilling the need of their citizens because of limited beds and necessary infrastructure. So to overcome this challenge, various companies came forward with the solution of Home monitoring but again they have ignored the fact of risk associated with the data protection of patients and ultimately new opportunity for the hackers to ripe their crop during this unseen disaster.

Not only into the COVID-19 scenario, the remote monitoring or assistance can play the lifesaving role for the remote area patients who are in emergency condition like trauma, Cardiac failure, emergency surgery procedures and many more. In these situation, the timely and effective response by a specialized doctor is highly desirable. In other cases, the reason for the requirement of emergency opinion can be because of natural hazards like earthquake or tsunami, etc. It has been clearly observed that maximum number of critical patients has lost their lives during the patient shifting process. Since there are various countries which has lack of good healthcare practitioner and maximum of them are in Tier I cities very far from the reach of Tier II and Tier III cities.

The author wants to propose the affordable and secure remote/home monitoring solution (MCPS) to overcome these challenges and save millions of lives. So our contributions in this paper is designing a medical cyber physical system which will

include: (1) Designing All-in-one basic patient monitoring devices having features like wireless connectivity for bio sensors, data conversion, network protection, Audio/Video functionality and secure transmission using public network, (2) Centralized database for data handling, storage, research and analysis and making it available for real time patient monitoring via digital app.

The paper has organized in the following order, i.e., Sect. 2 discuss key problems and the COVID-19 effect on the world and healthcare industry, Sect. 3 covers the benefits of Medical Cyber Physical System for remote monitoring of patient's, Sect. 4 discuss the Impact of Cyber-Attacks on Medical Cyber Physical System and some recent list of such attacks, Sect. 5 draws the Proposed Solution and future work and Sect. 6 presents the Conclusion of the study.

2 Problem Definition

As described above, the integration of Cyber Physical System into medical field brings various benefits related to efficiency, accuracy, reliability, availability, etc. however on the other hand it brings up two main challenges as mentioned below:

2.1 Security

Basically in the view of end point user, during the entire chain of patient data flow; medical device, the doctor and the physical storage of patient records can be trusted. Once the data sharing begins in digital mode from the physical medical device to the doctor who will be accessing this digital form of data via any electronic mode; the security of data from the attackers comes into the picture. The attackers can effect or even theft the data which can effect patient's privacy and security in various ways for, e.g., hacker can sell the data to various advertising agencies which compromises the privacy of patient's, hacker can use the financial details of patient's and cause serious financial damages, the attacker can access and modify the patient's monitoring data which can lead to wrong assessment and treatment which can be really dangerous to patient's life. So the design must be able to avoid any kind of intrusion and ensures the security of patient data at the very first level of data transmission, i.e., medical device system to the final level.

2.2 Expensive

It will be completely a false claim to say that such solutions are not available in present day. Today, there are various solutions available in the market which addresses these challenges but definitely none of the solution stands alone fulfill all the needs and

they are way too expensive for any organization or individual to incorporate these solutions into their system. However, some big organizations or institutions have these enterprise solution and giving the services using these solutions but again these services are limited to the upper layer of society since availing these services costs more as compare to traditional treatment services expense. So the design must be cost effective and should be available to all categories of the society.

2.3 Impact of COVID-19 on Healthcare Sector

The COVID-19 pandemic has drawn a new curve of learning for the healthcare providers globally. It is the first time in history, when any healthcare emergency has marked full stop on entire global economy and it has painfully demonstrated that how the healthcare and economy is inseparable for any nation or country. Basically healthcare sector is divided into two categories: **(A) Personals: Medical fraternity which includes Clinicians, Nurses and paramedical staff, etc. in any healthcare facility like Hospitals, Clinics, etc. and (B) Industries: Healthcare companies like device manufacturers, Drug and Medicine manufacturers, etc**.

(A) **Personals**: All kind pandemic come up with life threatening challenges so same for the COVID-19 situation when this pandemic has shaken the world. There was a huge terror among the people and everybody was rushing toward the ICU and the checkups. But the Healthcare domain was very ill prepared to tackle such emergency at this level. Hospitals and institution were forced to mobilize their resources at high scope to at least mark the response against this pandemic. The entire healthcare fraternity has to work day and night to serve their duty. The important fact is that the Hospitals and Clinics in the many countries who were accommodating those affected patients were greatly lacking in terms of policies, procedures, infrastructures, resources, medicine, knowledge and experience in handling such situation of pandemic, shortage of protection gadgets like PPE kits, etc. despite considering all these mentioned things, they all were facing physiological and mental impact, misbehavior, social and economic impact, even they were at the very high risk of getting infected but still they kept pursuing continuously their duty in this need of hour. Because of their sense of duty, today, all these medical fraternity members are regarded as Healthcare Warriors. This pandemic has made the various leaders to realize their current in capable position and to look forward for the alternative solution like remote monitoring as an answer to all these challenges.

(B) **Industries**: While Coronavirus pandemic has posed unplanned demand on healthcare infrastructure, the industry also has shown their vivid response to the demand and capability to bring new innovations to the market quickly. Whether it is related to shortage of medical devices or drug/medicine manufacturing or bringing the technology like Artificial Intelligence, IOT, Remote/Home Monitoring solution, etc. to provide the alternate solution of traditional medical

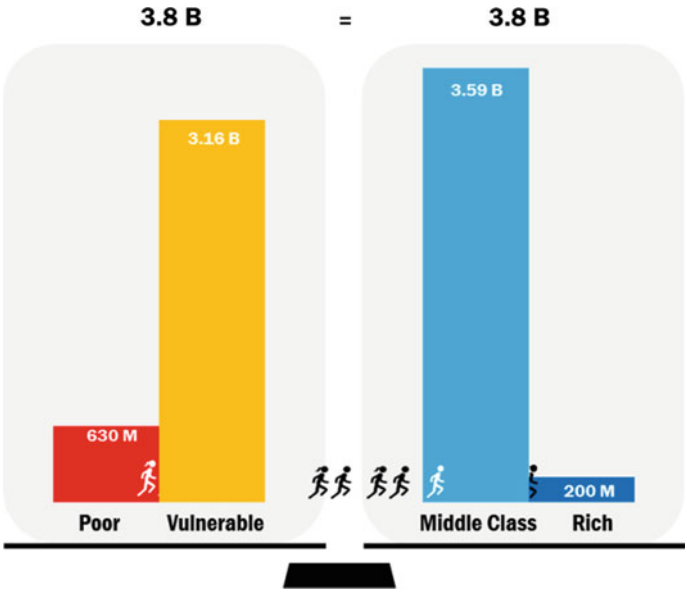

Fig. 2 Source: Projections by World Data Lab

practice. No doubt that these technologies has been proven extremely helpful and the world has accepted these technologies as part of this so called new world order but these companies has also made tremendous profit by providing these solutions.

Though the solution is available, since these facilities are very expensive so availing these services is not possible for entire population because around 3.16 billion people are still under poverty line and 3.59 billion people falls under middle class with only 200 million under rich class (projection by World Data laboratory) (Fig. 2).

The post-COVID-19 healthcare sector era will be more dominating by these technologies based solution like telehealth, remote care and other types of digital health solutions which will ultimately drive the solution providers to reassess their pricing models to make it more affordable for this untouched population.

3 Impact of Affordable Remote/Home Monitoring

In this digital era, it has been possible to provide consultation, prescription and even remote/home monitoring while the patients are at home or in ICU of any hospital located at far remote areas from the mainland where it is totally difficult to have a well experienced medical practitioner in life saving situations. There are several benefits of this practice:

(A) *Better access to well qualified and experienced healthcare team*
(B) *Improves quality of care*
(C) *Improves patient's lifestyle, e.g., for chronically ill patients*
(D) *Overcomes the paucity of critical healthcare facility in remote and rural areas*
(E) *Reduce length of stay*
(F) *Reduce mortality rate*
(G) *Reduce human error rate and improve accuracy*
(H) *Availability of point of care*
(I) *Availability and accessibility of real time data from anytime, anywhere*
(J) *Reduce infection rate and improves outcome*
(K) *Data analysis and research*
(L) *Better support and education*
(M) *Fast and accurate treatment*
(N) *Better monitoring for mental, psychological and other special category patient's*
(O) *Better monitoring for mood able or depression patient's*
(P) *Cost effective, thus availability for all economical category of society.*

The remote monitoring can substantially minimize the hospital visit and reduce the cost and inconvenience to the patient's. Since the monitoring device also will be connected to the network, so device health can be monitored continuously and can be replaced timely in case of failure which can lead to less downtime and high patient monitoring. Henceforth, because of N number of benefits, remote/home monitoring is proven to be very helpful not only for patients but doctors too. However, one of the main drawback of this solution is secure transmission of data from one location to another and prevention from unauthorized access from intruders (cyber-attacks).

4 Impact of Cyber-Attacks on Medical Cyber Physical System

According to the US department of health and human services office of civil rights, below are some examples of biggest Healthcare data breach of all time which indicates the importance of Healthcare data security:

4.1 **Anthem Blue Cross**: 78.8 Million Affected (January 2015)
4.2 **Premera Blue Cross**: 11+ Million Affected (January 2015)
4.3 **Excellus BlueCross BlueShield**: 10+ Million Affected (September 2015)
4.4 **TRICARE**: 4.9 Million Affected (September 2011)
4.5 **University of California, Los Angeles Health**: 4.5 Million (July 2015)
4.6 **Community Health Systems**: 4.5 Million Affected (April-June 2014)
4.7 **Advocate Health Care**: 4.03 Million Affected (August 2013)
4.8 **Medical Informatics Engineering**: 3.9 Million Affected (July 2015)
4.9 **Banner Health**: 3.62 Million Affected (August 2016)
4.10 **NewKirk Products**: 3.47 Million Affected (August 2016).

Some recent attacks which were happened in 2020 are BLACKBAUD (over 10 Million affected), LUXOTTICA (over 8.29 Lakh Affected), HEALTH SHARE OF OREGON (over 6.5 Lakh affected), ASPENPOINTE (around 3 Lakh affected) and MAGELLAN HEALTH (around 3.65 Lakh affected).

Today, there are so many global companies out in the market which provides professional services for data handling and secure data transmission. But these technologies are highly expensive and very complex solution to deploy which is very challenging in order to achieve the goal of affordable remote/home monitoring solution.

Below you can see the list of available solution provided by market leaders, comparison and their drawbacks:

S. No.	Company	Solution name	Solution type	Wireless sensor supports	Secure data transmission	In-build A/V in device	Clinical data dashboard	Drawback
1	GE	Centricity Tele-ICU	Limited to ICU	NA	3rd Party	No	Yes	Complex and highly expensive
2	Philips	ICCA eICU	Limited to ICU	NA	3rd Party	No	Yes	Complex and highly expensive
3	Masimo	Masimo SafetyNet	Limited to home monitoring	Yes	Yes	No	Yes	Mobile solution and expensive
4	Medtronic	MyCareLink	Limited to cardiology patient's home monitoring	Yes	Yes	No	Yes	Mobile solution and expensive
5	Cloud Physician	RADAR	Limited to ICU	NA	3rd Party	No	Yes	Complex and service-based model
6	E Next ICU	TELE Wellness	Neurology, radiology, dialysis	NA	3rd Party	No	Yes	Complex and highly expensive
7	Fortis Healthcare	Critinext	Limited to ICU	NA	3rd Party	No	No	Complex and highly expensive
8	ICU consultants	InteleICU	Limited to ICU	NA	3rd Party	No	Yes	Complex and highly expensive
9	Tytocare	Tytocare	Limited to NICU	NA	Yes	Yes	No	Complex and highly expensive
10	Springer Healthcare	Tele-ICU	Limited to ICU	NA	3rd Party	No	No	Complex and highly expensive
11	Adroit	E Clinic System	Limited to outpatient	NA	3rd Party	No	No	Complex and highly expensive
12	NextGen Healthcare Software	NextGen EMR	Limited to ICU	NA	3rd Party	No	Yes	Complex and highly expensive

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S. No.	Company	Solution name	Solution type	Wireless sensor supports	Secure data transmission	In-build A/V in device	Clinical data dashboard	Drawback
13	Athena Health	Ambulatory EMR	Limited to Wards	NA	Yes	No	Yes	Complex and highly expensive
14	Chiro Touch	Tele Consultant	Limited to consultation	NA	Yes	No	No	Complex and highly expensive
15	DrChrono	Tele Health	Limited to ICU	NA	Yes	No	Yes	Complex and highly expensive
16	WebPT	WebPT EMR	Limited to consultation	NA	Yes	No	No	Complex and highly expensive
17	E Clinical Works	healow Tele Health	Limited to ICU	NA	Yes	No	Yes	Complex and highly expensive
18	Epic	Epic Telehealth	Limited to ICU	NA	Yes	No	Yes	Complex and highly expensive
19	Next Tech	IntelleChartPRO	Limited ophthalmology	Na	Yes	No	Yes	Complex and highly expensive
20	Cerner	Cerner Ambulatory	Limited to ICU	NA	Yes	No	Yes	Complex and highly expensive

5 Proposed Model

Here, the author propose to build a device which can be placed next to the patient (at home, ambulance or hospital) with wireless sensors to collect the physiological data from patient. This multitasking patient monitoring device will have in-build monitoring system, camera device and secure data transmission functionality over the internet. Once this device is connected to patient, it will collect, convert and send the data to a centralized data center in real time.

Now the physical/doctor will have direct access to real time accurate patient, Audio and Video accessibility and will be able to make its clinical decision from anywhere anytime via the Mobile app or Web-based application. And once the data will be at centralized repository, there are many more things can be done with data like data reporting, data analytics and research, population health analytics, patient notification management and many more (Fig. 3).

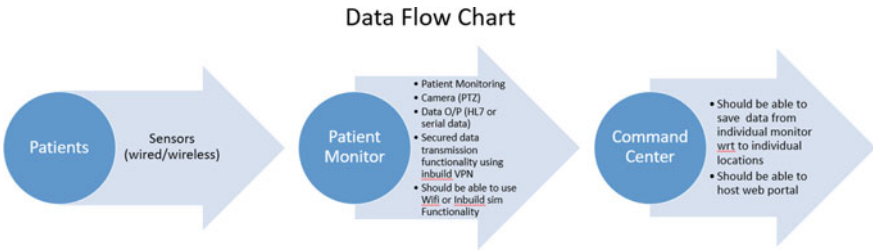

Fig. 3 Data exchange b/w all three entities

5.1 Design and Implementation

Sensors: Today in the digital era of IoT in healthcare, the medical companies are still using the traditional wired technology with sensors for patient monitoring. Here we propose to use the sensor with low power wireless personal area network (6LoWPAN) transmission capability which is based on IPv6. This makes the sensors small in size, less power consumption and transmit of information using Internet protocol (Fig. 4).

Device: The design of device will be completely state of the art having three main components:

Data Handling: The device will receive the data from the sensors wirelessly. This raw data will be converted into the transmissible format using the in-build conversion technique. This converted data will be encrypted into the secured form using the crypto technology (AES) and sent to the destination using the embedded Wi-Fi/LAN functionality.

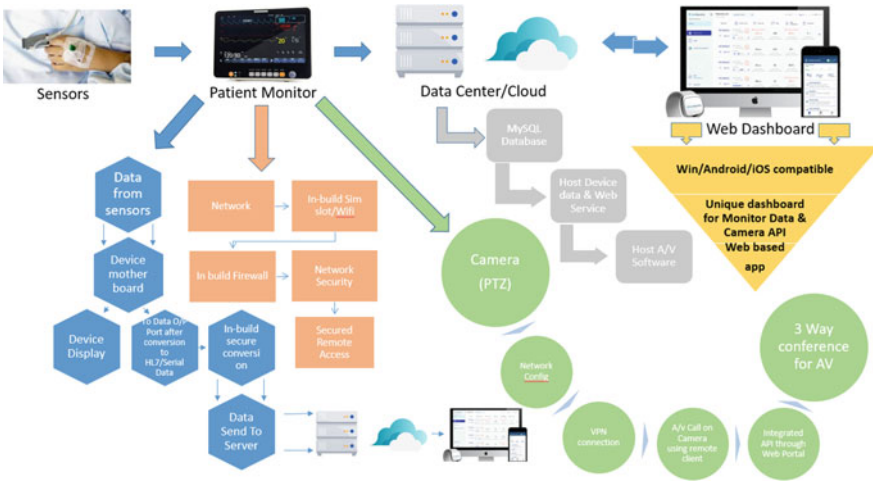

Fig. 4 Overview design of complete solution

Data communication: The device will have latest Wi-Fi/LAN connectivity functionality for using the public network. The secure data will be transmitted to destination using the Public Internet. The device will have embedded Micro SIM Slot for stand-alone network accessibility. It will have in-build firewall system to protect the unauthorized access to the device.

Integrated A/V Solution: The device will have integrated IP-based Camera device for remote view of the patient. The Camera will have PTZ functionality so that remote doctor can control the camera position and use accordingly. It will have integrated IP-based voice functionality as well, so that remote doctor can have voice interaction with bed side staff whenever required. This way the remote doctor's will be able to conduct regular patient review, emergency assistance and many more activity in very efficient way.

Data Storage and Handling: This is the next level, where the medical device will send the data to storage purpose and this physical/cloud server can act as a repository for data storage. Here, MySQL database can be used to save all the patient data that includes the demographic information and the device data. Now on the top of this server, we can create an analytic dashboard and perform various research and analytic work. The same data can be used for reporting purpose.

Web-Based UI and Mobile App: The Web-based UI and Mobile App will be the final component of the solution. The dashboard will publish the real time patient monitoring data on the screen using which the physical will able to make medical decisions and decide treatment plan for remote patients. This dashboard/Mobile App will read the data from the MySQL database and keep syncing on fixed intervals. This will make the physician to avail the patient data anytime and anywhere for any kind of evaluation. This app will have integrated Camera and VoIP call icon which can be used for video feed from bed side for patient assessment and audio call to interact with bed side nurse for advisory.

6 Conclusion

In this paper, we have presented the importance of Medical Cyber Physical System in remote monitoring of patient and which is undeniably a future version of healthcare industry. It is believed that the making this solution affordable can affect millions of people and help them in life threatening situation. In this paper, we have presented a MCPS having a medical device integrated with various digital tools to achieve this remote monitoring solution secure and cost effective.

For the future work, Firstly we need to collect more data from the existing service provider of Remote Monitoring service, understand their challenges so we can address all the possible need of the remote monitoring service provider. Then we need to work on the draft design of the proposed solution, data conversion algorithm, database design, Web-dash board/Mobile App design and hardware evaluation.

Compliance with Ethical Standard

Funding: This is to confirm that no funding has been obtained.

Conflict of Interest: This is to confirm that there has been no conflict of interest.

Ethical Approval: This is to confirm that this article does not contain any studies with human participants or animals performed by us.

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Chapter 43
Employee Emotions on Work from Home During COVID-19: Sentiment Analysis Approach

Aanyaa Chaudhary and Sonal Khandelwal

1 Introduction

The unprecedented evolution and expansion of COVID-19 in contemporary times has caused more than 172 million cases with over 3.7 million deaths world over, confirmed by WHO at the time of writing the paper (June, 2021). The disruptions in socio-economic lives are unparalleled with uncertainty still hovering. The crisis is devastating with increasing unemployment and devastating for underprivileged communities [1, 2]. COVID-19 has not just shattered daily routine, lifestyle of people at personal level but also has given a major blow on world economy [3]. Forbes [4] has predicted a severe economic crisis world over.

Since the COVID-19 is declared pandemic by World Health Organization (WHO) in March, 2020, has led to multidimensional challenge before business organizations which results in many conflicting priorities [5]. This has impacted the business which is facing with a major challenge of keeping the employees, as well as the customer safe along with sustaining and maintain liquidity and reorienting the operations. The human crisis poses an utmost responsibility on Human Resource (HR) managers and leaders.

The foremost challenge before HR initially was to assist employees to adapt to work from home in order to retrieve business. Redesigning technology and drastic digital challenge to support remote working along with skilling employees to perform job virtually was the onus of HR managers [6–10]. Thus, the pandemic demanded major restructuring of the core HR functions including internal communication, performance management, development, on boarding and succession planning [11].

Employees are experiencing emotional stress and uncertainty about future including fear of layoffs and salary cuts. The employers are struggling to keep

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the engagement level high and the significance of agile employees had never been realized as much as it is now and in the future [9, 12]

Latest advances in technology make abundant data sources available that guide decision making. Thus it is pertinent for HR managers to possess strong analytical skills to leverage data offered by various data sources. Thus if data is harvested effectively using various metrics and measures it drives organizational success.

The lockdown, social distancing and remote working has escalated the use of social media as a mode of communication. Micro blogging sites like Twitter are used extensively by people to express their opinions and emotions [13]. The HR leaders in organizations are concerned to understand how the employees are reacting and adapting to the new working norms. Latest analytical software assist in analysing the opinions from social media sites and thus, helping in business decisions as well. Use of such tools is helping HR mangers in comprehending and analysing employees' emotions and opinions in order to craft future policies and strategies.

This paper attempts to understand the opinions and emotions of employees on work from home by mining tweets from Twitter sites and analysing the sentiments behind them using R-Studio software. It aims to provide meaningful insights about the sentiments of employees in India on working from home thus the HR managers and organizations may draft their future course of action to create agile and engaged workforce.

2 Review of Literature

With the advent of COVID-19 there are new challenges and opportunities being faced by the Human resource management as employees have new obstacles in front of them in form of inability to adjust to their remote workplaces, inability to unplug the home from work, increased blurred lines between personal and private and domestic burden in employee's life [14]. COVID-19 is the classic case of how pathogens have created a long-lasting havoc on workplaces and society in general [15]. These newly emerged challenges call for HR managers to be well equipped because improperly managed human resource management might lead to disorderliness and lowers the productivity levels. The Human resource managers have been a linking pin between stable functioning of organization by implementing new normalcy norms at one end and enabling the workforce to act and adapt the new business model and culture that promotes recovery, resilience and sustainability, on the other [16].

There has been a paradigm shift in work life which is enabled by emerging role of technology. The disruptive and dynamic changes like untethering from a specific physical space necessitated remote working and work from home (WFH). In fact, remote working approach was considered in consequence of COVID-19. During COVID-19 confinements and due to remote working both the employers and employees were exposed to exceptional working conditions that led to stress and anxiety [5, 15, 17–19]. Human Resource (HR) managers facilitate in problem solving and in bringing back normal situation in the organization [20]. With the advent of

COVID-19 there are new challenges and opportunities being faced by the Human resource management as employees have new obstacles in front of them in form of inability to adjust to their remote workplaces, inability to unplug the home from work, increased blurred lines between personal and private and domestic burden in employee's life [14].

Hamouche [21] in her research examined the impact COVID-19 had on employee's mental health and how Human resource can manage and mitigate the impact. The human resource of the organization needs to ensure that there is optimum communication by involving the employees in developing the plan of getting back to work as well as being continuously in touch with the employees. The social isolation can again be reduced by keeping a tab on the mental health of employees via various techniques and providing social support in the form of virtual meets, fostering a supportive environment via employee assistance programmes. Similarly Collins et al. [22] mention that HR leaders are at a unique and better position to navigate this pandemic and it is an opportunity for HR leaders to recreate their status in the corporate world.

Mathis and Jackson [19] mentioned four possibly work place hazards two of the relevant ones being mental health of the employees and workplace pressure which is quite relevant when we put it in today's pandemic situation. In these times the organizations are very susceptible to financial losses, because even if the work continues in a hybrid model and the employee tests positive the work halts, causing financial strain to the organization. The corona virus related stress has been termed as Stress by Corona (SBC), which defines the dilemma and difficulties employees deal with internally whilst dealing with this Corona-based situation. The paper listed various fears because of SBC: Fear of getting affected, fear of quarantine, fear of family getting affected, stigma affecting families, fear of commuting to workplaces, peer pressure, harsh customers, fear of losing a job etc. to name a few. When SBC combines with various other stresses like personal, family organizational, environmental, etc. the result can be explosive [19].

Ghosh et al. [23] highlighted how COVID-19 not only killed as a disease but also due to mental stress and economic and financial difficulties that accompanied it. Whilst the economic and human life took a negative hit, the 68-day lockdown was a much-needed positive break for the environment. The clear digital divide and the lack of Internet infrastructure posed as challenge to the new change in workplace scenario although the lockdown saw a whopping 60% hike in the sales of Wi-Fi and Internet portable dongles. Staying at home resulted in stress, isolation, obesity, diabetes and increased risk of heart related issues, the positives being a stability and routine lifestyle was observed in diabetic patients and in places like India where the families still stay together, they got to spend time with each other [23]. Offering tele health services to employees can play an instrumental role in overcoming the challenges of the situation by reducing the mental Burden [24].

A study done at workplace in Japan [25] demonstrated that how there is a direct link between the implementations of measures by the workplaces and the mental health of the employees. The results indicated that the more intensive these measures were, the lesser were the fear levels amongst these employees, key factor being

increased communication and awareness. Job Satisfaction is directly propositional to the positive mental health. Stangrecka and Bagienska (2021) in their study shed light on various social factors that lead to a job satisfaction by using the Expectation States Theory (EST) the main factors including working relationships, job satisfaction and trust. Establishing interpersonal trust is of utmost importance to employee relations and job satisfaction.

Micro blogging creates excess of posts each day and is a key platform to share views by Internet users [10]. With the advent of social networks new modes to collect data concerning behaviours and opinions have emerged where social data is collected directly from social platform accounts of the users. The collection and analysis of data from social networks researchers grasp significant information by studying various facets of user behaviours [26].

Social Network Analysis (SNA) forms a scientific method to extract analyse the data and its structural characteristics both quantitatively and qualitatively. Social network is a competent technique to collaborate amongst the organization, research groups and also development units [27].

Sentiment Analysis is a systematic study of sentiments and emotions analysed out of texts towards a particular event [28]. In other words, it is also called opinion mining or attitude analysis as it digs the emotions and opinions of public or a target group and thus be used to study and analyse behaviour. The online media platforms are a large mine of unstructured data in terms of tweets, text, post, etc. and thus can be used very well for sentiment analysis. Twitter and Facebook have made their Application Programming Interface (API) to public to collect data. Opinion Mining can be used for Market and FOREX prediction, box office prediction, Business Analytics, Advertising (Recommender Systems), marketing, etc. Sentiment classification can be done either using machine learning or lexicon-based approach. Vagueness and Difficulty in analysing multilingual texts remains to be the common problem in opinion mining area. In most of the studies of SA, it focused at document levels. Documents here refer to blogs, forums, biography, tweets, etc. Over the years Sentiment classification accuracy has increased from 89 to 92% [29].

3 Objective of the Study

The study aimed to:

1. Make a deep dive into the depths of how the current tough times of a pandemic impacted the sentiments of working professional.
2. Understand the emotional turmoil that the employees went through in regards of their work and personal life.
3. Note the importance of the social media community's contribution and help in dealing with the pandemic and crises.

4 Research Methodology

The information was analysed using sentimental analysis. The research involves extraction of tweets from Twitter, a social media platform, in the form of unstructured data. In order to mine the text which was in the form of tweets a developer account was created on Twitter A developer account was created followed by an application seeking permission to mine tweets. As a result API keys, secret keys and tokens were generated with the authorization from Twitter. R Studio software was used to extract tweets. A total of 9600 tweets using various keywords like "Remote Working", "Hybrid Working", "Remote working", "Work from home and HR" from India from the period of 13, April 2021 to 21, April, 2021 that is the period of lockdown.

Table 1 depicts the keywords used with examples of tweets that were analysed.

The next process involved conversion of extracted tweets to data frame which were saved as CSV File containing 9600 tweets with 16 variables. The order of the text analysis is summarized in the flowchart below in Fig. 1.

Table 1 Keywords and tweets extracted

Keywords used to extract tweets	Example of tweets	Number of tweets
Remote working	"Remote working is here to stay" "Moving to remote working is not changing workplace culture; it is simply changing wallpaper. People are working more hours…"	3000
Hybrid working	"Hybrid working becomes a new norm for tech pros" "Hybrid working may change contractual terms and conditions for employees"	3000
Work from Home	"Companies to spend on tech for #workfromhome" "I like my home office. I like to work from home. I have modified and adapted." "If companies who made their employees come into work when working from home was a viable option were held financially responsible"	3000
Work from home and HR	People are happy working from home—so we are going to be happy managing remotely "2020 taught us how to support work from home"	600

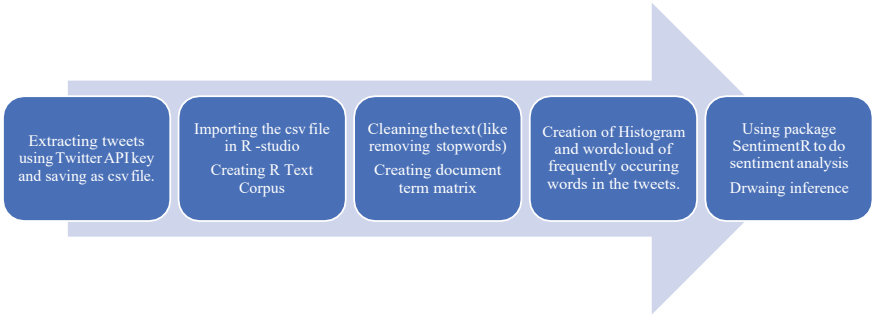

Fig. 1 Research methodology flow chart

5 Data Analysis, Results and Discussion

After the tweets were cleaned and a document term matrix was created, sentimental score was computed and represented in the form of the bar graph plot in Fig. 1. The sentiment analysis of the Tweets in context to Work from Home, depicted that more than 75% of the tweets had positive emotional tone whilst negative tone was present in very less tweets. This emphasized that people were optimistic about working from home. In order to analyse further, associated emotional quotient was identified. A total of eight emotions were analysed. Cumulative of anger, disgust, fear and sadness represents negative emotions and anticipation, joy, surprise, trust which embodies positive emotions. The results of the sentiment analysis are depicted in Fig. 1. Sentiment analysis clearly highlights that trust, anticipation and joy form the major emotional tone. As depicted in the figure emotion of trust were almost one-fourth of the tweets analysed closely followed by emotion of anticipation. Emotion of joy is next in majority that helps in concluding that people were hopeful and positive about working from home.

The greatness of the positive elements was the silver lining in the gloomy times of COVID-19 pandemic. It really put a spotlight on the fact that even one ray of sunshine can take over a lot of darkness of these times. The emotions of anticipation and trust were the highest scorers depicting that people were became hopeful of the situation over the period of time. It may be due to vaccine and positive results of the vaccination. Also, in a period of one year people were more trained and more equipped to work remotely. It took a bit of resistance to get used to the new changes which have never been experienced but over the period of months employees relatively got accustomed with the new work pattern. They made changes in their routine and picked up their productivity. Employees started trusting their employers more, maybe because employers and team leaders made due efforts to communicate. With the advancement in digital communication tools, the top leadership of the companies must have encouraged a two-way communication and that has in earlier researches also shown positive changes in the job engagement and job satisfaction of the employees. The people saved on commuting time and felt secure about not

catching infection as they were working from home. They had ample time to engage in alternative learning and engage in old hobbies and gave a chance to employees and families to reconnect which bought in the sentiment of joy and fulfillment.

The second phase of analysis was done using word cloud as shown in Fig. 3. The word cloud was created using the word cloud package in the R-Studio software. The words depicted here represent the most frequently used words in the context of the tweets. The bigger the words in size the higher their frequency which was quite similar to the bar graph described earlier. "Working" being centred on remote, home, hybrid, changing time, new systems being implemented across the organizations and all these got reflected in the tweets by these common words (Fig. 3).

Words like Good, Support, Safety and Gains illustrate positive emotional tone related to emotion of joy and trust. "Working" being centred on Remote, Home, Hybrid, Changing Time, New Systems, Digital and Smart showcase the innovative systems being implemented across the organizations and all these got reflected in the tweets by these common words. "Psychologically", "post lockdown", "maybe" can depict the negative emotions including the sense of uncertainty, terror, and general anxiety that was looming in the air during the period of the lockdown.

Word cloud reinforced the results of the sentiment analysis and people were perceiving work from hope as a positive move to face the pandemic phase.

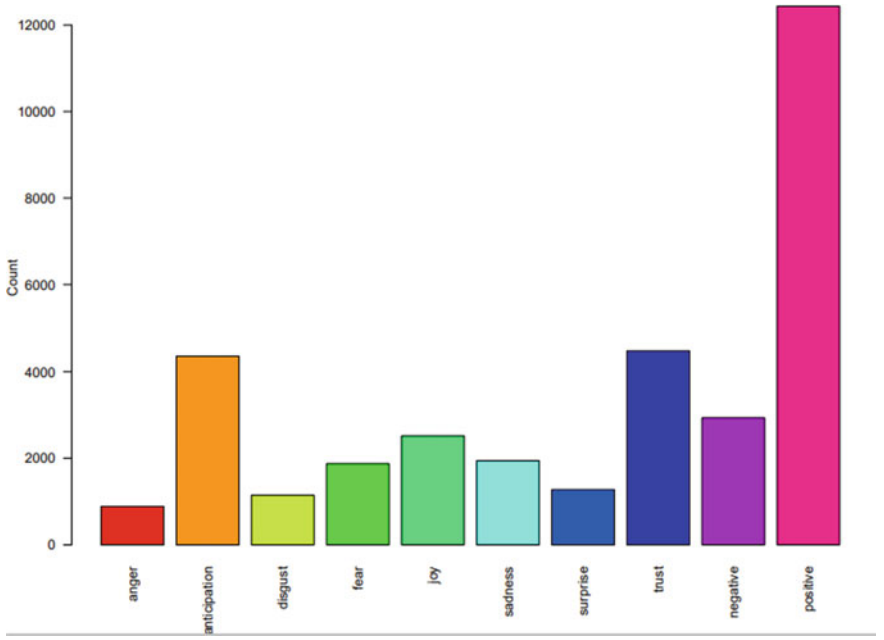

Fig. 2 Sentiment analysis of the tweets

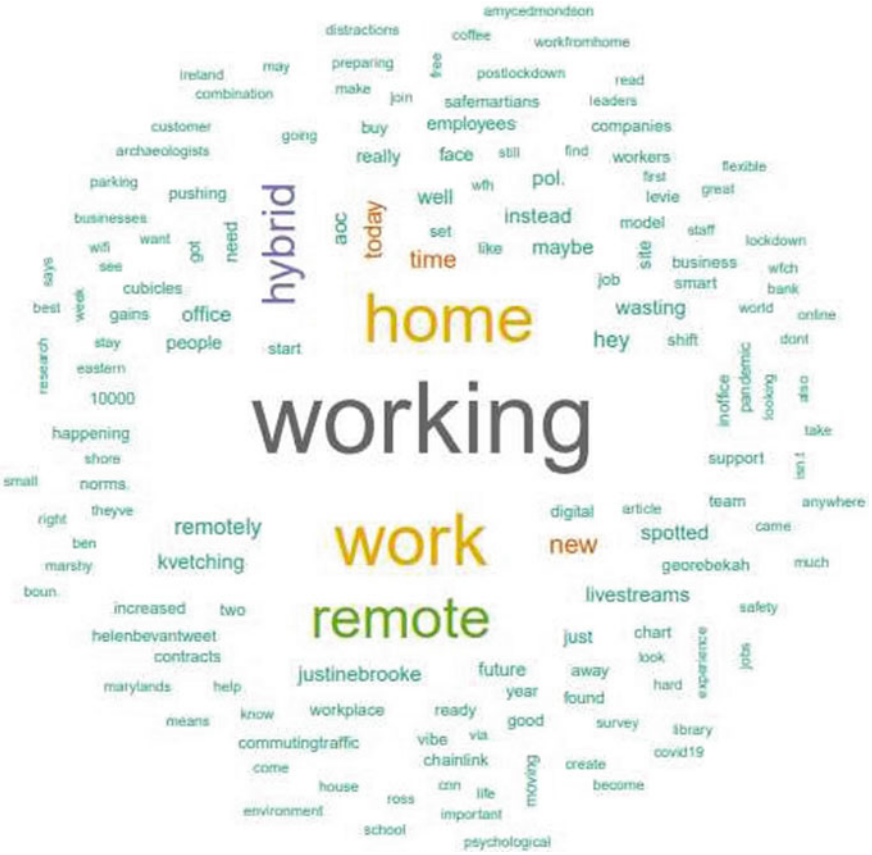

Fig. 3 Word cloud of the frequently used words in tweets. (Source: Analysis result from R-Studio Software)

6 Managerial Implication

Social media is gaining more and more impetus as it is providing valuable insights with the help of advanced tools in big data analytics. Business ecosystem and various government agencies can apply social media analytics to enhance the effectiveness of strategies. Human resource managers can study the opinions and emotions of employees and the problems being faced by them, more so in the unprecedented times like COVID-19 pandemic. Although factual data provides more substantial results but analysis like these where people give free and voluntary opinions can help in comprehending the sentiments that employees are undergoing whilst working from home. This paper sheds light on the feelings of employees due to current challenges and stressors experienced along with those that may be a potential threat. This information should help leaders and mangers to craft ingenious plans that reduce

the stress amongst workforce and maintain a congenial communication along with positive employee experience in current and post COVID-19 pandemic.

7 Limitations

An unavoidable limitation of Twitter is that the whole of the target audience is not represented as only one communication channel is taken into perspective. The sentimental analysis incorporated is software generated and it might face difficulties in detecting sentiments like sarcasm or jokes. There is a slight possibility that people might not always tweet what they feel just to go along with the flow. The target audience here were the employees working from home but there are a lot of organizations whose employees might be working from home at a smaller scale but however they are not present on online platforms like twitter and so their emotions and state of mind are not captured. There are various organizations especially government sector that do not have the infrastructure for remote working and thus their emotions are not accounted for in the study. Also, the data collected was for a short period and thus there is shortage of data collection which might lead to bias as it represents the people conversant in English, working from home in India and are on Twitter.

The future scope of the study can be focused on taking in consideration other communications channels like Instagram and Facebook. Conducting primary research may substantiate the results more. Moreover, research may be done for a longer duration and other parts of world.

8 Conclusion

The new work conditions with itself bought in a lot of challenges. Any new change is always met with resilience. This created a lot of negativity and uncertainty with the employees as they were also coping with the pandemic in their own ways. The organizations were initially focused on getting the technicalities right and then eventually realized that rehabilitation trainings was the need of the hour as they were dealing with employees of all age and generations and everyone came with their own set of challenges. It is an established fact that remote working and isolated living do have an impact on the mental health in long term and thus the companies health benefits need to identify this also which was blindsided previously by hiring an in-house psychologist or outsourcing therapists.

The social media and digital media played an important role in overcoming this challenge. They were a silent companion and drove away boredom and isolation for a lot of people. The platforms like twitter became a place stage for employees to express themselves and comfort themselves in knowing that they were not in it alone. Social media can be utilized more by the Human Resource leadership in order

to engage more with their employees in form of social learning or just an activity platform.

This paper aimed to dive into the minds of professional and gauge their emotions whilst working from home. The majority of positive emotions than negative ones indicate that people have been supportive and have adjusted to the new work culture. They have supported their organizations and government. The advent of vaccine and vaccination drive by many organizations is also a ray of hope. Thus, policy makers should synergize and craft more engaging cooperative strategies to cope the calamity.

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Chapter 44
45 nm CMOS-Based MTSPC DFF Design for High Frequency Operation

Suman Bishnoi, Shubham Gupta, Deepak Bhatia, and Riyaz Ahmed

1 Introduction

Finite-state machines (FSM) are the critical part of the control logic. D flip flops are one of the major functions in synchronous sequential circuit. It has been analyzed in [1] that about a fifth to quarter of processor power is consumed by the control logic. With ever evolving architectural sophistication of components such as register and out-of-order execution in a superscalar microprocessor [2] continue to prevail, the control logic is likely to become more complex, its power dissipation is likely to grow.

A flip flop is a digital electronic circuit that stores a logical state of one or multiple data input signal in response to a clock pulse. Flip flop are of two types—static and dynamic. Static flip flop is not fast enough [3] and consequently it has to be used in MHz range. To overcome the problem a TSPC D flip flop is selected. Conventional latches requires both true and complementary clock signal.

The true single phase clock uses only one clock which never gets inverted and thus suits both static and dynamic CMOS circuits. Positive edge triggered D flip flops often gets implemented in very high speed integrated circuit using dynamic logic. This means that the digital output is stored on parasitic device capacitance while the device is not transitioning. The design of dynamic flip flop enables convenient setting resetting operation since by mere discharging a node or more than one node the reset operation can be achieved. A common dynamic flip flop variety is the true single phase clock (TSPC) type which performs the flip flop operation with little power and at high speeds. But dynamic flip flops generally cannot work at low clock speed:

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given enough time leakage paths may discharge the parasitic capacitance enough to cause flip flop to enter in valid state.

In this paper we aim to improve the shortcoming in speed and power consumption of TSPC D flip flop. So, we put forward a modified version of positive edge triggered TSPC D flip flop called modified preset TSPC D flip flop (MTSPC DFF). This version suspends the toggling which in turn removes the intermediate glitches and thus operation of the circuit gets augmented significantly.

2 Literature Survey

Uming Ko [4] the paper analyses several CMOS master slave D flip flop and double pass transistor logic and simulate their behavior in push pull and push pull isolation configuration and compare the performance parameter such as speed and power in the given configuration Shrivastava [5] has worked on GNRFET as a promising substitute for low force application for its better graft over the channel. Aguirre-Hernandez [6], In this paper, an investigation of past proposed clock gating plans for flip flops was done, calling attention to the focal points and downsides displayed for each plan, as far as speed and force scattering. Gupta [7] worked on low powered design of SR flip flop using 45 nm technology, the speedy technical trends show the decrease in geometrical features such as size and power consumption for integrated circuit in VLSI systems. The paper compares the existing design and show the contrast between power, propagation delay and speed.

Upadhyay [8] Understanding the impact of GNRFET as a low force application and its ability to improve conductance in the designed transistor using GNRFET. Nikolic [9] Innovation scaling has entered another period, where chip execution is compelled by power dissemination. Force limits shift with the application area; in any case, they direct the decisions of innovation and engineering and require execution procedures that exchange off execution for power reserve funds. This paper analyses innovation alternatives in the force restricted scaling system and surveys affectability-based examination that can be utilized for the ideal determination of ideal structures and circuit usage to accomplish the best execution under force limitations.

3 Proposed D Flip Flop

Here we analyze the working of the existing design of TSPC DFF and its vices and the modified new design which aims to remove the shortcoming. The proposed modified true single phase clocked DFF consumes significantly less power and power delay product compared to TSPC DFF.

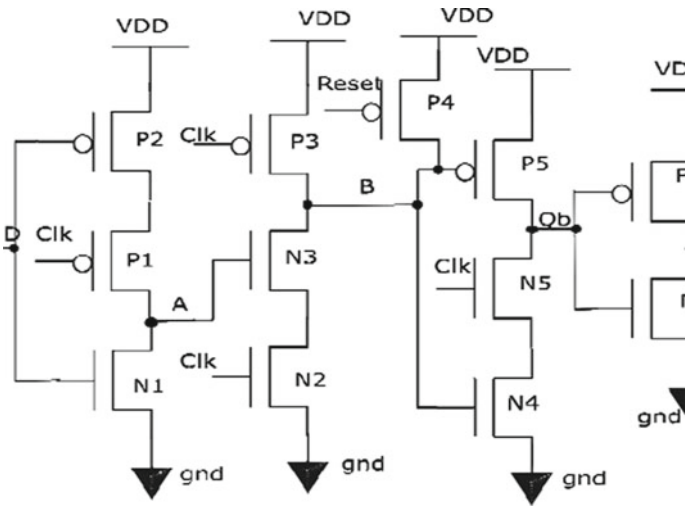

Fig. 1 Schematic diagram of TSPC-based D flip flop

3.1 Working of Existing TSPC D Flip Flop

Figure 1 shows the existing positive edge triggered TSPC D flip flop. The output Qb is same as the input when the clk pulse is LOW. Since, clk is LOW, PMOS(P3) is ON and node B charge to HIGH but Qb maintains their previous value. While, if clk is HIGH, then PMOS(P3) is OFF and node B is not affected. So, when clk its position from HIGH to LOW, the output is unaffected by its input. When clk transmits from LOW to HIGH, the output Qb gives the complement of the input and Q gives the output same as the input. When input (reset) of PMOS(P4) is at LOW the preset PMOS is at ON state and output Qb maintains the HIGH value till reset is at HIGH.

Figure 2 shows W-edit waveform result of the existing positive edge triggered TSPC DFF and for waveform we were used Tanner EDA PTM 180 nm technology with 1 GHz clock frequency and stop time of 10 ns. The power consumption of the circuit is 75.43 μW.

3.2 Working of Proposed MTSPC D Flip Flop

When the duration of propagation delay is less than the duration of clock pulse then there is always the chance of toggling in the circuit which increases the noise at output and hence increasing the power consumption which is happening in the existing TSPC DFF. If we look in Fig. 1 at node B, we see there is path directly connected to the ground, which makes the node B always HIGH when clk is at LOW and come back to LOW when clk is at HIGH. This toggling happens every time

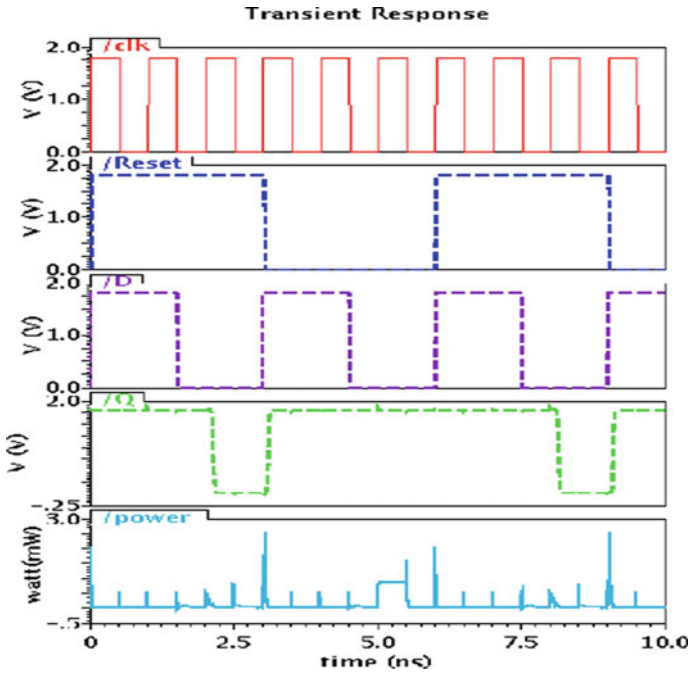

Fig. 2 Waveform of TSPC DFF in W-Edit

whenever clk makes transition from LOW to HIGH. So, to remove this problem we have introduced a PMOS transistor at the place where node B connected to the ground. So that whenever the path to ground is ON it should remove the toggling. Also does not affect the operation of the TSPC DFF. The proposed model of the DFF is shown in Fig. 3.

If clk and input D is at LOW, then output Qb maintains their previous value. If input is at HIGH, then node also at HIGH and output remains unaffected. If clk transits from LOW to HIGH and D is HIGH, then node B is at HIGH and output Qb is at LOW, hence Q is at HIGH. If clk transits from LOW to HIGH and D is LOW, then node B is at LOW and output Qb is at HIGH, hence Q is at LOW. When input(reset) of PMOS(P4) is at LOW the preset PMOS is at ON state and output Qb maintains the HIGH value till reset is at HIGH.

4 Simulation Result

We have simulated the performance of the True Single Phase Clocked D flip flop and the proposed positive edge triggered MTSPC D flip flop using PTM Tanner 180 and 45 nm technology shown in Table 1. To evaluate the performance on parameters such

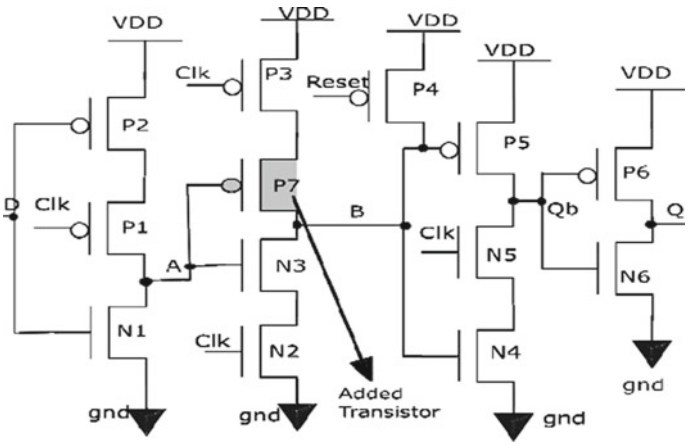

Fig. 3 Schematic diagram of modified TSPC DFF

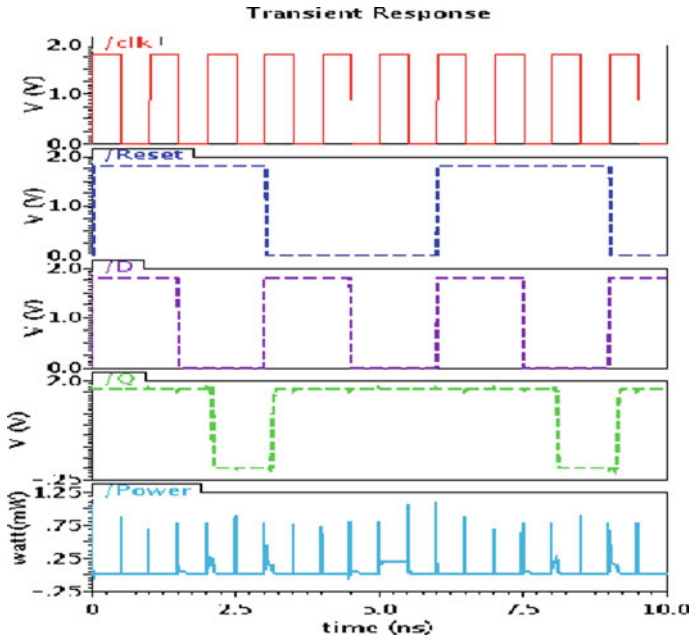

Fig. 4 Waveform of MTSPC DFF in W-Edit

as power consumption, delay and noise, we have designed a 7-bit gray counter using DFF's shown in Table 2. The gray counter not only gives us empirical evidence of quantum of the performance improved but also helps to extend the frontier of usage of gray counter. Gray counter find application in analog to digital converters (ADC) designing, they are used to encode the position of motor. Synchronous Gray

Table 1 Performance comparison of different technology

Performance parameters	TSPC DFF [17] (180 nm technology)	MTSPC DFF [17] (180 nm technology)	MTSPC DFF (45 nm technology)
Average power consumption (μW)	75.43	21.83	0.33
Hold time (t_{hold})	≈ 0	≈ 0	≈ 0
Setup time (tsetup) (ps)	70.13	64.14	54.63
Average clock-to-Q delay (ps)	118.27	91.99	67.36
Input clock frequency (MHz)	500	1	1

Table 2 Performance comparison of different technology using gray code

Performance parameters	TSPC DFF [17]-based gray counter (180 nm technology)	MTSPC DFF [17]-based gray counter (180 nm technology)	MTSPC DFF-based gray counter (45 nm technology)
Maximum operating frequency (MHz)	500	1	1
Maximum propagation delay MSB (ns)	1.6	0.96	0.75
Power consumption	1.52 mW	244.2 μW	188.7 μW
Power delay product (PDP) (pJ)	2.4	0.23	0.141

counter use edge triggered flip flop that changes the state on either positive or negative edges. This leads to continuous toggling at each change in clock signal. To maintain the operation of counter so that it could count properly a feedback pathway from most significant bit (MSB) to LSB is coupled with LSB-MSB. These requirements complicate the design and in turn the implementation of counter in high frequency operation. An Asynchronous Gray counter was used to remedy the problems [10–15]. The gray code counter in Fig. 5 consists of two levels of flip flops in toggle mode operation. The first level is asynchronous binary counter. Here the entire output of first level sans MSB goes to next level toggle operation. MSB bit obtained at first level and outputs obtained at next level forms the gray code. Faster positive edge triggered flip flop is critical in implementing high frequency counter operation. Existing CMOS technique is not good enough for such operation [16]. So, a Modified True single phase positive edge triggered flip flop (MTSPC) is implemented for high frequency operations. The new technique significantly reduces the propagation delay and leakage loss and thus improves efficiency of high frequency gray code counter. These counters find application in Positron Emission Tomography in medical field.

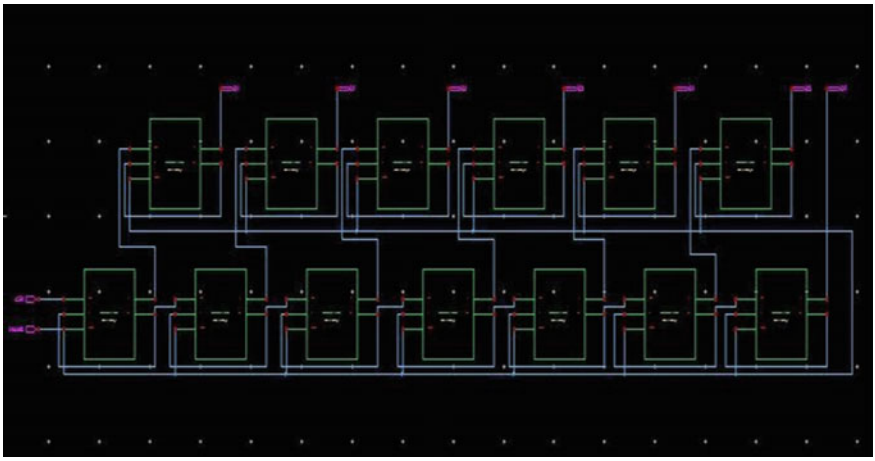

Fig. 5 7-bit asynchronous gray code counter

5 Conclusion

In this paper we have proposed a new preset abled modified true single phase clocked DFF based on 45 nm CMOS technology. We simulated the circuit using Tanner EDA simulation Tool and compared the result with 180 nm MSTPC DFF. The technique utilizes a clocked dynamic logic. The 7-bit gray counter which has been implemented based on the modified designs provides an operating frequency of 1 GHz and this can be improved further. This is significantly higher than the 7-bit gray counter which is implemented based on TSPC design which has got operating frequency around 500 MHz the TSPC DFF has another major drawback of having more noise at output, this causes distortion at output during simulation and consumes a very large power. The modified TSPC DFF does not suffer from continuous toggling which reduces power consumption in 7-bit counter to be precise 85%. This particular feature put it in demand in all the devices where a compact circuit with high efficiency is required. There is a further scope of improvement in design using 32 and 5 nm which could further improve the parameter such as power consumption, power delay product. Also, the operating frequency can be improved further using this technology which opens the door for implementation of 7-bit gray counter in devices which operates in higher gigahertz range.

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Chapter 45
An Improved Convolutional Neural Network for Classification of Type-2 Diabetes Mellitus

Shatakshi Singh, Bhoomika Rathore, Harshita Das, Shalini Agrawal, Dawa Bhutia, Vinod Maan, Sunil Kumar Jangir, and Manish Kumar

1 Introduction

Diabetes Mellitus is a collection of metabolic ailments, resulting from the abnormal insulin action, insulin secretion or both. It is characterized by Hyperglycemia and impaired metabolism of carbohydrates, fats and proteins. Retinopathy, nephropathy and autonomic neuropathy are the complications that are specific to Diabetes [1]. It is also common to find Hypertension and abnormalities of lipoprotein metabolism in Diabetic people. Diabetes Mellitus can be broadly classified into Type-1 and Type-2. Less percentage of people suffers from Type-1. Type-2 accounts for about 90–95% of the total diabetic population [2]. It is referred to as non-insulin dependent diabetes. It ranges primarily from insulin deficiency to predominantly defect linked with insulin resistance leading to abnormal insulin secretion. In Type-2 diabetes, hyperglycemia grows at slow rate and early stage is also not severe enough to notice the symptoms. Hence, this form of diabetes might go undiagnosed. It affects different organs of the human body which can cause detrimental effects including damage to large (macro vascular) and small (micro vascular) blood vessels, which can further lead to heart attack and problems with the kidneys, eyes, gums, feet and nerves [3].

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An early stage detection of this form of Diabetes can increase the life-expectancy and can prevent progression of diabetes to a significant level. Machine learning algorithm [4] can help to a significant level to solve this problem of early detection, which can assist the physicians to predict and diagnose diseases at an early stage by ameliorating the speed, performance, reliability and accuracy of diagnosis. Lifestyle plays a crucial role in diabetes Mellitus, specifically for Type-2 diabetes. Hence it can be modified according to the predictions made by the model.

The conventional method of detection of Diabetes includes tedious task of patients making numerous visits to various labs and doctors. There is also probability of manual error. At times, the anxiety and workload of the physician also affects the identification of disease and trauma level. These factors lead to the pitfall of the conventional methods of diagnosis of Diabetes Mellitus. Recent studies shows that 80% of Type-2 diabetes problems can be prevented by timely interventions by changing lifestyle or therapeutic methods [5]. The machine learning approach can play a great role in diagnosing disease as early as possible [6]. In this manner a large number of diabetic deaths can be checked. Computer-based automated classification techniques can play an important role in diagnosis [7]. Its implementation can remarkably decrease the therapeutic errors, which will lead to decline in both human as well as financial loses. It will not only improve the accuracy but also help in managing patient's time and wealth. Many researchers have worked on different methods of diagnosing diabetes [8]. Swapna et al. applied CNN on ECG dataset showing Heart Rate Variation for early diagnosis of diabetes [9]. Parte et al. proposed a method for non-invasive diagnosis of diabetes using CNN-SVM by analyzing the acetone level in breath.

In this paper, improved deep learning network, i.e., Functional Link Convolutional Neural Network [10] is applied for the diabetes classification. The proposed technique is compared with available state-of-the-art ML techniques such as Logistic Regression, K-Nearest Neighbors, Random Forest. Also, the efficiency of the proposed technique is presented on various quality metrics (for instance: accuracy, recall, precision and F1-score). The layout the paper is as follows: Sect. 2 present the Methodology of the proposed technique Sects. 3 and 4 exhibits the Results and Conclusion of this article.

2 Functional Link Convolutional Neural Network

Recently Machine Learning algorithms have been used in health care sector for the early and rapid diagnosis assistance of various diseases. Due to their ability to identify hidden patterns and correlations in data, they are found to be effective for non-linear problems. Figure 1 demonstrates an improved Convolutional Neural Network (CNN) called Functional Link Convolutional Neural Network (FLCNN). The input vector is represented by $\{X_1, X_2, X_3, \ldots X_n\}$ and the target data is represented by $\{t_1, t_2, t_3 \ldots t_n\}$. The inputs and target labels are normalized using Eq. (1).

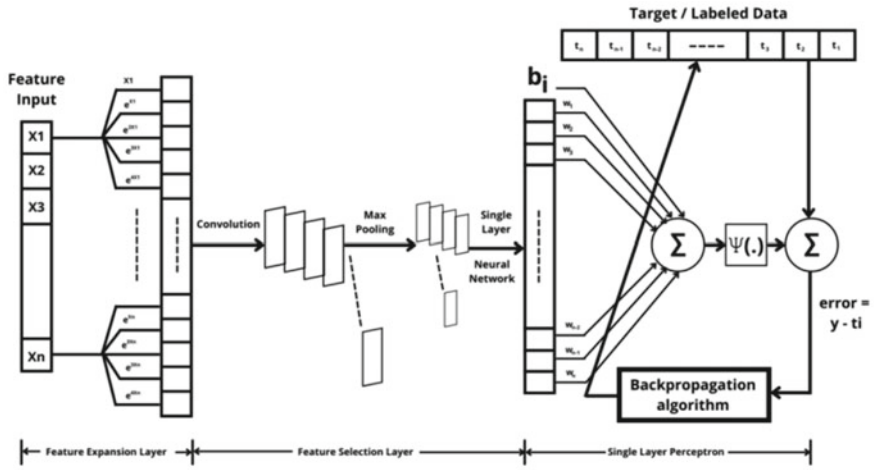

Fig. 1 Diagrammatic representation of functional link convolutional neural network

$$\text{Normalized data frame, } \text{NF} = \frac{C - C_{\text{mean}}}{C_{\text{dev}}} \tag{1}$$

where C is the original value of a feature in dataset, C_{mean} is the mean and C_{dev} is he standard deviation of the of the respective column. Further these inputs are expanded exponentially as shown in Eq. (2). The functionally expanded input is are given as input to the convolutional and pooling layers of the network which generate the feature maps.

$$\text{ENF} = \{[\text{NF}_1, \text{e}^{\text{NF}_1}, \text{e}^{2\text{NF}_1}, \text{e}^{3\text{NF}_1}, \text{e}^{4\text{NF}_1}]\} \tag{2}$$

$$x_i(n) = \text{ENF}_i(n) \circledast k_i(n) \tag{3}$$

Equation (3) shows the general convolutional operation. Layer by layer the size of feature map increases, hence to make it computationally less intensive down sampling is done using Eq. (4).

$$\text{Down sampled feature, } X_i = \max\left(x_i^*\right) \tag{4}$$

The down sampled data is then passed through the fully connected layer where the prediction task is performed. The output is generated using Eq. (5).

$$\hat{y}(n) = \varphi\left(\sum_{q=1}^{L} X_q(n) w_q(n) + b_q(n)\right) \tag{5}$$

The output $\hat{y}$ is the predicted class, w_q and b_q are the shared weights and bias, respectively, and φ represents the sigmoid activation function. This output is predicted using the saved weights and bias values computed during the training of neural network. In each iteration of training process, the weights are updated to reduce the loss or error in the classification. This process, known as training or learning is repeated until the network error is minimized. In the proposed FLCNN network the bias and weights are updated by Eqs. (6–7). ϵ represents the learning factor and t is the instantaneous iterative state, and $\frac{\partial \hat{e}}{\partial w_i}$ represents the error.

$$w_{\mathrm{i}}(n+1) = w_i(n) - \epsilon \frac{\partial \hat{e}}{\partial w_i} \tag{6}$$

$$b_i(n+1) = b_i(n) - \epsilon \frac{\partial \hat{e}}{\partial b_i} \tag{7}$$

3 Results and Discussion

The simulation work for this experiment was done on Google Colaboratory using Python 3.6, which is a cloud based GUI for python. For experimentation, Localized Diabetes Disease Dataset (LDD) was used, which was originally collected from Bombay Medical Hall, Ranchi, Jharkhand, India. The dataset includes the following attributes: Age, Sex, Fasting Blood Sugar, Diastolic Blood Pressure, Systolic Blood Pressure, Body Mass Index, Average Sugar, Waist Circumference, Hip Circumference, Total Cholesterol, Family History, 2 h post glucose load, and the label showing if a person is diabetic or not. Some of the features play a more significant role in predicting the output. Figure 2 shows the Feature Importance score of the features in LDD Dataset. FPG, Cholesterol, Average Blood Sugar and BMI play a significant role while determining that a person is diabetic or not.

The data is divided in the 80:20 ratios for training and testing of the algorithms. Figure 3 shows the confusion matrix showing the performance of FLCNN on testing data using True Positive (TP), True Negative (TN), False Positive (FP) and False Negative (FN) values. These values are useful while determining the performance measures like accuracy, recall, specificity and sensitivity, etc.

To assess the performance of algorithms various performance metrics are used. Table 1 shows the summary of performance metrics including accuracy, recall, precision and F1-score for different algorithms applied on the LDD Dataset.

$$\text{Accuracy}(\%) = \left(\frac{\text{TP} + \text{TN}}{\text{TP} + \text{FN} + \text{FP} + \text{TN}}\right) \times 100 \tag{8}$$

$$\text{Recall}(\%) = \left(\frac{\text{TP}}{\text{TP} + \text{FN}}\right) \times 100 \tag{9}$$

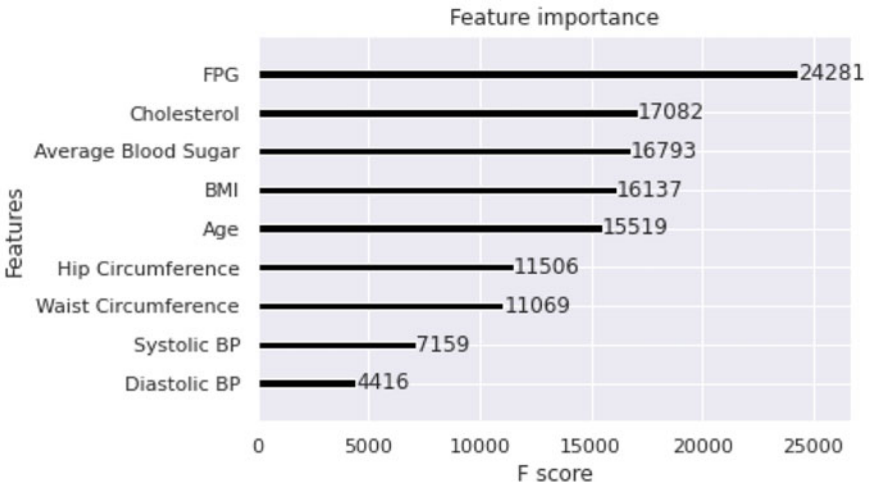

Fig. 2 Feature importance of different feature in LDD dataset

Fig. 3 Confusion metrics for FLCNN classifier

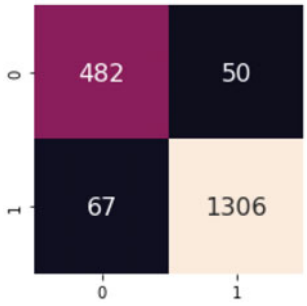

Table 1 Performance evaluation metrics for applied classifiers

Classifiers	Performance measurers						
	Precision		Recall		F1-score		Accuracy (%)
	0	1	0	1	0	1	
LR	0.85	0.87	0.70	0.95	0.77	0.91	87.01
KNN	0.77	0.87	0.71	0.90	0.74	0.89	84.23
SVC	0.80	0.83	0.59	0.93	0.68	0.88	83. 10
NB	0.76	0.95	0.91	0.87	0.83	0.91	88.34
DT	0.83	0.91	0.79	0.92	0.81	0.92	88.56
RF	0.88	0.88	0.70	0.96	0.78	0.92	88.14
XGB	0.82	0.82	0.55	0.95	0.65	0.88	82.31
FLCNN	**0.87**	**0.88**	**0.89**	**0.91**	**0.92**	**0.93**	**90.45**

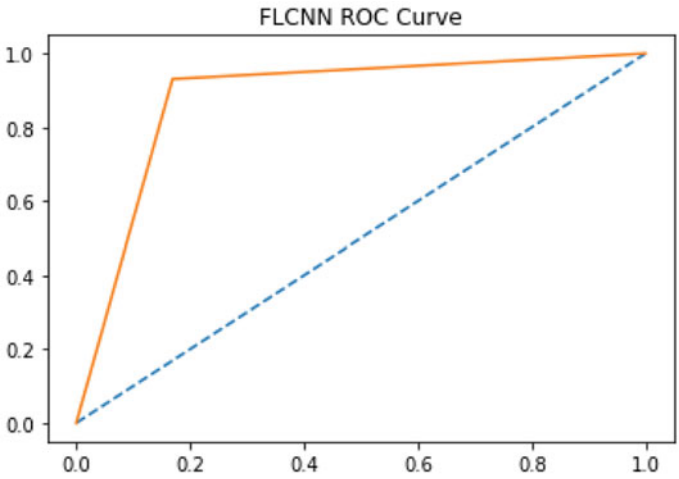

Fig. 4 ROC curve of FLCNN

$$\text{Precision}(\%) = \left(\frac{\text{TP}}{\text{TP} + \text{FP}}\right) \times 100 \tag{10}$$

$$\text{F1} - \text{Score} = \left(\frac{2(\text{Precision} * \text{Recall})}{\text{Precision} + \text{Recall}}\right) \tag{11}$$

Values of these performance evaluation metrics are given in Table 1. It shows that FLCNN has outperformed other Machine Learning-based classifiers for diabetes classification. FLCNN has a less dense architecture with no hidden layers, that makes it computationally effective than other neural networks.

Figure 4 presents the ROC curve of FLCNN classifier. The Area Under Curve (AUC) shows how well it performs on the test data. It demonstrates the tradeoff between specificity (x-axis) and sensitivity (y-axis). Figure 5 presents the ROC curves of other Machine learning classifiers, which shows that XG Boost outperformed other classifiers. Both the curves cannot be plotted on the same graph because the data was functionally expanded for FLCNN. FLCNN attains ROC value of 0.988 which shows that it performed well in the diagnostic test. It could also be used to solve other non-linear prediction and classification problems in a computationally effective manner.

4 Conclusion

Diabetes Mellitus is a collection of metabolic ailments, resulting from the abnormal insulin action, insulin secretion or both. This work implements the Functional Link

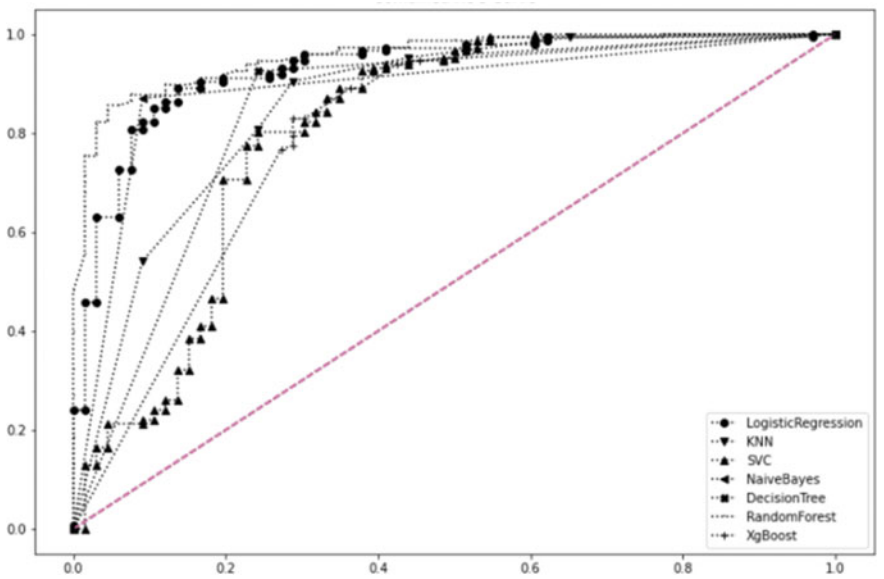

Fig. 5 ROC curve of machine learning based classifiers

Convolutional Neural Network, which is an improved CNN for classification of diabetes. The results obtained are also compared with other machine learning classifiers. FLCNN achieved the highest accuracy among all. It is a computationally effective neural network with no hidden layers. It can also be used for solving other non-linear problems, in a computationally effective manner.

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Chapter 46
Reviewing Fake News Classification Algorithms

Y. Arora and Sunil Sikka

1 Introduction

The transfer of raw data or information across the world has become very fast and efficient with the help of the high-speed internet. Within a matter of few seconds huge amount of information can be transmitted from one corner of the world to another corner. In today's time, even a five-year-old with a phone in his hand can generate data and spread information. A large number of citizens in many countries do not watch television or read newspapers, instead they receive their news from social media [2]. An example of such country is USA, where approximately 62% of the citizens receive news via social media [2].

Fake news gets transmitted so fast because its content is attractive. The fake news makers make sure that public or viewers are attractive to their content. With the surge in social media usage, fake news makers have made it their main platform to share their content. Fake news could be related to anything like politics, sports, technology, entertainment industry, etc. Turns out that the creators of fake news make huge amount of money by doing this fraudulent work. One type of misstatement is fake news, consisting of false information that is proclaimed as factually correct to deceive the audience using traditional or social media. Fake news on any media can affect a society or individual in different ways. It can have severe repercussions in terms of financial and political decision making as well as destroying an individual's social standing [3]. Example of a recent fake news transmission in India: There was a post on social media that 'Any social media post related to COVID-19 is a punishable offense'. Many people believed that this was a genuine news but later the truth came out on social media itself claiming that it is a fake news. The US presidential elections 2016 was the major time when a lot of fake news was being speeded across the

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country on various social media websites namely, Facebook, Twitter, Instagram, etc. As compared to real news, fake news spreads quickly by making it more appealing on the viewers end. It gets difficult to distinguish between the fake news and real news. The difference between this paper and other papers on the similar topics is that in this Passive Aggressive classifier is specifically, being used for the purpose of fake news detection and we have compared the accuracies given by this classifier with the accuracies given by other machine learning and deep learning classifiers. Whenever we have a dataset with millions of records, it is basically a combination of fake news and real news. It is a real difficult task for humans to segregate fake news and real news. It is almost impossible for humans to do this task. It will take a huge amount of time for humans to do this and thinking practically, it is not a feasible way to classify fake news and real news. To do this task scientists has come up with very feasible different types of supervised and unsupervised machine learning and deep learning algorithms which classifies fake and real news with quite good accuracy. To see the accuracy, different accuracy metrics like accuracy score, precision, recall and F1 score are looked upon [1, 4, 5]

Passive Aggressive Classifier

The passive aggressive algorithms are a family of algorithms which are designed for large-scale learning. They are similar to the perceptron in a way that they also do not require a learning rate. However, the difference is that they include a regularization parameter 'C' [6, 7].

- **Passive**: If the prediction is correct, keep the model and do not make any changes. i.e., the data in the example is not enough to cause any changes in the model.
- **Aggressive**: If the prediction is incorrect, make changes to the model. i.e., some change to the model may correct it.

Important Parameters involved with passive aggressive classifier are as follows: [8]

- C: This is the regularization parameter, and denotes the penalization the model will make on an incorrect prediction
- mixite: The maximum number of iterations the model makes over the training data.tol: The stopping criterion. If it is set to None, the model will stop when (*loss* > *previous_loss* – *tol*). By default, it is set to 1e−3.

2 Dataset and Preprocessing

The dataset is taken from Kaggle. The data set is an Excel sheet that consists of 20,800 records and 5 features. These records are the mixture of fake and real news.

Data cleaning is performed on this dataset, i.e., null values are removed, stop words are removed, stemming is performed and all the data is converted into lower case. After the data cleaning is performed, we are left with 18,285 records in our

final corpus. After this step our corpus is transformed into array format using bag of words model [9, 10, 11].

After implementing this step the dataset gets converted into 18,285 * 5000 matrix. Next step is to split the data into training and test part. 33% of the data is allocated for testing and 67% for training part with random state parameter set to zero. There are different parameters related to different ML models. For instance, in Random Forest Classifier 'n_estimators' equal to 200 and criterion as entropy, in passive aggressive classifier 'max_iter' equal to 50, in Logistic Regression, SVC and DTC we are specifying 'random_state' equal to 42 are specified. These parameters can be changed or updated according to the problem statement.

3 Results and Discussion

In Deep learning (DL) algorithms Sequential model to create classifier are used. In this 100 neurons in LSTM layer are taken. One Hot Representation to convert text into vectors. After converting text into vectors, we perform padding. Padding is a process which makes the length of each vector equal. Since this is a binary classification problem, binary cross entropy is used as loss parameter and Adam optimizer to optimize classification model is used. Later, sigmoid activation function is used in dense layer because this is a binary classification problem. Observe the accuracy of our models by adding an additional layer, i.e., dropout layer. Sometimes the addition of dropout layer can give very good results in terms of accuracy.

After observing Tables 1 and 2, it is said that DTC is not performing good as compared to other ML models, but PAC, RFC and SVC are giving 100% accuracy when TF-IDF technique are used to convert textual data into vectors. Naïve Bayes model is not giving good accuracy when using TF-IDF.

After observing Tables 3 and 4, it is seen that after the addition of dropout layer, the accuracies of LSTM and Bi-Directional LSTM model have increased a little.

Table 1 Accuracy given by different ML models while using Bag of words model to convert text into arrays/vectors

Model	Precision	Recall	F1 score	Accuracy_score
Passive aggressive	93	92	93	91.91
Decision trees	100	60	75	77.54
Random forest	97	91	94	93.20
SVC	98	89	93	92.92
Naïve Bayes	92	90	91	90.19
KNN	84	64	78	80
Logistic regression	95.5	99.3	97.4	97.7

Table 2 Accuracies given by different ML models while using TF-IDF model to convert text into arrays/vectors

Model	Precision	Recall	F1 score	Accuracy_score
Passive aggressive	100	100	99.9	100
Decision trees	65.3	99.9	79	77.1
Random forest	100	100	100	100
SVC	100	100	100	100
Naïve Bayes	71	98	82	76.63
KNN	44	100	61	68
Logistic regression	89.7	99.7	94.4	95

Table 3 Accuracies given by DL models

Model	Precision	Recall	F1 score	Accuracy_score
LSTM	93	92	92	91.18
Bi-directional LSTM	91	92	91	90.30

Table 4 Accuracies given by DL models after addition of dropout layer

Model	Precision	Recall	F1 score	Accuracy_score
LSTM	92	92	92	91.48
Bi-directional LSTM	93	91	92	90.91

4 Conclusion

After observing all the four tables it can be concluded that among all the ML models which are considered, PAC, RFC, SVC with TF-IDF vectorization are performing in a great way as they are giving 100% accuracy on test set and also conclude that DTC is the worst performing ML model with this specific dataset. Among both the DL models, they are equally good after the addition of dropout layer.

There is not even a difference of 1% in the accuracy scores of both the DL models. However, the accuracies of other models could be increased by performing hyperparameter optimization using Randomized Search CV or Grid Search CV. In DL models accuracy could be increased by increasing the number of layers between the input layer and output layer. Fake news is a major problem in the current time, still many researchers are working and trying to find new algorithms so as to detect the fake news with much better accuracy.

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Chapter 47
A Review on Congestion Control Using Routing Technique and Machine Learning

S. Hassija, Y. Arora, K. Tripathi, and M. Vijarania

1 Introduction

The wireless network use telecommunication network [1]. The telecommunication in the network is carried out by radio communication. There are various types of wireless network viz. wireless LAN, Wireless MAN, Wireless PAN, Wireless WAN, MANET, WANET, Cellular networks. MANET, WANET networks are ad hoc networks because there is no prior network [2]. The biggest challenge for WSN is congestion control. In a network when data/packet gets transferred from source to destination using routing techniques it sometimes results in congestion in a network. The approach of dealing congestion after the occurrence of congestion is known as Congestion Control. With routing protocols ad hoc network are divided into two parts: Proactive (Table-driven) and Reactive (On-Demand) routing protocols [3]. There are two approaches toward the Congestion control:

(1) Point-to-point Congestion Control: In point-to-point technique, the congestion is detected from point-to-point system loss and delay. This approach is employed by TCP.
(2) Network managed congestion control technique: In the Network managed congestion control technique, routers offer feedback on the congestion control management to the end-user systems.

Congestion in a network mainly occurs if the load on a network the number of data packet sent on the network is greater than the capacity of network. Now a days in society large amount of information is generated and transferred to each other in

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https://doi.org/10.1007/978-981-19-2065-3_47

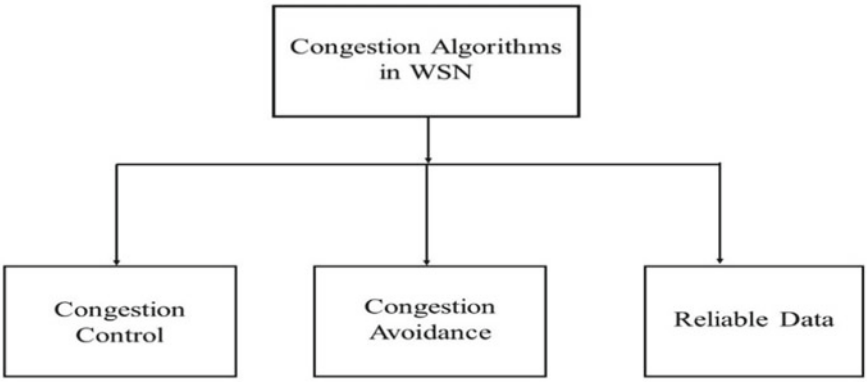

Fig. 1 Congestion Algorithms in WSN

every second which is known as information explosion. The main cause of congestion in a network that too much data tries to get through the link or nodes [4].

In order to control the congestion in a network there are two broad categories.

(1) Open loop congestion control
(2) Closed loop congestion control.

In WSN the algorithm that deal with congestion can classified into various categories viz. Congestion Control, Congestion Avoidance, and Reliable Data Transmission [5] that shown in Fig. 1.

Some methods to detect the congestion:

(1) Monitor the buffer states.
(2) Check local channel occupancy.
(3) Calculate the number of event sources.

1.1 Causes of Network Congestion

(1) Over-Used Devices: To handle the traffic in a network designed some devices such as routers, firewall, and switches.
(2) Multiple devices: A network using multiple devices. Every network has a support that provide to all devices. Multiple devices can resolve multiple requests that came from devices.
(3) Inefficient design or poor configuration: Every network designed according to user requirements because in real life every day user requires some changes.

1.2 Tackling Network Congestion

(1) Traffic monitoring and throttling: Multiple devices are using in a network then all devices send multiple requests to each other to control that request monitor all the traffic in a network. Traffic throttling means sender trying to manage the data transfer to each other in a network in a gladly deliver.
(2) Bandwidth: To increase the network's bandwidth then increase the amount of transfer able information.
(3) Segmenting and Prioritizing: To monitor the traffic in a network divide the network into smaller sub networks that will increase the efficiency and it will establish the space for practical priorities. This process is known as segmenting. Prioritization means to processes assign priority so that congestion does not occur in a network. This process supports the technology and implements appropriate design.

Large amounts of packets are presents in a network, and then packet delay and packet's damage problem occur in a network that will decrease the performance. This situation is known as congestion. To handle the problem of congestion network layer and transport layer will take the responsibility.

When data arrives at client end at a very high speed then that data or packets are not possible to store or forward then congestion occur at router. When congestion occurs then router should reject all the data/packets. Some cases are there when congestion occurs as bottleneck:

(1) Client receives data/packets from multiple channels but it will forward all the packets only from single channel.
(2) Bandwidth rate are higher from incoming channel to outgoing channel.
(3) Comparatively router CPU processing channel processing is satisfactory to handle the updates of routing tables, mange the packets in format, etc.
(4) TCP protocol is reliable for end-to-end processing.
(5) When packets move from queue to processing then congestion occur.
(6) Some delay in acknowledgment from client's side.
(7) Path not able to find, takes some times to produce result.

Machine Learning

Machine learning is the key enabler of Artificial intelligence. It makes the computer to act without explicitly programming them. Machine learning figure out some facts: how to perform the task that based on generalized data for, e.g., improve themselves from past experiences.

Now a day's machine learning is using everywhere in our daily life like industries, business, science, government sector, to solve some important tasks. Even in YouTube also using machine learning if you search anything on YouTube then you can get all related videos. Netflix, Prime, are also the examples of machine learning.

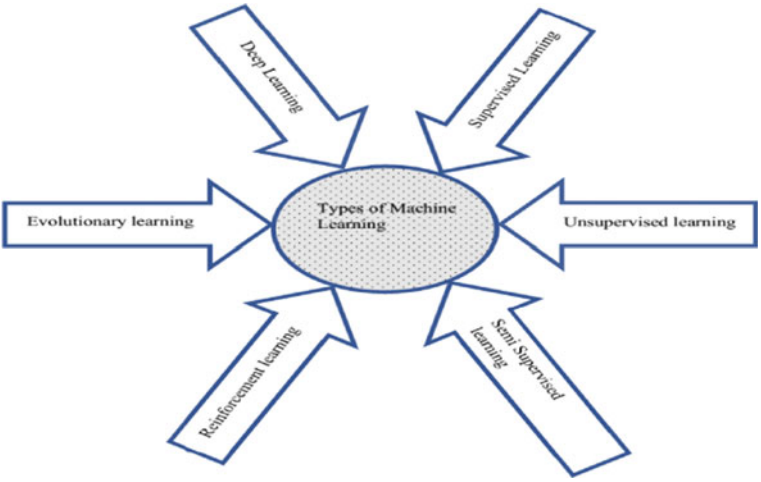

Fig. 2 Types of Machine Learning

It is a key technology for financial, commercial and data science technology. ML also gives some important things viz. self-driving car, speech reorganization, automatic practical systems, etc.

Learning is the process that improves the system's performance by its experience. Artificial intelligence improves the thinking power of any system/computer. Machine learning is a subpart of AI. There are many types of machine learning techniques [6] that are presented in Fig. 2.

If user will search on goggle related to any topic like Artificial intelligence it will show the result to the user all related topics this is happens through the goggle recommendation. Google understand the requirement of users. Same thing if user will search on Amazon related laptops, then after some time it will show the result related laptops, this happens through Amazon recommendation. All this process done with the help of machine learning.

1.3 Difference Between Traditional Programming and Machine Learning

C, C++, Java, and other languages are using for traditional programming. It takes the input as a data and the program and it will give the output as shown in Fig. 3.

On the other hand machine learning takes the input as a data and output, and it generates the prediction as a model. The prediction is estimate for accuracy and if the accuracy is acceptable, then the machine learning is deployed. If the accuracy is not acceptable, then the machine learning is trained again and again with data set till the desired model will not generate.

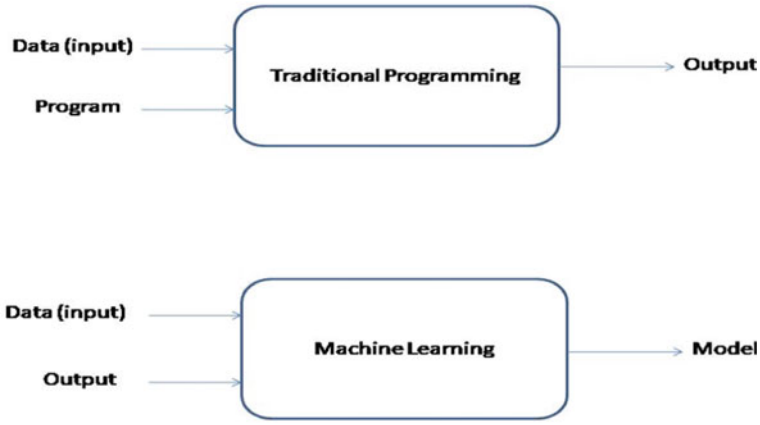

Fig. 3 Traditional programming versus machine learning

Machine learning is an application of Artificial intelligence (AI). It gives the ability to devices from their past experiences and it will improve itself.

2 Routing Protocol

Routing is the process to find the best route or path for delivering a packet or data from source node to destination node [7]. These optimized routes are used to forward the data packet from source to destination [8, 9]. Routing protocols are classified into two categories such as wired network and wireless network. In wired network the routing protocols are divided into two parts:

(1) External routing protocol
(2) Internal routing protocols.

Routing protocol's classification depend on mode of operations [2]:

(1) Link state routing protocols
(2) Distance vector routing protocols
(3) Path vector routing protocols
(4) Hybrid routing protocols.

Routing techniques are classified into three major categories viz. Data centric Routing, Flat Routing, and Hierarchical Routing [10]. These protocols in MANET play an important role to check the quality of service (QOS) and increase the performance of a network [11].

The VANET Routing protocols are subdivided [12] and the architecture of VANET communication into two categories: vehicle-to-vehicle (V2V) and vehicle-to-infrastructure-based (V2I) routing protocols.

3 Related Work

Yadav et al. [13] proposed a data fusion technique to solve the major issues that is to improve the efficiency of sensors (Table 1). This technique is used to reduce the redundancy of data which consume a lot of energy. This method improves the reliability as well as reduces the traffic in a network.

Kanellopoulos [14] proposed a TCP enhancement for wireless links. The main concept of TCP mechanism is token bucket traffic shaping that is used during packet routing at each node. When sender sends the data/packet to the receiver then receiver send an Acknowledge (ACK) message to the sender on a wired transport layer.

Najm et al. [15] proposed a 5G IOT environment based on machine learning using Decision Tree (DT) approach. This approach improves the congestion control on a network. The C4.5 DT approach improves the performance of machine learning and its tree-based graph techniques find the best or optimal path to solve the congestion problem in a network.

Hu et al. [16] proposed the software defined network (SDN) approach to solve the problem of congestion in a network. The SDN approach uses SDCC algorithm. SDCC algorithm is based on SDN architecture and it can obtain a global topology for unified network management.

Ghaffari [17] proposed an optimal algorithm for predicting the patterns of nodes and reduce the delay of packet transmission. He deployed reinforcement machine learning techniques for routing in MANET. MANET consists of set of nodes which can move and freely communicate with the wired network.

Ding et al. [18] proposed optimizing routing algorithm based on congestion control (CCOR). The CCOR algorithm at first constructs the queuing network model to detect and identify the nodes, congestion degree, and network bottlenecks. This algorithm takes the decision for optimized route to increase the energy efficiency and congestion control.

Xu et al. [19] proposed optimized multipath for congestion control that are designed in the context of TCP-friendliness, load balancing, and stability.

Ghaffari [20] has highlighted major congestion control challenges. In a network whenever a data/packet is sent toward to the sink node then some problems occur, i.e., packet loss and increase the amount of energy. Some challenges are: buffer occupancy (In WSN every sensor has a buffer that is used for buffering the incoming packet), channel load, packet service time, combination of buffer occupancy and channel load.

Jain and Grover [10] proposed routing techniques that are data centric, flat architecture and hierarchical for WSN. These techniques address two major issues of WSN, i.e., energy efficiency and lifetime of sensors. Data centric routing algorithm assign the path on the basis of query content. These techniques have routing protocols viz., flooding, gossiping, direct diffusion, LEACH, PEGASIS, TEEN, and APTEEN.

Long et al. [21] proposed the mechanism that is based on the Open flow network that define a method in judging the link of congestion control threshold. When in a network congestion occur then immediately congestion control mechanism gets

started and the maximum bandwidth of data flow in the congestion link is identified and reroute the load balance.

Ghobadi et al. [22] proposed a dynamic framework that is based on SDN OpenTcp. OpenTcp is a new architecture that widely deploys and modifies the source side, forwarding nodes, controllers, and other global network that will to solve the congestion problem.

Lu et al. [23] proposed an algorithm for congestion control that supports multiple active queue management.

Han et al. [24] proposed a machine learning-based loss discrimination algorithm (LDA) for wireless TCP congestion control in a network (Table 2). This algorithm used to maintain the congestion window. In the congestion window packet loss problem occur due to wireless channel error. This algorithm implements in a LINUX Kernel where the packet loss problem occurs. Then compare this result with TCP Reno, TCP West wood, TCP Veno.

Zhao et al. [4] define congestion control in WSN. The congestion control, schemes in WSN classified into two categories: MAC layer, Cross layer scheme.

Jamieson et al. [25] define the carrier sense in radio networks. It also represents the amount of energy that received from antenna at a time.

Wang et al. [26] proposed a hybrid channel that includes sender and receiver initiated. When sender send some data to receiver end sometimes due to network issue receiver cannot receive that data at same time but sender continue to send data to receiver without the knowledge that receiver receives that data or not. Hybrid approach means to create an acknowledge scheme, i.e., handshake. This scheme having simple extension IEEE 802.11 MAC Protocol (Tables 1 and 2).

Table 1 Routing Techniques

Author	Tittle of paper	Contribution	Gaps for further Improvements
Yadav and Ujjwal [13]	Sensor data fusion and clustering: a congestion detection and avoidance approach in wireless sensor networks	In this paper used data fusion technique to solve the major issues that is to improve the efficiency of sensors	To avoid congestion in a network implement upgraded algorithms
Kanellopoulos [14]	Congestion control for MANETs: an overview	This paper describes the various congestion control approaches for MANET	There are some challenges: • Congestion control in the MAC or network layer • Load-balanced congestion adaptive routing • Congestion control in multipath routing protocol

(continued)

Table 1 (continued)

Author	Tittle of paper	Contribution	Gaps for further Improvements
Najm et al. [15]	Machine Learning Prediction Approach to Enhance Congestion Control in 5G IoT Environment	This paper describes the 5G IOT environment on a machine learning using Decision Tree (DT) approach	This paper presents some gap area: • In congestion control compare machine learning in 5G IOT environment optimization • To implement the machine learning prediction technique of machine learning on hardware
Hu et al. [16]	Software defined congestion control algorithm for IP networks	To solve the problem of congestion, use software defined network (SDN) approach [14]	To design the algorithm for UDP packets of different attributes and adds different parameters to provide a fair and accurate data flow
Ghaffari [17]	Real time routing algorithm for mobile ad hoc networks using reinforcement learning and heuristic algorithms	This paper highlights the machine learning techniques for routing	This paper presents some gap area: • To increase the efficiency of algorithm for that make an assumption for environment • Make an algorithm to increase the packet delivery rate and time • Improve the conditions for nodes and states • Use grouping patterns to enhance the efficiency of algorithm
Ding et al. [18]	Optimizing routing based on congestion control for wireless sensor networks	This paper proposed optimizing routing algorithm based on congestion control (CCOR)	To avoid congestion in a network implement upgraded models and algorithms

(continued)

Table 1 (continued)

Author	Tittle of paper	Contribution	Gaps for further Improvements
Xu et al. [19]	Congestion control design for multipath transport protocols: a survey	This paper presents multipath algorithm for congestion control	This paper presents some gap area: • To save the energy of data transmission use multiple TCP path for increasing the efficiency and move the traffic to the less congested path/energy efficiency design • Congestion control for new network architecture • Intelligent computer-generated algorithm
Ghaffari [20]	Congestion control mechanisms in wireless sensor networks: a survey	This is a survey on major congestion control challenges in WSN	More focus on security, self-adapted distributed scalable, decentralized and autonomous congestion control. Impact of WSN increases the efficiency of hybrid protocol
Jain and Grover [10]	Routing techniques in wireless sensor network	This paper present three routing techniques data centric, flat architecture, and hierarchical	To implement techniques that will increase the lifetime of sensors and low the energy consumption
Long et al. [21]	LABERIO: dynamic load-balanced routing in OpenFlow-enabled networks	This paper proposed LABERIO, path switching algorithm, to balance the traffic dynamically during the transmission. Load balancing algorithm that used in a network, i.e., round robin and LOBUS	When the distributed network grows bigger and bigger then it neglect the unpredictable changes of the load status on tons of links In static load balancing does not have feedback real time information about traffic amount on each link

(continued)

Table 1 (continued)

Author	Tittle of paper	Contribution	Gaps for further Improvements
Ghobadi et al. [22]	Rethinking end-to-end congestion control in software defined networks	This paper presents a dynamic framework that based on SDN OpenTCP	OpenTCP is limited in scope but can be extended to support programmable and adaptive TCP congestion control To design the congestion control policies
Lu et al. [23]	OpenFlow control for cooperating AQM scheme	This paper presents an algorithm for congestion control that supports multiple active queue management	This paper presents some gap area: • To analysis the stability of AQM system in the multilayer network • Design congestion control algorithm that does not affect the robustness of the complexity

Table 2 Machine Learning Techniques

Author	Tittle of paper	Contribution	Gaps for further Improvements
Han et al. [24]	Machine Learning-based Loss Discrimination Algorithm for Wireless TCP Congestion Control	This paper presents a machine learning-based discrimination algorithm for wireless TCP congestion control	Packet loss problem occur in a network due to wireless channel environment
Zhao et al. [4]	A survey of congestion control mechanisms in wireless sensor networks	This paper defines the schemes to solve the problem of congestion either at the MAC layer or through a cross layer approach	The performance of CSMA is not completely satisfying in WSN then use CSMA with TDMA

(continued)

Table 2 (continued)

Author	Tittle of paper	Contribution	Gaps for further Improvements
Jamieson et al. [25]	Understanding the real-world performance of carrier sense	This paper defines the experiments for the congestion control problem through carrier sense multiple access	This paper presents some gap area: • This method only affects the distant transmission • On the exposed re-transmission carrier sense has poor performance • In the receiver's radio at a time only one node should be transmitting • Grow the plan of 802.11 testbed so that we can learn the effect of global inference of spread spectrum system
Wang et al. [26]	A hybrid collision avoidance scheme for ad hoc networks	This paper proposed a hybrid collision avoidance method. In this methods node are in two different modes: • Sender Initiated • Receiver Initiated IEEE 802.11 MAC Protocol used to easily transfer the data between sender and receiver with a handshake technique	Use other protocols to exchange the data between sender and receiver very sharply and fairly with ad hoc network because IEEE 802.11 MAC Protocol does not do it fairly

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Chapter 48
Detecting Disorders of Ophthalmology Using Artificial Intelligence-Based Deep Learning

R. Deepa and S. Vaishnavi

1 Foreign Body in Eye

An object is called as (foreign body) stick of dust, a wood slice which is struck in the inner part of eye. It could not be removable with self-care need to be visit a doctor or emergency clinic nearby. Injuries in foreign body in the eye can be cured without any complications.

2 Corneal Abrasion

A corneal abrasion is a strike on clean forepart surface of eye (a cornea is part of eye). It can happen in an instant. That is the clear layer that covers the iris, the colored part of eye. The black dot in the center of the eye, which contracts or expands according to the light level, is called a pupil.

3 Corneal Ulcer

A corneal ulcer is a laceration cornea in the pencil thin layer over iris (colored part) of eye. It is known as keratinize.

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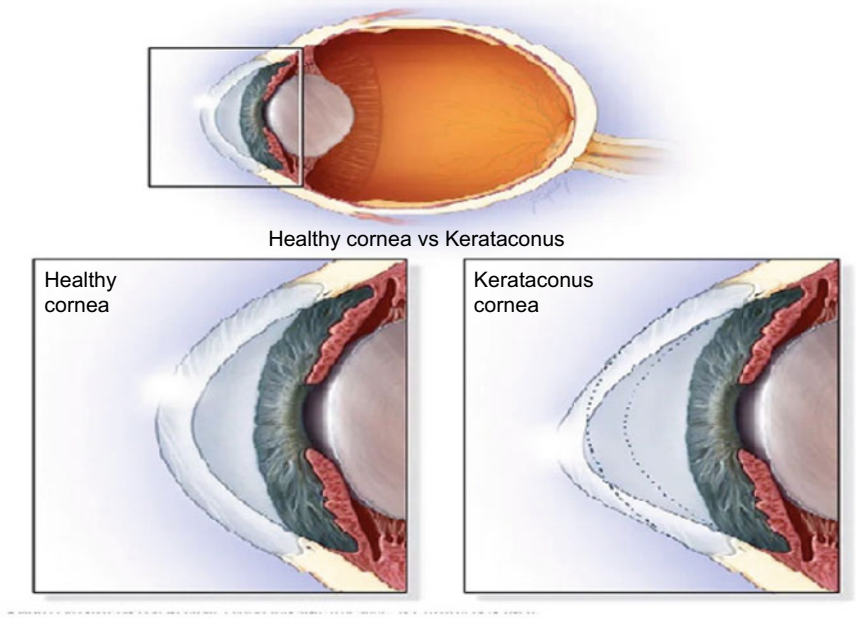

Fig. 1 Kerataconus

4 Keratoconus

Keratoconus takes place when cornea in the eye is clean, discoid-shaped frontier area of eye thinners, slowly swells out into a coned figure. A cone figure in cornea forms blurred. Keratoconus usually affects both of the eyes; it effects middle age persons of 10–25 (Fig. 1).

5 Kayser–Fleischer

Kayser–Fleischer (KF) rings are general ophthalmologic detection in patients who are identified with Wilson disease. Initially, due to the accumulation of silver, KF rings are seen in addition of the patients with neurologic involved from Wilson disease. The rings are caused by accumulation of excess copper on the interior area of the cornea in the Descemet membrane. A slit lamp tests the compulsory to make a diagnosis of KF rings particularly in initial stages unless the rings are seen to naked eye in conditions of severe copper overload. Kayser–Fleischer rings do not cause any impairment of sight but disappear with therapies and reappear with disease development. KF rings not identify to Wilson disease alone; they are realized in further chronic cholestatic disorders such as children with neonatal cholestasis.

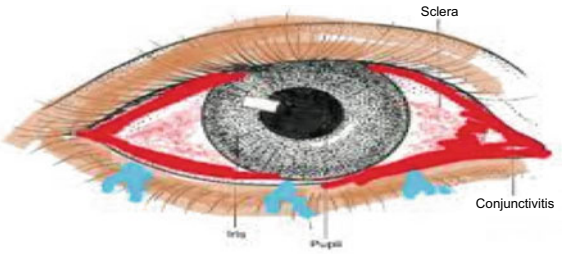

Fig. 2 Giant papillary conjunctivitis

6 Giant Papillary Conjunctivitis

Giant papillary conjunctivitis (GPC) is an affected reaction of eye. It occurs when one or several small round bumps (papillae) develop on the underside of the eyelid. The lower base of eyelid is called as upper tarsal conjunctivae. These bumps mature when the upper tarsus

scrubs done something foreign body of the eyes. This is called as giant states to the swells, being wider than one millimeter in size. There are two forms of GPC: Primary and secondary are responses to allergic but have dissimilar causes (Fig. 2).

Mainly, GPC two forms are as follows:

- Vernal keratoconjunctivitis.
- Atopic keratoconjunctivitis.

7 General Eye Disorders Measuring Precautions

- If the patient is diagnosed with a minor eye injury, avoid rubbing your eyes.
- An eye doctor only can recommend the right care for various eye complicating disorders. Ophthalmologist will look into the eyes and take away the objects if any. Anesthetic eye drops will be given in this process to make clear steps.
- Recent times, injury will heal in short period of time. The doctor may prescribe eye drops to decrease the chances of injury. Vital compulsory to use eye droplets.
- Also, oral medications can be given to patients with excess aching or little sensitivity has healed. Current anesthetic solution may be given to allow examine and treatment.

8 Artificial Intelligence Applications in Ophthalmolic Field

Artificial Intelligence is the fastest growing technology for requiring surgeons and computer scientists to consume an ethical knowledge of technologies besides to enhance training medicinal managing for further development. The urgence of unmanned plane, autonomous automobiles, processing language and face detecting

system, the artificial intelligence (AI) has remarkably revolutionized lifestyle. In recent surveys, AI specifies astonishing efficient to make better than human beings in roughly tasks, certainly in field of recognition image. As in the imagery center of ophthalmology, quantity of image data is increasing dramatically; analyzing and processing these data are required rapidly. AI applied into decipher health statistics and complete unexpected progress diagnosed intelligently.

9 Result and Conclusion

This paper concludes the fundamental flow work of developing AI model studied with implementing of artificial intelligence in ophthalmology detecting disorders. Future work setting can be concentrated on methodical AI stages to analyze common eye diseases made with multimodal data in the world of reality (Chart 1).

Detecting Disorders:

In spite the deep learning technique performs outstanding outcomes on time, their "black box" gives to understand hardly to perform exact outline. "Evidence-based medicine(EBM) is the timeline to expertise clinical values, patient values and research evidence." Physicians are toughly aimed to ensure unknowable machine that cannot deliver the interpretations of patients diagnosed with a specific disease. The techniques that can perform artificial intelligence techniques with huge translucent, potential detecting the training data certify the algorithms performing good. Different models used to interpret artificial intelligence techniques must be established and apply in artificial intelligence analysis. Furthermore, the standards are

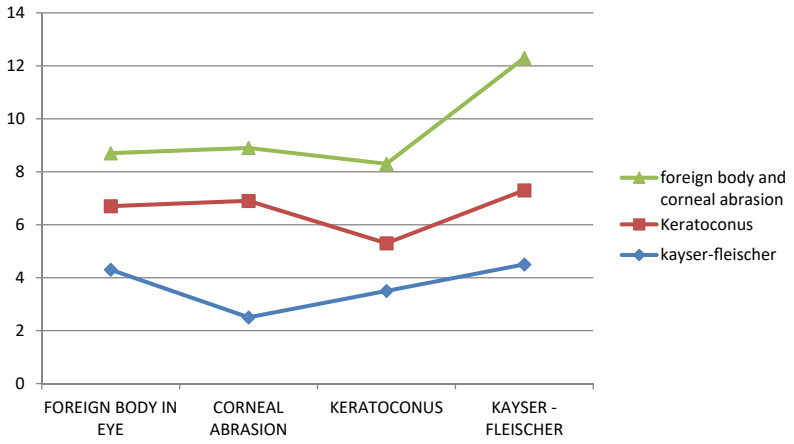

Chart 1 Mapping on ophthamalic disease detecting disorders

scientifically assessing the methods to measure and develop. By developing illustratable systematic AI platforms using efficient and higher leveler then multitasking, data with advanced technologies can improve the materiality of artificial intelligence in clinical conditions. There are possibilities to implement intelligent systems in determined procedures of clinical progress, behavioral regulative, and legal issues growth; artificial intelligence will guarantee extraordinary revolutionary plays a huge part in recent ophthalmologic disorders problem-solving patterns to build a remarkable clinical impact in enhances in future.

Chapter 49
Collaborative Learning; A Case Study at Army Institute of Technology, Pune

Mridula Chandola, Nithya Basker, and Sachin Tanwade

1 Introduction

Teaching methodologies have changed significantly over the years. In order to deliver the best learning outcome, experiments with new methodologies have been designed and implemented, time and again. The traditional 'chalk and talk' method used for several years is now being challenged by modern thoughts and ideas. The new ideas encourage interaction and knowledge over grades and rote learning [1]. With modern techniques like Collaborative Learning, Spaced Learning, Flipped Classroom and Gamification on the rise, the focus of learning has shifted to a more hands on approach, as opposed to the traditional methods that focused only on theoretical knowledge. The modern ways encourage the teacher to play the role of a facilitator in the class [2]. This paper focuses on one such paradigm, i.e. the Collaborative Learning [3].

Collaborative Learning is based on learners functioning in groups of two or more to work out problems and find innovative solutions [4]. This process encourages the participants to understand rather than memorize [5]. Collaborative learning includes tasks and activities that aim to develop team spirit, communication skills, time management skills, critical thinking amongst others [6]. Working in groups is social and intellectual challenge for the participants, who are expected to put forth their individual viewpoint and defend it, whilst at the same time accommodating the inputs of others. The activities performed aim to teach the participants partnership over rivalry [7]. The success or failure of the group is dependent on active involvement of each individual of the group, thus motivating each member of the group to put in their best [8]. Collaborative Learning is an amalgamation of the old and new ways of teaching to achieve the learning outcomes.

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Collaborative Learning challenges the deep-rooted presumptions about teaching and learning. It leads to a shift in the traditional classroom model, assigning both the student and the teacher, new roles and responsibilities [9]. Both the teachers as well as the students need to step out of their comfort zone to adapt. Gauging each student's progress in a group is also a challenge [10].

The students' perception of the proficiency gained by various activities in collaborative learning environment is being analysed in this paper. This would help in improving the classroom activities and designing and developing new activities to help the students acquire the desired skill sets.

2 Current Study

2.1 Participants

The participants in the study were First Year and Second Year Engineering students from Army Institute of Technology (AIT), Pune. The institute caters to the wards of army personnel. The students are admitted to the institution based on their score in the national level test Joint Entrance test (JEE) conducted by National Testing Agency (NTA). These students come from all over the country. In the survey, a total of 57 students participated. These students were learning Soft Skills as a part of their syllabus and as a value added course.

2.2 Methodology

To examine the effectiveness of skills learnt from Collaborative Activities conducted in class, an online survey was conducted over a period of five days in the month of July 2021. The skills learnt from the activities taught in class were to be rated on a scale of one to ten, one being the least and ten being the highest.

2.3 Activity Description

In the survey, 7 of the activities conducted in class were listed, along with the skills they aimed to develop in the students. The activities included:

A. **Mute Play**: In this activity, students in groups of 6–7 set up a mute play on varied themes. The activity, i.e. setting the mute play and presenting it in front of the class had to be completed in the stipulated time period.

B. **Interview**: In this activity, students were asked to work in pairs and present a TV/Radio talk show where one student played the role of an interviewer whilst the other played the role of a celebrity.
C. **Problem Solving**: In this activity students were given several real-life situations which involved using the steps of problem solving to come up with the best possible solution.
D. **Debate**: In this activity, students were divided into two groups and were given a topic to discuss. One team spoke for the motion and the other team spoke against it, based on the role assigned by the teacher, for each of the teams. The debate ended with a conclusion.
E. **Video Making**: In this activity students, using their phones/handheld devices, made a 3 min short film, to create awareness against irresponsible behaviour like wastage of water, leaving light, fans and other electrical appliances on when not in use, and defacing public property.
F. **Creative Writing**: In this activity, students were given story starting lines and using them they had to write a story together.
G. **Time Management Activity**: In this activity, students were given several tasks to complete in the allotted time. Each activity carried marks, and the goal of the exercise was to score the maximum marks.

2.4 The Above Mentioned Activities Aimed to Achieve the Following Skills

- Developing Team Spirit
- Improving Communication Skills
- Out of the Box or Critical Thinking
- Increasing Employability
- Improving Time Management Skills
- Improving Confidence.

3 Results

The students graded various activities on the scale of 1–10, with 1 being the lowest and 10 the highest, based on their perception about the effectiveness of the activity in developing a particular skill set. The average of the grades so given, was calculated to generate the data for analysis, as is shown in Table 1 and subsequent graphs.

Table 1 Various activities are graded for the skill they help develop

Activity	Team spirit	Improving communication	Out of box thinking	Increasing employability	Improving time management	Improving confidence
A	8.603	8.155	8.672	7.568	8	8.896
B	8.293	9	8.142	8.578	8.7	9.206
C	8	7.571	9.068	7.714	8	8.913
D	8.55	8.645	8.448	8.103	8	9.017
E	7.775	8.103	8.344	7.844	8.137	8.5
F	7.275	8.172	8.931	7.827	8.017	8.5
G	7.741	7.758	8.396	8.258	9.068	8.775

3.1 Team Spirit

As can be seen in Fig. 1 students perceived the collaborative group activities Mute play and the Debate helped increase their team spirit the most. In these activities the students brain stormed to come out with a solution that they thought was the best to help their group excel. On the other hand the activity, Creative Writing was thought to be the least useful in developing team spirit.

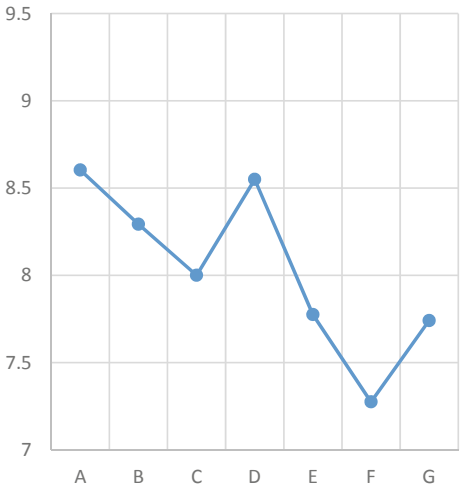

Fig. 1 Indicates the perceived success of activities in developing team spirit

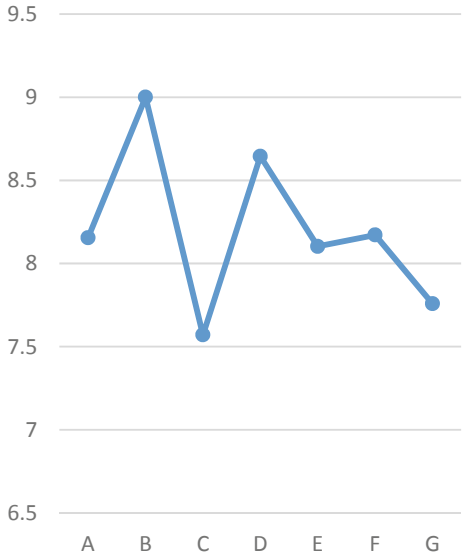

Fig. 2 Indicates the perceived success of activities in developing communication skills

3.2 Improving Communication Skills

Students considered interviews as the best way to improve communication skills as can be seen from Fig. 2. Students rated problem solving skills as least supportive for developing communication skills.

3.3 Out of Box Thinking

One needs an open mind to solve problems. As per Fig. 3, students believe that problem solving helps them to think out of the box and come up with creative solutions. Exercises like mute play and creative writing also helps them develop out of box thinking, whilst the activity Interview is the least effective.

3.4 Increase Employability

Interview rates as the best activity for increasing employability, as is shown in Fig. 4. Good time management skills are also essential for employability as per students. They rated the mute play and contrary to expectation, the activity problem solving as the least useful for getting a job.

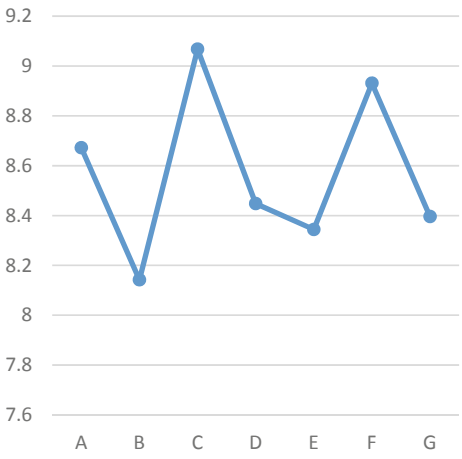

Fig. 3 Indicates the perceived success of activities in developing out of box thinking

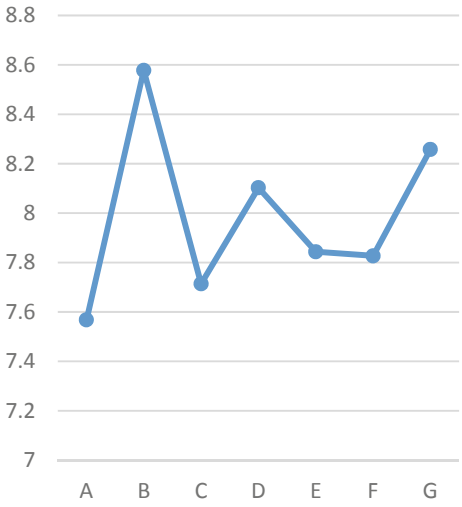

Fig. 4 Indicates the perceived success of activities in improving employability

3.5 Improving Time Management

The activity done on time management was found most useful for learning time management skill as per Fig. 5. Activity Interview also taught the students time management skills.

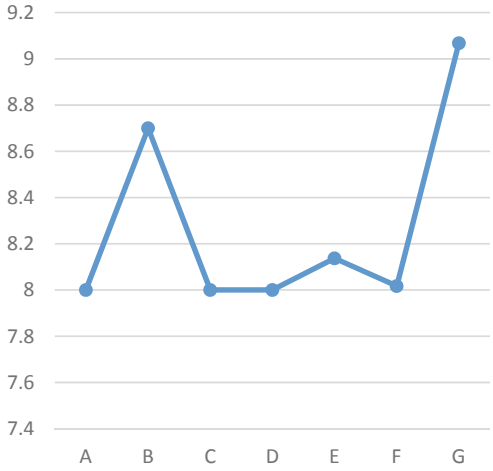

Fig. 5 Indicates the perceived success of activities in improving time management skills

3.6 Improving Confidence

A number of activities helped students develop their confidence as shown in Fig. 6. Interview was the most beneficial and video making and the creative writing the least.

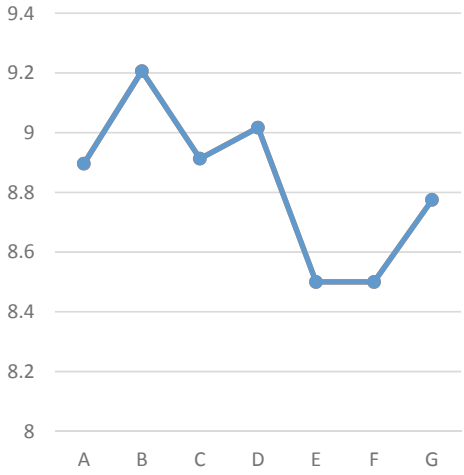

Fig. 6 Indicates the perceived success of activities in improving confidence

4 Conclusions

The relation between various activities conducted in the classroom and the targeted skill development are shown in Fig. 7. The conclusions that can be drawn about the utility value of various activities and some suggestions to improve the effectiveness of these activities are listed below.

4.1 Mute Play

The students perceived this activity enhanced their team spirit and out of box thinking. The original goal of the exercise was to improve the nonverbal communication, which is also a very important aspect of good communication skills. The students associate self-confidence with talking/verbal exercises. In view of this input, a better idea could be to encourage students to perform activities involving verbal communication, emphasizing the nonverbal indicators of good communication.

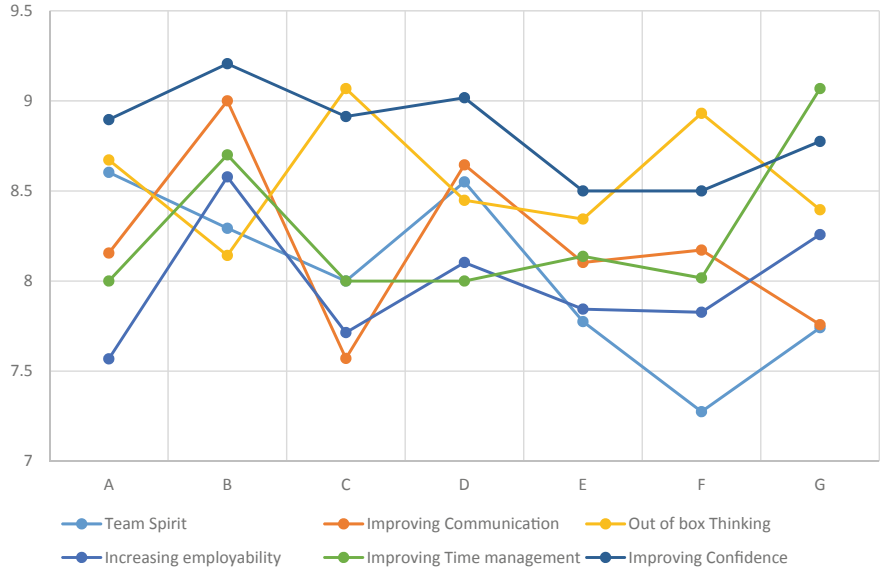

Fig. 7 Activity and the corresponding skill set developed, graded on the scale of 1–10

4.2 Interview

This activity was a popular one with the students. The students believed that the activity assisted them in multiple ways. The activity involved role play, which is an effective way of developing communication skills, out of box thinking and increasing confidence and hence the employability [11]. This activity could also be enhanced by guided role play.

4.3 Problem Solving

Students agree that this activity helps develop out of box thinking and adds to their self-confidence. Industry is increasingly looking for problem solvers [12]. Hence more emphasis should be laid on this activity. Students did not recognize the importance of communication skill in problem solving. It should be impressed on them that good communication skills are necessary to make people accept the solution they offer.

4.4 Debate

This was another activity which was well received by the students. They perceived that this activity helped in their all-round development. Students at AIT are well read and abreast with current affairs. So they do very well in this activity and appreciate its potential. They come from an army back ground, which helps them.

4.5 Video Making

In this activity, students made videos on social issues. They enjoyed this activity and to some extent thought this activity helped in their overall development. The activity could give better result if the students are encouraged to popularize their video.

4.6 Creative Writing

Creative writing was the least popular activity with the students. This could be because the students did not perceive the need of writing a story. The impact of the activity could be increased by making it a writing activity for say an ad campaign. This would improve their writing skills, an important form of communication.

4.7 Time Management

Time management activities were done in a group. The students like working in the groups, so they found the activity useful in developing out of box thinking, time management, employability and self-confidence. The students' view that this activity did not help much in developing the team spirit, came as a surprise, since this was a team activity. To change this perception, the activity could be carried out as a competition between groups to complete the given time bound tasks. Along with time management skills, this has helped students learn to become problem solvers, in turn increasing their employability.

With some modifications, as has been discussed above, keeping the desired learning outcomes in mind, these activities can be tailored to enhance the skill set of graduating engineers.

This success of the case study indicates that there is a need to spread awareness about the collaborative processes, activities and tools used in the classroom. Teachers must become better equipped to design, implement and evaluate collaborative learning environments. Hence, it is crucial to evaluate and improvise the activities being carried out in the class and their effectiveness, time and again.

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Chapter 50
Millimeter Wave SIW Antenna for 5G Application

T. A. Balarajuswamy and Nakkeeran Rangaswamy

1 Introduction

A letter containing this proposal recommends utilizing Roger 5880 as a substrate for 28 and 38 GHz millimeter wave antennas. "In the antenna, a single element configuration has greater gain and performance. According to current testing, the bulk of studies are presently done in the lower order 5G frequency bands, particularly 28 GHz, 38 GHz, and 73 GHz. This testing is now being done in preparation for 5G future wireless technologies. Substrate integrated wave (SIW): SIW is constructed from a dielectric-filled waveguide that has metallic vias on its side walls. The bulk of this field's literature concentrates on lower 5G bands, with a majority of the rest dealing with higher order 5G bands. In cavity-backed triangular ring geometry, a dual-polar patch antenna is investigated [1]. This dual-band, broadband light attenuator for X-band and K-band applications, has a C-shaped single feed horn antenna. The working range of an X-shaped slot antenna is 34.7–36.1 GHz, and the realized gain is 6.7 dB. Also, the actual bandwidth is 4.23%. Two separate dual-band, MIMO, VAST antennas, each with three air-filled slots for 28 GHz, radiates at the top edge of three slots that are mostly air but which are overlaid with small micro-masted antennas for the 38 GHz range for 5G mobile phones. In 28 and 38 GHz range, a dual-band printed slot antenna [2] had gains of 5.3 and 5.6 dB. In MIMO microstrip printed-circuit antennas, a 2-element rectangular patch antenna is used, which offers 7.18 dBi of gain in the 28-GHz band and 9.24 dBi in the 38-GHz band [3]. The second-band antenna has an elliptically shaped ground plane etched to provide a bandwidth of 4.2 and 6.9 dBi. A dual-band S-band half-channel SAW transceiver was also investigated (explored) [4]. At 28 GHz, the gain was found to be 5.2 dB, while at 38 GHz, it was

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found to be 5.9 dB. A linear array of four elements is used to obtain a significant gain. With higher orders, the succession of components becomes more chaotic, making the elements stand out from one another, and the noise increases. This may mitigate some of the problems, but the antenna should be designed with greater efficiency and a stronger gain to achieve better performance. The modified form, in which improved impedance matching is provided in the tapered portion, is also known as the flared SIW structure. The radiating slots are positioned in the cylindrical plane of the SIW cavity and are equally spaced throughout the length of the center of the cavity." Moving the slot forward or backward will change the SIW's resonance frequency.

2 Proposed Antenna

Figure 1 depicts a 2-dimensional SIW antenna that has conductive vias between two rows of cavities on top and on the bottom, as well as a dielectric substrate that is packed in between. On the inner side of the SIW structure, there are two vias, while on the outer side, there are four. As a result, transverse magnetic (TM) modes are not present. In the dominant mode, TE10 is used. "In Fig. 1, the geometry of a dual-band SIW single antenna element is shown. We suggest using a single layer of Roger 5880 as substrate. The specification is a 0.254-thick single-layer RT/Duroid 5880 substrate ($\varepsilon_r = 2.2$, loss tangent $\delta = 0.0009$). The SIW through holes have a

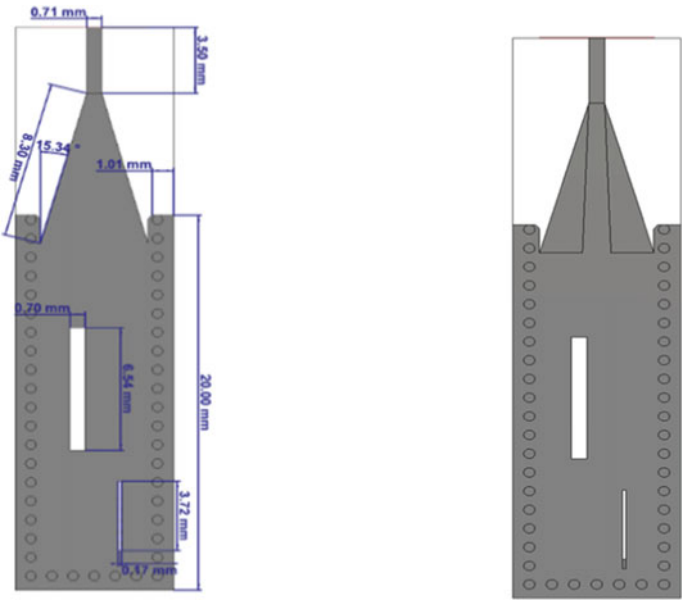

Fig. 1 Structure of SIW antenna

Table 1 Dimension of proposed antenna

Parameter	Dimension (mm)	Parameter	Dimension (mm)
L	30	FL2	8.30
W	7.5	FG	1.01
R	0.25	SL1	6.54
H	0.254	SW1	0.70
FW	0.71	SL2	3.72
FL1	3.50	SW2	0.17

diameter of 0.50 mm and a center-to-center gap of 1 mm between them." The 3 mm tape measures are each 30 mm long and 7.5 mm wide. The length and breadth of the slot may be measured using the SL1, and SW1, whereas proportions such as SL:SW, SW:SL, SL:SW, or the percentage "SL:SW, SW:SL, SL:SW, or a ratio of SL:SW, SW:SL, SL:SW, may be computed. FW uses the phrases segment FL1 and segment FL2. FG is symmetrically oriented on both the *X* and *Y* axis. Table 1 lists parameter values of antenna.

3 Results and Discussion

Using CST Studio, "the proposed antenna's simulated configuration is shown in Fig. 2. The following parameters have also been noted, thereby resulting in an increase in performance of 92.20% at 38 GHz. For 28-GHz, the antenna gain is 7.12 dBi." The directivity is improved to 7.29 dBi at the center frequency of 0.932 GHz for added bandwidth at 28 GHz and at 38 GHz, the efficiency is 92.20%, and the gain is

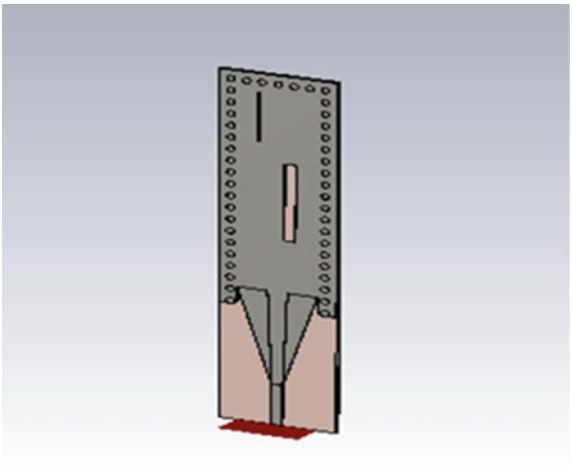

Fig. 2 Simulated antenna configuration

9.04 dBi with directivity of 9.39 dBi with added bandwidth of 0.550 GHz at 38 GHz. Compared to other designs in literature, we have found a significant increase in gain, polarization efficiency, and directivity in the proposed antenna.

3.1 Simulated Antenna Configuration

As part of the system design process, the first iteration of the prototype had a Roger 5880 K input coupling and a 40 GHz K shape connector is used. Copper is included in the plated vias to accomplish the task, and the SIW patches are 30 mm in length and width of 7.5 mm. The performance of the functional characteristics of the simulated antenna is determined.

Return Loss: Return loss is defined as the ratio of reflected power to the incident power in dB. It is the difference in dB between the forward and the reflected power. A high-return loss will result in low-insertion loss and less reflected signal. The suggested return loss of the antenna is shown in Fig. 3. At 28 GHz, the simulated value of resonant frequency is 28.20 GHz with a return loss of −28.77 dB and bandwidth of 0.932 GHz. At 38 GHz, the simulated value of resonant frequency is 37.70 GHz with a return loss of −25.74 dB and bandwidth of 0.550 GHz.

VSWR: Reflection coefficient, which is also known as the VSWR, defines the power that is reflected from the antenna. Maximum and lowest amplitude of the standing wave are known as VSWR. In Fig. 4, the VSWR of the antenna is shown 1.03 and 1.08 for VSWR at 28 GHz and 39 GHz, respectively, up to two dollars is plenty.

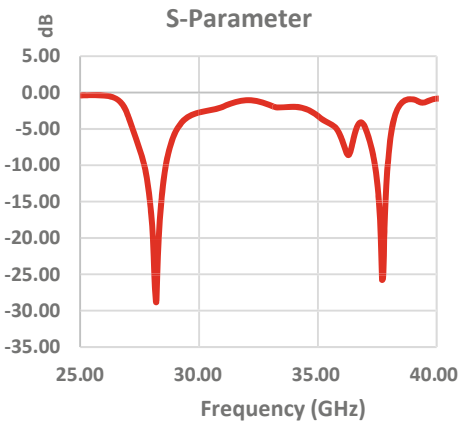

Fig. 3 Return loss of antenna

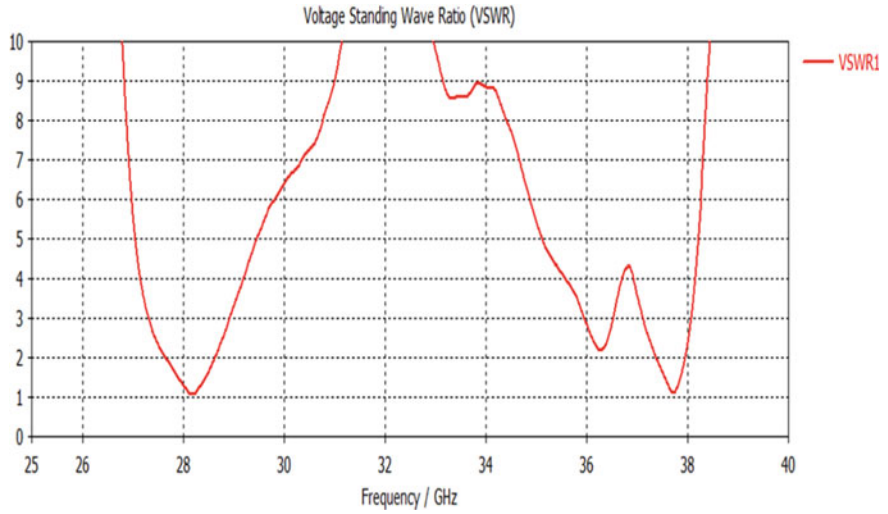

Fig. 4 VSWR of antenna

4 Gain at 28 and 38 GHz

Maximum power density emitted by the antenna is compared to the maximum power density radiated by an isotropic antenna, and the ratio of the two values is called gain. 7.12 dBi and 9.4 dBi are found at 29 GHz and 38 GHz, respectively, shown in Fig. 5 and also in Fig. 6. At 28 GHz and 38 GHz, respectively, the amount of gain increases by Fig. 7. And also in Figs. 7 and 8 depict a 3D plot of gain, which shows 28 GHz at top and 38 GHz at bottom.

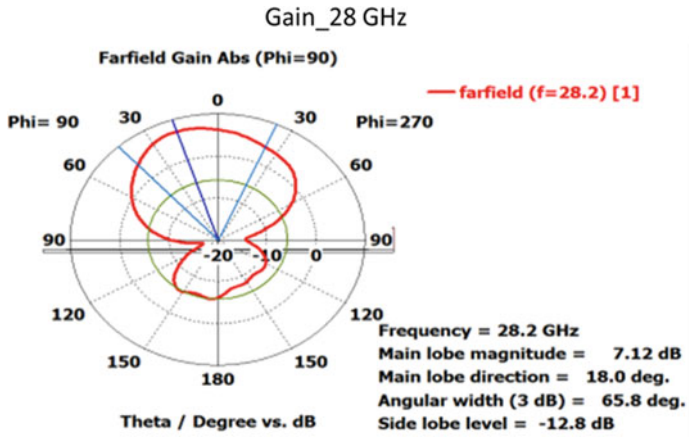

Fig. 5 Gain at 28 GHz

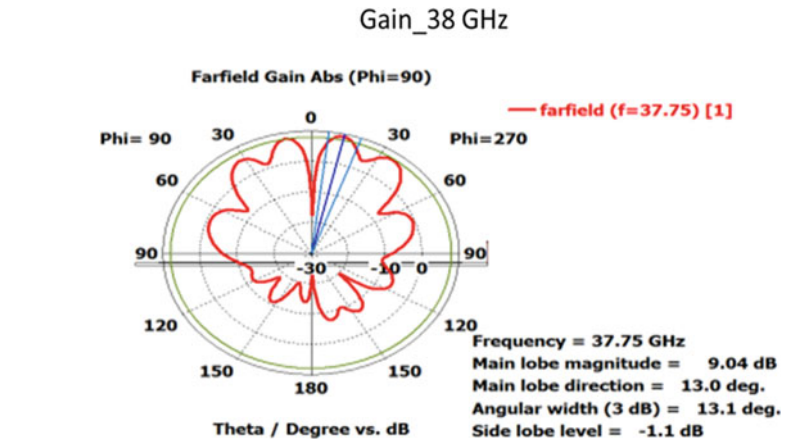

Fig. 6 Gain at 38 GHz

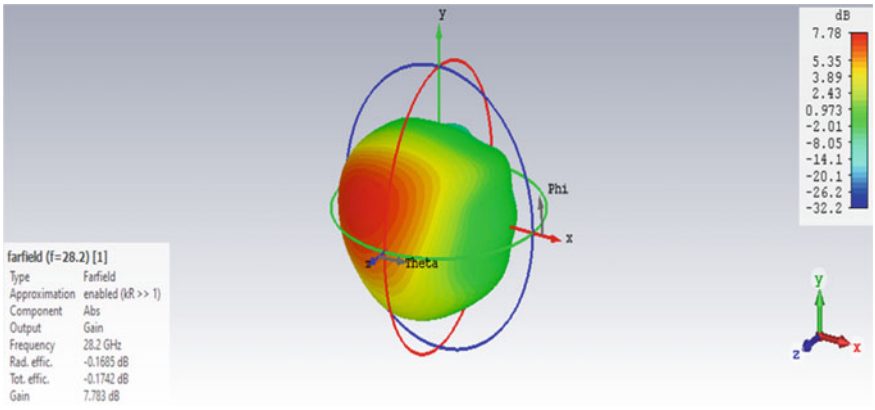

Fig. 7 3D plot of gain at 28 GHz

4.1 Directivity at 28 and 38 GHz

Directivity is a measure of concentration of antenna's radiation pattern in a particular direction. "The directivity at 28 GHz and 38 GHz is 7.29 dBi and 9.39 dBi, respectively." Figures 9 and 10 depict the directivity at 28 and 38 GHz. Figures 11 and 12 show the 3D plot of directivity of antenna at 28 and 38 GHz.

Efficiency at 28 and 38 GHz: Affected object these radiation efficiencies are 96.19% and 92.20%, respectively, for 28 GHz and 38 GHz. Overall, the antenna is 96.05% efficient at 28 GHz and 91.94% efficient at 38 GHz. Figure 13 illustrates the radiation efficiency of the antenna, whereas Fig. 14 presents the overall efficiency of the antenna.

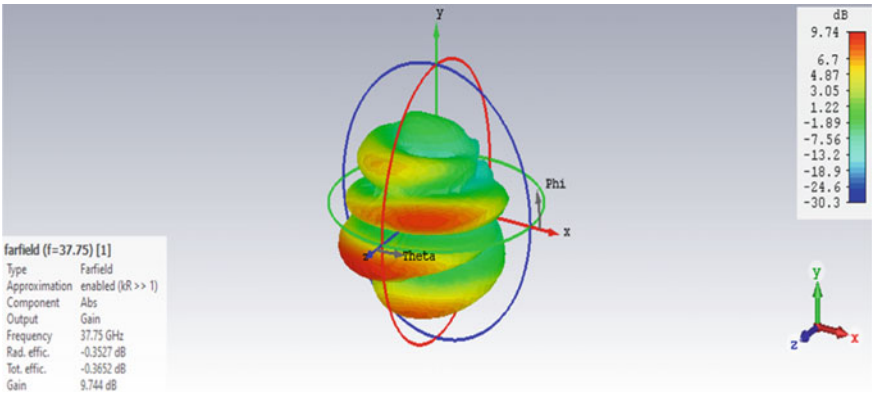

Fig. 8 3D plot of gain at 38 GHz

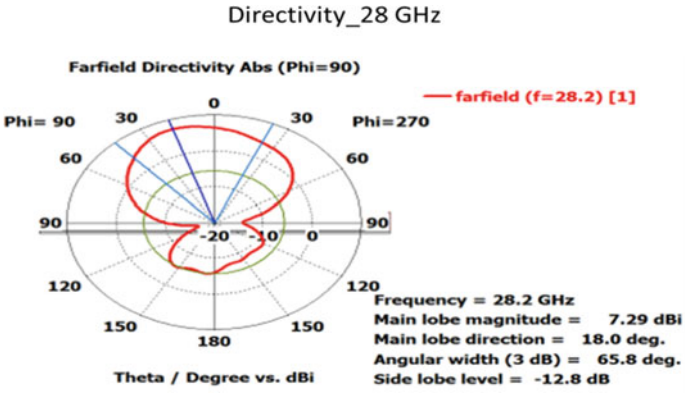

Fig. 9 Directivity at 28 GHz

E-Plane and H-Plane at 28 and 38 GHz: Elevation of the electric field impacted polarization of radiation and that affected the direction of the electric field. "Both the E-field and the propagation vector may be found on the E-plane. H-plane is a parallel to the above-mentioned H-plane, in which the propagation vector and the H-field coexist." In other words, because of it, the E and H-planes are orthogonal to each other, but they have different propagation vectors. In Figs. 15 and 16, you can observe E-plane and H-plane in 28 GHz. Gain was simulated to be 7.12 dB at 28 GHz. The voltage at Phi = 90° is applied to the E-plane. On the whole, the radiation patterns are directed within a certain range. The pattern in the H-plane is omnidirectional within acceptable bounds when it is taken at the far field gain component at Phi = 0°.

At 38 GHz, E-plane and H-plane are seen in Figs. 17 and 18. At 38 GHz, the simulated value of gain is 9.04 dB. E-plane is taken at the far field gain component at

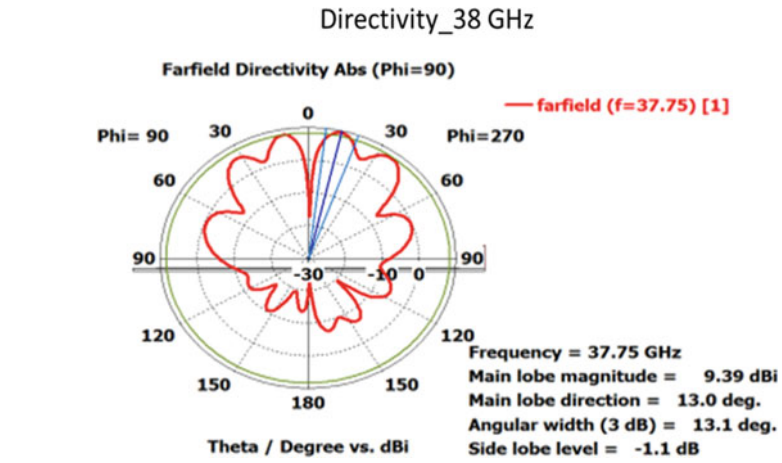

Fig. 10 Directivity at 38 GHz

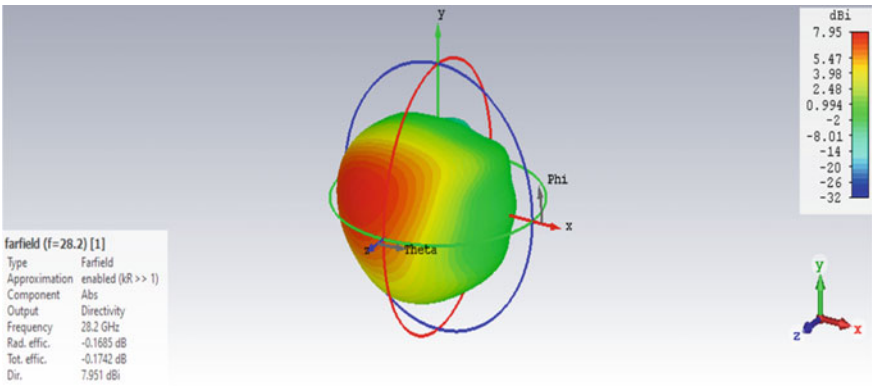

Fig. 11 3D plot of directivity at 28 GHz

Phi = 90°. The radiation patterns are mostly omnidirectional within suitable limits. In the H-plane, taken at the far field gain component at Phi = 0°. The pattern is somewhat directional within suitable limits.

5 Comparison Study

Table 2 shows the comparative simulated study of the presented structure with other antennas in literature.

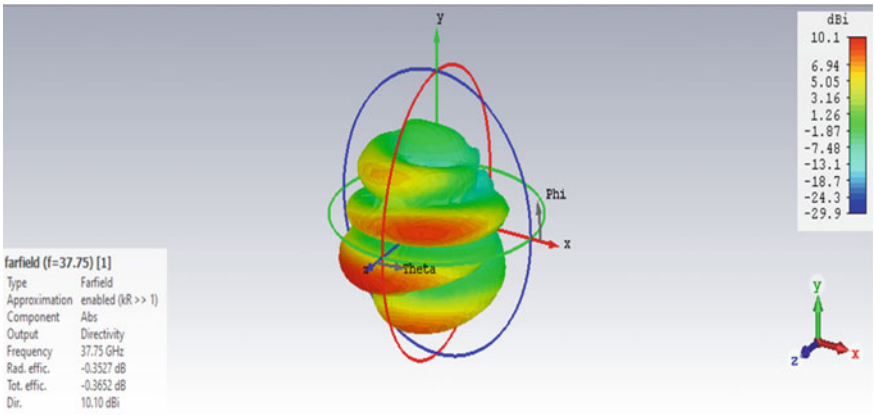

Fig. 12 3D plot of directivity at 38 GHz

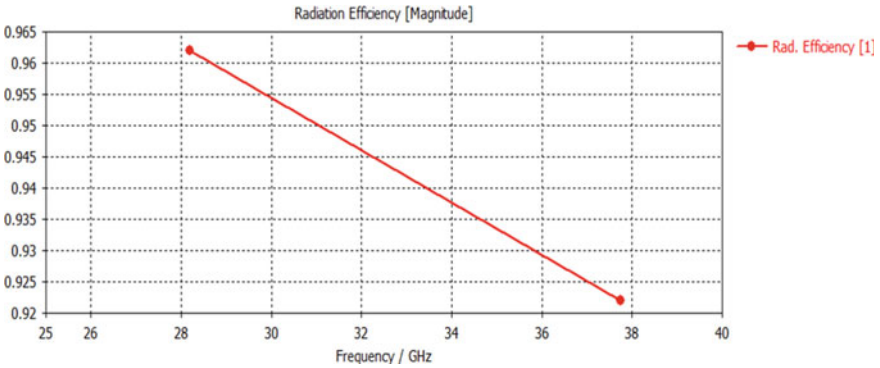

Fig. 13 Radiation efficiency of antenna

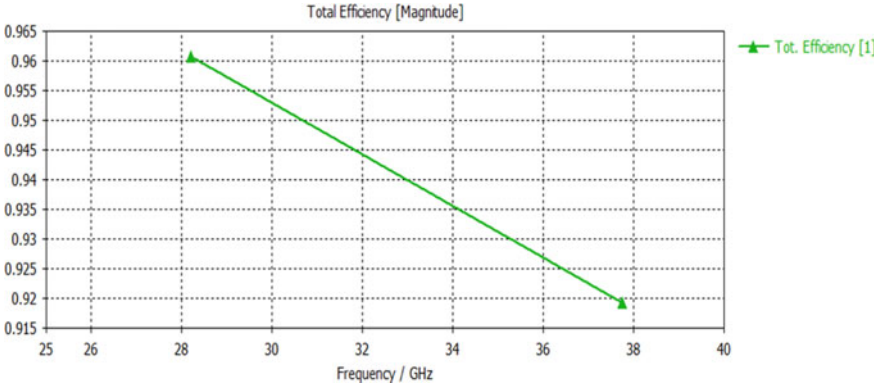

Fig. 14 Total efficiency of antenna

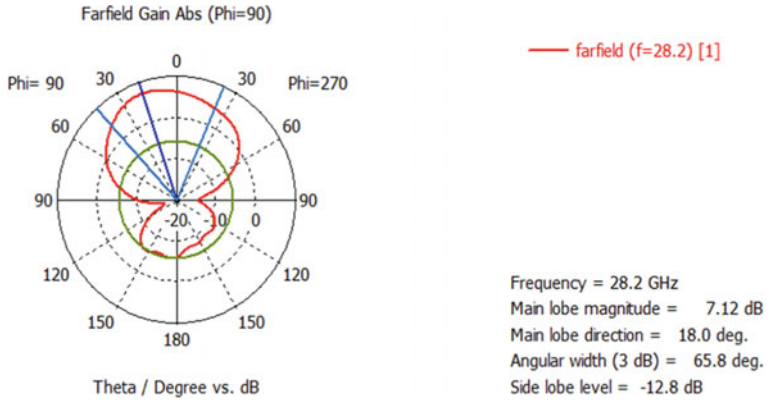

Fig. 15 E-plane at 28 GHz

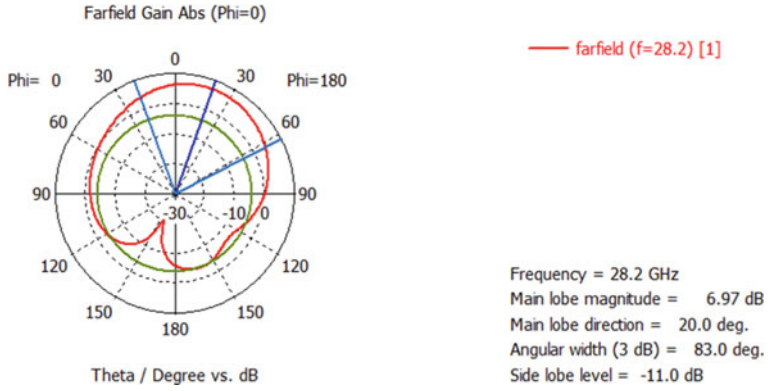

Fig. 16 H-plane at 28 GHz

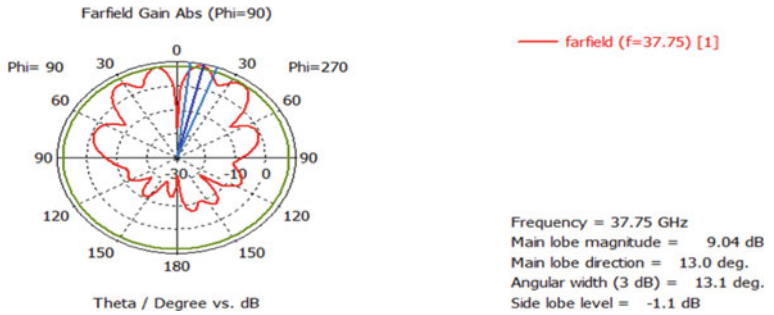

Fig. 17 E-plane at 38 GHz

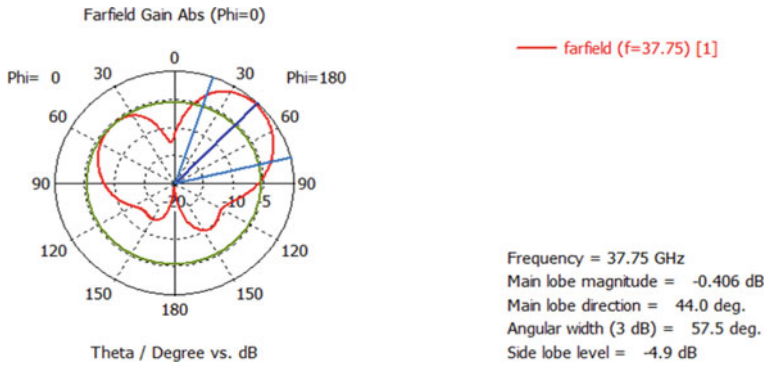

Fig. 18 H-plane at 38 GHz

Table 2 Proposed antenna structure comparison with antennas in literature

Reference papers	No. of elements	Frequency (GHz)	Gain (dBi)	Bandwidth (GHz)	Radiation efficiency (%)
Ashraf et al. [4]	Single element	28	5.2	0.45	NS
		38	5.9	2.20	NS
Marzouk et al. [5]	Single element	28	5.126	NS	91.02
		38	4.607	NS	92.81
Ashraf et al. [2]	Single element	28	5.3	NS	93
		38	5.6	NS	94
Marzouk et al. [3]	Two elements	27.946	7.18	NS	91.24
		37.83	9.24	NS	89.63
Haraz et al. [6]	Single element	28	4.2	NS	80
		38	6.9	NS	85
Proposed work	Single element	28.20	7.12	0.932	96.19
		37.70	9.04	0.550	92.20

NS not specified

6 Conclusion

A single element two slot SIW antenna with a Roger 5880 substrate and K-style connection was designed to achieve better efficiency and bandwidth gains. The suggested SIW antenna has been developed for Ka-band uses in the 28 and 38 GHz millimeter wave range, which are suitable for 5G applications. The profit of 28 GHz is 7.12 dBi with a return loss of −28.77 dB, whereas the profit of 38 GHz is of 9.04 dB with a return loss of −25.74 dB. Higher band frequency: The efficiency result at 28 and 38 GHz was 96.19 and 92.20%. The flaring portion of the tapered section is covered in an antenna element at both ends by an inset which covers the first two

vias, producing high gain and greater performance. The architecture of the antenna has been developed and is compatible with the results. In future, authors should explore using PIN diode-based antennas or increasing the number of elements of a one-element antenna to improve their daily usefulness.

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Chapter 51
Importance of Medical Instruments in Treating COVID Patients: A Case Study of Alwar District in Rajasthan

Arushi Saraswat

1 Introduction

By the end of 2019, Wuhan, China, reported a new viral infection, now known by the name of COVID-19. Compared to other variants of coronavirus it shows less severe pathogenesis but is highly transmissible [1]. It generally affects the upper respiratory tract but in more severe cases can reach up to the lungs. The WHO declared it a Public Health Emergency on January 30, 2020 and a pandemic on March 11, 2020.

Different medical equipment's are required for treatment of patients, especially those who are in severe condition. WHO states oxygen as an essential medicine for COVID-19.

Since oxygen is the crucial requirement for COVID patients, oxygen related instruments have been primarily dealt in this paper. What are the problems faced in while using equipment's prescribed by WHO in treating patients? What other necessary human and material linkages are needed with these instruments? What has been the availability status of these instruments during the second wave? Are there any natural remedies that can minimize use of these instruments for treating low level of oxygen in human body?

Second wave of COVID-19 in India showed great demand for oxygen. This study attempts to analyze instruments, the status of these instruments in Alwar District in Rajasthan, India and preparations needed in the light of above study regarding the expected third wave and future outbreaks, if any.

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2 Medical Equipments

The list of equipments required during COVID-19 given by WHO is as follows [2]:

Oxygen supply devices include oxygen concentrators, which concentrates oxygen from ambient air. They deliver oxygen at bedside via attached nasal cannula; oxygen cylinder that hold oxygen in a high pressure, non-liquid state fitted with valve and pressure regulator.

Oxygen delivery devices include the nasal oxygen cannula with prongs, masks with reservoir bag, venture masks.

Devices used for oxygen regulating and conditioning include the flowmeter, Thorpe tube which are needed to measure and control the rate of oxygen flow from a high pressure cylinder; flow splitter which includes an inlet valve that delivers oxygen to multiple independent flowmeters each one providing an outlet; non heated bubble humidifier, that reduces dryness of oxygen by bubbling the gas through distilled water; and tubing designed for external connection of an oxygen delivery source.

Manual ventilation devices comprise of self-inflating resuscitation bag with masks, heat and moisture exchanger filter, colorimetric end tidal detector.

Patients monitoring devices include pulse oximeter which can be handheld or in form of tabletop or fingertip.

Invasive ventilators include: ventilators for intensive care unit providing temporary ventilator and respiratory assistance to patients who cannot breathe on their own or those who require assistance to maintain adequate ventilation. Ventilators for transport provide temporary ventilator assistance with a full degree of portability. Ventilators for sub-acute care are designed to mainly provide noninvasive ventilation but in case of emergency can provide temporary invasive ventilation.

Noninvasive ventilators consist of continuous positive airway pressure CPAP, which is used in spontaneously breathing patients, who require short term mechanical assistance. These units deliver mixture of air and oxygen at high flow rates through a circuit and patient interface. Bilevel positive airway pressure is designed to apply CPAP to non-intubated patients, allowing clinicians to adjust two different pressures during inspiratory and expiratory phases of breath. High flow nasal cannula also known as heated humidified high flow therapy or high flow nasal oxygen is designed to deliver high flow rates with heated humidification to non-intubated patients. Warm and humidified gas decreases airway inflammation and reduces caloric expenditure in acute respiratory failure.

3 Material and Human Linkages

3.1 Cryogenic Tankers

As the 2nd wave hit Rajasthan, requirement for oxygen tankers increased. They were needed to supply oxygen from one area to other as the oxygen plants were limited to

specific areas. Mr. Sunil Gupta, Joint Secretory and Treasurer of All India Industries Gases Manufacturing quoted "Country is not deficient in Oxygen. The problem lies in its timely transportation to Hospital". Even 10% of oxygen tankers required for transportation are not yet available.[1] Transportation facilities became a necessity for the proper oxygen supply. Increased number of tankers will provide oxygen to places where it is needed.

That time the state had a total of about 277 metric ton of oxygen. The state provided a budget of about 1.90 crore to district collectors for buying oxygen concentrators. On the other hand, seeing the severity of cases, the state government decided to airlift 30–35 metric ton oxygen tanks from Reliance Refinery, Jamnagar Gujarat to Jodhpur.[2] The transportation of oxygen played a crucial role for its proper management.

3.2 Oxygen Beds and Ventilators

Another important requirement associated with oxygen is availability of beds in the hospital. On 25th April in Alwar among the total of 651 oxygen beds 400 were full and 251 were vacant, ICU Bed in total were 131 among which 77 were full and 54 were vacant, and among a total of 65 ICU beds ventilators 46 were full and 19 were vacant.[3] The number of patients were increasing rapidly at that time and these beds were getting occupied by patients who were in severe condition.

The COVID dedicated health center in Munawar CHC, was locked.[4] There was lack of responsibility and negligence on the part of medical workers toward their duty in such an emergency.

In Ramgarh, 21 beds in 7 rooms were in total out of which 13 beds were without bedsheets and mattresses. Fans were not working. Toilets were uncleaned, without lighting and water. There were 2 oxygen cylinders in total. No doctor on duty was present. A total of 3 patients were admitted.[5] Rooms and beds were poorly prepared and even the basic needs were not available.

In Rajgarh, male ward had 16, female ward had 14 bed in total. Twelve of these were oxygen beds, but oxygen cylinder was found only on one bed. The facility of concentrator was not arranged. Number of staff was 4. No patient was admitted.[6]

In both, Rajgarh and Ramgarh sufficient number of oxygen cylinders for beds were not available.

In Pinan, a total of 30 beds were arranged out of which 12 were prepared. 3 beds had the facility for oxygen and a total of 7 oxygen cylinders were available.

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[1] Dainik Bhaskar: 27April, 2021.

[2] Dainik Bhaskar: 24 April, 2021.

[3] Dainik Bhaskar: 26 April, 2021.

[4] Alwar bhaskar: 9 May, 2021.

[5] Alwar bhaskar: 9 May, 2021.

[6] Alwar bhaskar: 9 May, 2021.

Two doctors, 2 from nursing staff and 6 teachers were on duty. Still no patient was admitted.[7]

In Lakshmangarh, there were 12 beds and a total of 4 oxygen cylinders available. Three doctors were on duty. Drinking water was not available. No patient had been admitted or referred.[8]

Bansur had 3 COVID centers. Among these three, the Kasturba Gandhi residential hostel had 40, CHC Bansur had 12 and the Bansur Hospital had 40 beds. All of them in total had 33 oxygen beds, 32 oxygen cylinders, but there was no central pipe line for supplying the beds. There were 12 doctors in each center, a staff of 8 for dedicated COVID health center and a staff of 15 at dedicated COVID hospital. No patient was admitted in 2 centers.[9] This shows that even though the medical staff was available, oxygen was available, but they were of no use because of improper preparation for the supply of oxygen.

The Thanagaji Community health center had 9 beds. Two beds had oxygen and there were 6 oxygen cylinders. Four doctors and 4 of nursing staff were on duty. Two patients were admitted. Government ITI isolation center was closed as there were no patients. Quarantine center in Lahaka BasDev Narayan Hostel having 40 beds was operational.[10]

The satellite hospital in Khertal had a dedicated COVID health center with 20 beds. Every bed was supplied with oxygen. Wards were air conditioned. A total of 16 COVID patients had been admitted since 23rd April. Five had been discharged. One patient had been referred to Alwar. At that time ten patients were admitted and were on oxygen. Among these three were from Haryana. A total of 11 oxygen cylinders were available. Ten empty cylinders had been sent to Bhiwadi for refilling. A total of 3 doctors with 17 workers were on duty in COVID department.[11]

This area showed good preparation and adequate management of the resources. Others areas also need to improvise on this. In general, the other areas lacked in one or the other facilities, and the patients had to go to the main city which was already facing management difficulties. This overburdened the situation there. Also, some places had adequate facilities but were with no patients predicts lack of awareness among people, or their lack of surety about the treatment available there.

3.3 Oxygen Cylinders and Oxygen Plants

The second wave showed great demand for oxygen cylinders. The availability of these cylinders was directly linked to production in oxygen plants and their supply.

[7] Alwar bhaskar: 9 May, 2021.

[8] Alwar bhaskar: 9 May, 2021.

[9] Alwar bhaskar: 9 May, 2021.

[10] Alwar bhaskar: 9 May, 2021.

[11] Alwar bhaskar: 9 May, 2021.

On April 26, 2021; 700 patients were on oxygen support in Alwar and average consumption by 1 patient was two and a half cylinders per day. The city was receiving a supply of about 800–900 cylinders per day. The Alwar INOX Plant, Bhiwadi Alwar; the Synergy Steel Plant, MIA, Alwar were supplying to other districts of the Rajasthan and Delhi. Industrial supply had been converted to medical supply. Alwar was getting only eight to ten kilo liter oxygen per day, though the INOX plant was producing 120 kilo liter gas per day. Alwar was not getting the required 12–13 kilo liters. The oxygen unit at Bhiwadi was under the control of union government. New oxygen generation plant was expected to begin within 5days.[12] This shows that production of oxygen in other areas of Rajasthan and Delhi was not enough and the District had to suffer. The central government should have paid attention on Alwar District.

3.4 Tests Needed for Finding the Level of Corona Infection[13]

Interleukin-6: This test tells about level of infection in lungs. In conditions of breathing difficulty this test is more significant/ necessary than High resolution CT Scan HRCT of the Chest.
D-Dimer: It tests about blood coagulation.
Pro calcitonin: This tells whether the infection is viral or bacterial.
C—Reactive Protein Quantitative: By this test infections undetected by HRCT are detected before development of complications in the body.
S—ferritin level: This also tells about the level of infection. It eases the treatment process.
Troponin: It detects cardiac problems arising in the patients so that in immediate treatment can save heart of the patient. After this test's tocilizumab is needed, which is provided by government hospitals free of cost.

Facility of these tests is not available in the Government Hospital and patients have to go private labs for these tests, which delays the treatment, thus aggravating the problem caused by oxygen deficiency. Government needs to provide facilities for these tests.

4 Magnitude of Oxygen Requirement

By April 28, Daily oxygen consumption had reached 320 tons. The State had a quota of 140 ton but consumed a total of 161 ton. On 29th April, the state received 20 less ton than it quota because the Jaman Nagar plant was closed that day for about to 4–8 h, to increase the plants potential. On the other hand, the Bhiwadi plant was

[12] Alwar Bhaskar: 27 April, 2021.
[13] Alwar Bhaskar: 27 April, 2021.

closed on 28th April for Maintenance. The state needed 310 tons of oxygen but was receiving 300 tons. Three hundred sixty-five ton of oxygen was expected within 2–3 days. More than 600 ton of oxygen requirement was expected in the first week of May. The medical education department advised the patients in home isolation to use proning to improve oxygen level.[14]

The plants need to be closed for improvising which is necessity for efficient production. This means more plants need to be set up so that the state does not go in crisis in such a situation. We also come to know about importance of exercises which also act as medicine as they increase the oxygen flow.

Daily requirement of oxygen cylinders in Alwar is about 1600 but the city is getting around 1000–1100 cylinders only. Officials said that that problem in oxygen plant two days earlier resulted in this inconvenience which will be improved soon.[15]

Hitesh oxygen plant engineer quoted "Fluctuation in electricity caused the problem, patients need 90% quality of oxygen which then got reduced to 70%". It was improvised soon.[16]

Supply line of the oxygen plant located in the Government Hospital got leaked and patients had breathing difficulties.[17] This shows that close monitoring is required by the skilled staff from time to time. The plant must be checked on regularly.

Also, Chief Minister of the state asked central government to supply oxygen according to active cases. Gujarat whose active cases are 137,794 was getting a supply of 975 and Rajasthan with 169,519 active cases had a supply of 265 oxygen.[18] The union government must supply oxygen according to state wise requirements. Although, the State must in future be prepared for such situations, still the overall production needs to be increased.

CMHO quoted that since treatment of patients is possible from home so they should get admitted in hospital only when the doctor advises them to do so since there are only limited resources. There was defect in oxygen sensor of the new packed ventilators and the parameter could not be set for their calibration; and KTPL Company for maintenance of medical equipments demanded an estimate of about one and half lakh for replacing about 41 oxygen sensors and other equipments. The oxygen supply with calibration give 100% oxygen flow. Replacing sensor in ventilators is required every 1–2 years for maintain proper flow. Without calibration the oxygen flow is about 36–40%.[19] The District administration and hospital administration later approved it.[20]

Supply from newly set up automatic oxygen plant 600 L per minute to wards on general hospital started late night on 7th May. This cylinder has potential of 120 D Type cylinder oxygen production in 24 h. Along with the previously set plant

[14] Dainik Bhaskar April 29, 2021.

[15] Dainik Bhaskar, Alwar bhaskar, 30 April, 2021.

[16] Dainik Bhaskar, 7 May, 2021.

[17] Dainik Bhaskar, 15–16 May, 2021.

[18] Dainik Bhaskar: 30 April, 2021.

[19] Dainik Bhaskar, Alwar bhaskar: 02 May, 2021.

[20] Dainik Bhaskar, Alwar bhaskar: 9 May, 2021.

in January both these plants can supply 210 cylinders of oxygen in 24 h. Although daily consumption is more than 400 cylinders due to the increased number of patients in the hospital.[21]

5 Factors Influencing Medical Equipments

In General hospital, Alwar; patients admitted in month of April were a total of 3503, in which 2156 were From Alwar, 232 were From Dausa, Bharatpur and Jaipur, 673 were From Haryana, 34 were from UP, 342 From Delhi, 23 from Bihar and 17 from Bengal. In the beginning of May, number of admitted patients were 2476, from which 1298 were from Alwar, 176 from Dausa, Bharatpur and Jaipur, 612 from Haryana, 14 from UP, 33 from Madhya Pradesh, 334 from Delhi, 14 from Bihar and 15 from Bengal.[22] This was an indirect factor affecting the availability of medical facilities and equipments. This resulted in difficulty in oxygen management because the city was treating patients from outside too. The city must be prepared with an extra margin of oxygen, medical equipments. Because services need to be provided for people in need.

Oxygen in Advance life support ambulance carrying COVID patient Rahul Sharma from Alwar to Jaipur got used halfway about 1.5 h up to Dausa which resulted in his death. The total journey is about 3 h.[23] From this we come to know that medical personnel should monitor the condition of the patient timely. The condition of the cylinders should be checked. Equipment by itself is not complete, it is a machine, therefore trained professional monitoring is necessary, and patients cannot just be left under supervision of attendants.

In Alwar, 3 government and 23 private hospitals are dedicated for COVID which have 1520 beds and 121 ventilators. But 29 ventilators were still packed and patients were on high flow masks and bipap machines. General Hospital COVID Nodal Officer, Dr. Ashok Mahawar stated that there are medical equipments for treatment of patients but lack of physicians and anesthetics.[24] The medical system needs to improvise on this for future. Like medical equipments, skilled workers are as much important as equipments to handle a situation like this.

Medical and health department generated a cut off for admission on urgent temporary basis. The list included General nursery and midwifery, lab technicians, arg, research assistant RCTPCR, Lab technician RTCPCR, Senior lab technician RCTPCR.[25]

To control COVID pandemic CHC and PHC and other government hospitals are going to provide 3 months of on job training program and 1 month of training

[21] Dainik Bhaskar, Alwar bhaskar: 9 May, 2021.

[22] Dainik bhaskar, 29 May, 2021.

[23] Dainik Bhaskar, Alwar Bhaskar: 23 May, 2021.

[24] Dainik bhaskar, Alwar bhaskar: 28 April, 2021.

[25] Dainik bhaskar, Alwar Bhaskar, 8 May, 2021.

program for Emergency Medical technicians, General duty assistant, critical care JDA Advance, home health assistant, medical equipments technician, and phlebotomist.[26] This is a very good initiative by the government. This will help in smooth and efficient working in future. In this way, skilled force will help during the 3rd wave.

Oximeters were also in high demand during this crisis. People made stock of oximeter hence they were not available in markets. Later, they increased their rates from 400–500 to about 2500–3000.[27] This is a very immoral behavior on part of Citizens. Medical equipments are meant to be used, not misused.

Divisional commissioner Mr. Dinesh Yadav instructed collector Mr. Natrumal Pahadiya to do micro level monitoring at rural level for preventing COVID.[28] This is an example of good management which will indirectly leave the medical equipments for those who would need it the most.

6 Conclusion and Suggestions

Medical equipments played a very crucial role in assessing, managing, treating and even saving the life of a patient. It is very difficult for a highly populated developing country like India to keep these medical instruments in reserve in sufficient quantity.

Oxygen plants, tanks must be established so that the state can fight the 3rd wave, and get prepared for further future outbreaks. In Alwar, in emergency situations, oxygen concentrators procured were of sub-standard quality in the Government hospital. Industrial oxygen must be treated and cylinders sterilized, before using on humans, so that we can prevent complications like black fungus. Skills must be imparted to people so that resources can be used fruitfully. In Alwar many available instruments could not be used due to lack of skilled manpower.

Ambulance, oxygen beds, tests are supportive linkages which were lacking in Alwar and all these should be arranged for dreaded third wave.

Similarly, hand sanitizer, hand wash, disinfectant and other hygienic products, and masks are also as important as oxygen. These can help the health sector indirectly by reducing demand for oxygen. Since oxygen availability is scarce, these are also medications. These are also easy to produce.

Hand wash purchase before COVID was 14% which has now increased to around 33% of Indian Citizens.[29] This shows that with increased awareness the production has also increased.

Also, since oxygen is important, proning, herbal remedies and nature labs also act as medical equipments. In Alwar it was seen that COVID patients who moved to

[26] Dainik bhaskar, Alwar Bhaskar, 28 May, 2021.

[27] Dainik bhaskar, Alwar Bhaskar, 7 May, 2021.

[28] Dainik Bhaskar, Alwar Bhaskar: 8 May, 2021.

[29] Dainik Bhaskar: 27 April, 2021.

natural surroundings improved their oxygen levels without using oxygen cylinders. Hospitals should provide yoga facilities.

Alwar faced various problems and lacked during the second wave. Timely preparation, proper management and positive attitude will help us to fight and win over the 3rd wave!

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Chapter 52
Sustainability Through Microfinance Among the Small Farmers of Kotdwar Bhabhar Region in Uttarakhand

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1 Introduction

Microfinance, also known as microcredit, is a financial service which is provided to the low-income groups or individuals, unemployed, needy, poor people who have some idea of income generation and those who do not have any access to the traditional banking services. Microfinancing is much approved and the most availed banking service in today's financial market affairs. Microfinance is provided in the form of loans, and periodic remittances to small business holders and entrepreneurs in the poor and needy section of the society. Microfinance provides easy access to capital for the people who are not financially fit. Other than microfinancing institutions, the needy poor people depend on other source of entrepreneurial cash money like—borrowing from a family, friend, or a relative. Microfinance widely depends on the project which helps to create surroundings of faith with an aim to provide banking services to poor. It aims at multidimensional strategies to make sure the guarantee of financial flow toward the rural economy and to ensure the creation of building assets for better sustainable income generation for the existing as well as future generations.

Microlending would be partial without mention of Mr. Muhammad Yunus who received Nobel Peace Prize in 2006 for promoting entrepreneurial concept of microfinance (microcredit) to uplift the large population from poverty in Bangladesh.

In present state of Indian affairs, Reserve Bank of India (RBI) systematizes the setup of regulatory policy framework through which low-income borrowers can be promoted to healthy competition between the microfinance lenders. RBI just

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needs to remove the barrier so that the smooth functioning of microlending can be done. Microfinance is one of the main sectors that get severely hit by the COVID-19 pandemic. We see that low-income groups are powerless and at a loss to meet their daily essentials. On the other hand, money lenders are slackening due to non-availability of borrowers.

India is a growing economy where poverty still is one of the major concerns. It has around 84 million peoples living in indigence which is up to approximately 6% of the total population by May 2021. It is distinct from other nations in terms of political, economic, social impoverishment of the people. Poverty is a condition in which the people circumstances are such that they cannot afford the financial resources and basic necessities for a minimal standard of living. India's way to compute the poverty is a "poverty line". The ones who do not have enough resource to buy the basic necessity in terms of goods come in poverty line bracket. According to the report of "Global Multidimensional Poverty Index", 22% people live in multidimensional poverty, i.e., majority of the population in poverty are not able to have clean water, food housing, education, employment, and heath care facilities.

India is one of the second largest countries among the world in production of wheat, rice, textile raw material, roots, pulses, fish, eggs, coconut, sugarcane, and various vegetables. India is, therefore, taking numerous steps to eradicate poverty. Emigrants are moving into urban from rural to satisfy their necessities. The only way to stop migration is to develop the balance of facilities-education, medical, entertainment, income, industrial sector, and their habitat territory. Due to lack of resources, people are unable to maintain decent standard of life. Microfinance is a way more important to stop poverty and uplift the poor section of the society. It serves to fulfill the financial problems as well as common crises of the poor.

2 Purpose and Significance of Study

Microfinance provides remedies in alleviation of poverty. It supports poor people to generate income and improve their standard of living. The program for poverty alleviation grows at a brisk rate of economic growth with intensity of human resource development and distribution of equity. India is one of the major economies who played an apex role in contributing to the world economy. Majority of the people in India, i.e., around 68.8% of the total population lives under the extreme poverty and are unable to have clean water, basic sanitize, housing, education, food, employment, shelter, medical facilities. This can leave unexpected and long effects on their quality of life.

This study details the socio-economic impact of microfinance on small farmer's life in the Kotdwar Bhabhar region and is a survey to check the standard of living with the other aids of health, shelter, and education. The coarse alluvial soil zone beneath the Shivalik Hills is known as "Bhabhar". In this region, underground water level is deep which rises to the surface of the land in the "Terai". It also produces huge return per unit in terms of agricultural output due to its good fertility.

This study is conducted to show the agricultural life of small farmers after getting microfinance loan and the objectives are to explore-

1. The effect of microfinance loan on small farmer's income.
2. To identify the current social situation of loan seekers.
3. To give suggestions to policy makers for designing new microfinance products.

3 Literature Review

Microfinance with the combination of social responsibility becomes the growing force for dynamic and innovatory factor thus alters the finance and non-finance services to assist sustainable development (Marion Alter Jon 2012).

The group focused on the socio-environmental program of sustainable development. It observed the relationship between the gender equity and the environment before moving on to microfinance (Warnecki 2015).

According to Ramaswamy and Krishnamoorthy [1], many authors have inspected majority of microfinance models in different developing countries as an orderly set up to evaluate the challenges faced by several institutions in addition to acknowledge the regulatory status and legal interval, with the aim of success implementation of microfinance toward sustainable development.

According to the study by Jose and Chacko [2], the larger contribution to microfinance sector in terms of sustainable development is lacking due to the fund diversification and lack of complete investment in microfinance sector.

In India, microfinance is a developing activity for poverty reduction, empowerment of the women with the combination of sustainable development. It is an attempt to explain how much microcredit is productive and economically beneficial for sustainable rural development, both in rural and urban areas (Upadhyaya [3]).

Importance of "Social Entrepreneurship" is in bringing about social transformation and achieving long-term development by resolving the issue such as poverty, inequality, and safety (Bansal et al. [4]).

According to the study by Li et al. (2020), the outcome of credit and return on assets shows positive and negative results on "Microfinance Institutions" engaged in "sustainable development" because of regional disparities.

One of the first objectivities to investigate green microfinance for the prospective "Microfinance Institution" is believed to be useful for organization and policy makers in evaluating the role and contribution of microfinance in solving the major environmental issues (Uddin et al. 2021).

According to the study the report in both urban and rural region, the actions performed in each of these studies have made significant contributions to poverty reduction and economic growth [5].

In combination with organizational aspects and cultural aspects, microfinance provides an investigation for examining the correlation between the actual performances of the factors related to sustainability. Microfinance arose as a response to the impoverished with long-term approach to his capital needs [6].

One of the major schemes in microfinance for sustainable development examines the role of Microfinance Institutions (MFIs) and saving clubs in providing expensive renewable energy equipment, especially to off grid population. Microfinance does play role in promoting more affordable and ecologically sustainable energy solutions like solar hot water heaters, housing insulation, and small scale solar panel systems for electricity [7].

Microfinance Institutions have the potential to be significant drivers of ecologically and socially sustainable growth aiming to go green by becoming most engaged sector in environmental management which is largely fueled by social duty [8]. For the socially responsible institutions, microfinance became lending driver—which is more active and innovative to promote environmentally friendly practices through financial and non-financial services [9].

"Green microfinance" is an introduction of environmental criteria in microfinance products to promote sustainable activities and provide access to clean or more efficient energy or to mitigate climate and environmental risk for low-income households or small enterprises in a dynamic and developing market [10]. Today, National Bank for Agriculture and Rural Development provides affordable door to door banking and has established itself as a self-help movement with the goal of establishing long-term livelihood prospects [11, 12].

According to the report of microfinance, loan portfolio grew 17% which increased by 2 trillion in the financial year 2021 as compared to the previous year 2020 which was 2.54 trillion. (Updated on 28 May 2021). In the first quarter of Financial Year 2021, the overall average size of the lending under microfinance was Rs. 43,434 from banks, Rs. 41,306 from non-bank financiers, Rs. 35,223 was from Non-banking Financial Companies (NBFCs) and Rs. 39,637 for the entire sector.

4 Research Methodology

This study is based on primary data collected by the researcher from the city Kotdwar of Pauri Garhwal district in Uttarakhand. The sample drawn from this population was "random", wherein both male and female participants who are engaged in farming and allied activities with the help of agricultural loans and microfinance loans were targeted.

In total of 127 respondents were randomly selected. These respondents were microfinance beneficiaries. This survey is totally explanatory in nature rather than exploratory, wherein, we are trying to understand how microfinance among the farmers has been helpful in promoting sustainable development and green development in the fragile ecology of the "Bhabhar" ecosystem. The researcher prepared an "interview schedule" because literacy rate is moderate for the selected population, and hence, most respondents are unable to understand questions in English.

For analysis of our available data, Statistical Package for Social Science Software (SPSS) and simple statistics have been used. To find out the relationship between the different variables, "chi-square test" was used. For describing characteristics of

the sample, simple percentages were calculated. The main ground of the conversion of quantitative data into numeric form, as a percentage was calculated by using the given formula-

1. $P = F/N * 100$ in which
   P = Probability
   F = Frequency
   N = Number of examinee
   100 = Constant
2. $\chi^2 = \sum(O_i - E_i)^2/E_i$ where
   χ^2 = Chi-square
   O_i = Observed value
   E_i = Expected value

In order to test the consequences of the result, the value which is calculated by the chi-square was compared with the tabulated worth at a provided level of freedom. After the calculation, the value of chi-square was more than the tabulation value, which is assumed substantial.

Building connection with people helped researcher in collecting primary data easily.

5 Results and Discussion

5.1 General Information

According to Table 1, 29.92% of the microfinance beneficiaries have incomes between Rs. 150,000 and Rs. 300,000, while 43.30% have annual income between Rs. 300,000 and Rs. 450,000. An annual average income of remaining 26.77% is between Rs. 450,000 and Rs. 600,000.

On the other hand, 14.17% of microfinance beneficiaries cultivate 21–30 bigha of land for the crop production, 38.58% of the microfinance beneficiaries cultivate 11–20 bigha land for the crop cultivation. 06.29% of the beneficiaries cultivate 31–40 bigha for agricultural production and a large 40.94% of the beneficiaries cultivate 1–10 bigha of land for crop production.

The general observation shows that the condition of the farmers in Kotdwar bhabhar is quite well as they have access to good house holdings, education, clean water, health facility, etc., which are important indicators for quality life.

Table 1 Demographic table

Category	Frequency	Percent
Age groups		
18–27	11	08.66
28–37	14	11.02
38–47	55	43.30
48–57	42	33.07
58–68	05	3.93
Total	**127**	**100.00**
Family type		
Nuclear	54	42.51
Joint	73	57.48
Total	**127**	**100.00**
Marital status		
Single	78	61.41
Married	49	38.58
Total	**127**	**100.00**
Educational status		
Illiterate	12	09.44
High school	16	12.59
Intermediate	60	47.24
Graduate	39	03.70
Total	**127**	**100.00**
Annual income (Rupees)		
1.5–3.00 lakhs	38	29.92
3.00–4.5 lakhs	55	43.30
4.5–6.00 lakhs	34	26.77
Total	**127**	**100.00**
Cultivated area (1 Bigha = 1.52 ha*)*		
1–10 Bigha	52	40.94
11–20 Bigha	49	38.58
21–30 Bigha	18	14.17
31–40 Bigha	08	06.29
Total	**127**	**100.00**

Source Primary data

5.2 Major Crops Cultivated

Agriculture production in India is dependent on rainy season and so is in Kotdwar. Farmers mainly devote themselves to produce Rabi crop wheat in addition to other crops like mustard, potato, mango, guava, litchi, etc., that can generate an additional source of income. This is done to diversify the debt risk and improve the standard of living.

5.3 Sources of Irrigation Water

For irrigating the farm, 76% of the microfinance beneficiaries use canal water. Remaining 9% depend on tube well water to irrigate their farms. Overall the large proportion of selected population uses canal water to irrigate their agriculture land. Quite a few people also depend on rainfall to irrigate their seasonal crops.

In our research, 81% of the beneficiaries have canal as a source of irrigation, and the remaining 19% have the luxury of tube well water too. Canal water is the artificial passage to carry water to every field of agriculture for irrigation. Canal distributes and diverts water through proper irrigation system locally called as "guls" and "kuls" and is used for many purposes other than agricultural irrigation.

5.4 Response on Microfinance Loan Term

Among the examinee, 38% of the people used agriculture term loan for the duration of 1–7 years, while other 27% of the examinee used agriculture loan for the duration of 9–12 years which is a medium term loan. Remaining 23% of the examinee used loan for 12–15 years as long-term loan without the hidden charges and is the longest period of the loan disbursement according to the data.

According to the Agriculture Audit Stabilization during last decade, loan taking capacity has increased drastically. The loan amount went up to Rs. 8.34 Crore in Zila Sahkari Bank Ltd. Kotdwar, Garhwal.

The motive of taking microfinance loan is to the increase income for better living. Eligible farmers have tried to better their standard of living by establishing the agro-based units in the different rural areas. The main purpose for agriculture loan and microfinance is to purchase the better quality seeds, pesticides, fertilizer, equipment, tool machines. According to our data, 23% beneficiaries used the microfinance loan to buy seeds and fertilizers; on the other hand, 27% of the people used loan to buy seeds and pesticides and 62% of the people took loan for purchasing the equipment and machinery, while 5.8% of the beneficiaries took loan to buy livestock (buffalo, cattle, and poultry).

5.5 Microfinance Loan and Allied Activity

52% of beneficiaries find that impact of microfinance loan on allied activity is high. Other 38.8% beneficiaries find the effect of loan as having medium impact on their allied activities. Only 9.2% of the beneficiaries do not find any affect of loan on allied activities.

5.6 Microfinance Loan and Health

Through microfinance ventures, the farmers have increased their income and can easily access medical facility compared to financial situation before. Among the respondents, 47.6% have admitted a good impact of loan on their health condition, 41.3% of the beneficiaries have admitted having an impact to some extent, and 11.10% of the examinees are not effect by the loan and are in a same condition as before.

In past, the beneficiaries were not able to have access to medical facilities due to high rate of health services and lack of medical services nearby. Now, these beneficiaries are able to have access to health facility and can reach good medical center.

One of the government's primary concerns is the health and to improve the condition of its people. For this, the government provides hospital and doctor services in rural areas. 92.9% of the beneficiaries have access to local medical center in the geographic region and remaining 7.1% of the beneficiaries do not have medical center in their area hence, they have to travel to the next place for accessing medical services.

5.7 Microfinance Loan and Market Access

Transport is one of a critical aspect with regards to farmers approach to markets for economic purpose. One of the schemes extends facility to buy mode of transport. 53.4% of the beneficiaries have a positive impact of loan through which they could buy the transport conveyance to transport their crops to market. 26.7% of the beneficiaries cannot utilize funds for transport vehicle. Remaining 19.9% said that microfinance has not had any impact on purchasing any mode of transportation. Many farmers rely on rented or private modes as these come at a cheaper rate. On the other hand, the farmers use their loan for purchasing agricultural equipment, transportation rentals, and even personal vehicle like cycle, bike, and tractor.

Before the agriculture loan, farmers have access to rented and private mode of transportation among which 38.5% of the examinee has their personal mean of transportation. In Kotdwar, there are several business men who provide transport services

Table 2 Pearson chi-square, likelihood ratio and linear-by-linear association

	Value	Df	Asymp. Sig. (2-sided)
Pearson chi-square	47.638[a]	4	0.000
Likelihood ratio	51.526	4	0.000
Linear-by-linear Association	07.208	1	0.006
N of valid cases	127		

[a] 2 cells (24.2%) have expected count less than 5. The minimum expected count is 3.67

to the farmers to deliver agriculture products to markets. After the agricultural loan, the major part of the examinee 80.30% went for their personal mode of transportation and remaining 19.7% of the examinee still go for the private source of transportation after having the agricultural loan.

5.8 Microfinance Loan and Household Welfare

Microfinance helps the poor section of our society in overcoming the financial obstacle to enhance the household welfare. From the data, it shows that 52.30% of the beneficiaries have a direct and large impact of loan on the household welfare. Meantime 32.80% of the sample found loan impact to some measurable degree and remaining 14.90% of the beneficiaries do not find any change in the household welfare through microfinance loan.

6 Hypothesis Test

H1: Microfinance has increased the income level of small farmers in Kotdwar Bhabhar (Table 2).

The Pearson chi-square indicates that the relationship between the two variables (i.e., microfinance and income) is significant. Microfinance loan programs have significant impact on farmer's income.

7 Conclusion and Recommendations

Microfinance is the means to build the block of assets that can generate income and improve the standard of living of the borrowers [13]. It addresses the restriction in agriculture sector through which small farmers are able to meet their demands for

allied activities economically [14]. It provides various opportunities for borrowers to improve their standard of living, as well as, increase their income and have some financial stability. It is concluded that the financial institution or the informal sector of microfinance should reduce the interest on agriculture and allied activities loan through which every small farmer can avail the basic facility and lead the progress for rural economic development.

It is socially and economically a source for development of the farmers [15]. Through microfinance farmer is able to have basic necessity from household to market. Farmer is able to purchase land for agriculture as well for building house and are able to educate their children in private schools as well. Today, health of the farmers is improving by having medical facilities in remote areas of Uttarakhand [16].

Microfinance increases the growth of farmers by promoting investment and also helps other farmers to live decent life by giving them work. It should be noted that because of moderate literacy level, the farmers are not able to optimize profits as their technique and management skills need to be worked upon. Government should provide education programs through which the farmers can be guided to increase their productivity and can maximize profits.

Microfinance lets the poor people to use funds and generate additional income. In Kotdwar, 5.00% of the total land area is used for agriculture. Agriculture practices are being lost because youth does not want to engage in agriculture, and old farmers are not able to deal and access new markets and new policies initiative. It can be concluded that extending land uses and removing intermediaries can improve the linkages toward the market and can save a part of income to reinvest.

Improvement in credit access, new technology, applying best practices, developing financial edge of the farmers can lower down their costs and increase revenue. Farmers should make portfolio in which the input price and output price should be considered.

Farmers should better their relationships with each other and develop forward and backward linkage to improve efficiency and effectiveness of their work [17–20].

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Chapter 53
Animal Accident Prevention on Railway Tracks Using Convolution Neural Network

Sandeep Khatri and Jasraj Meena

1 Introduction

Railways are a major contributor in the economy of this country. It has been so since last few years as it has expanded and provides energy efficient and cost-effective methods of transporting goods and passengers than other mode of transportation. This method of transport if used judiciously can meet the global efforts to reduce the emission of greenhouse gases, which in turn can help achieve goals set by the climate change convention. Countries have decided keeping in mind the advantages of this mode of transport that it would be wise to increase its share in comparison with other modes of transport [1]. But as with all the other good things there comes the disadvantages, railways being expanded has also covered wildlife area that has disturbed the harmony of the ecosystem. There is a need of assessing the railways effect on wildlife and solutions to keep the animals as unaffected as possible from this mode of transportation.

However, as with many other economic endeavours, railways have environmental impacts ranging from several forms of pollution to wildlife mortality. Therefore, a careful assessment of railways' impacts on nature and of mitigation measures is in order. Animal death is becoming a major concern day by day in the whole world because it upsets the ecological balance and in some cases, even species are endangered. The International Union for Conversation of Nature (IUCN) has already given the Indian elephant an endangered status [2]. Due to space requirements for living, farming and transportation, much of the forest has been cleared. Due to transportation needs, there are a lot of roads and railways in/near the green area or forest areas. These trails usually pass through a lot of forested areas and thus pose a danger to

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wildlife. The rushing little animals are alert enough to act whenever they feel and realize the dangers of the trains. However, large animals like the elephant cannot save themselves and thus end up losing their lives. Many researchers have studied the statistics of animals killed in train collisions over the past few years as well as the measures taken by the Government of India in handling the issue thoroughly [3].

The relationship between the railways and wildlife is analysed to know the different impacts of railways. In a study, it is found that mortality is one of the major impact of railways on wildlife. The other impacts include habitat loss, migration and disturbance in their daily life. The irregular traffic flow is found as the reason of most number of accidents.

Several larger mammalian species have been killed in accidents with trains which includes rhinoceros, lion, leopard, tiger, sambar deer, gaur, sloth bear and nilgai [4]. The most affected animal of all is, the Asian elephant, and irony is that it is also the mascot of Indian Railways. Railway tracks pass through wildlife in states of West Bengal, Odisha, Kerela, Assam, Uttarakhand, Jharkhand and Tamil Nadu, where in the past 20 years, 200 elephant has died due to accidents [5].

The need for placing the system in place to prevent these accidents have never been more clear than before also keeping in mind the cost. The objective of this paper is to provide a light-weighted convolution network model to detect the animals on track with the help of mounted cameras on specific locations in wildlife. There has been many researchers working to make the process of object detection efficient. Advance systems than the proposed network exist but due to its low-computation cost, it can be easily used at the site. The proposed method contains less layers and it does not only identify elephants which is the major concern of this paper but also other animals as to provide multi-label classification.

The paper is organized as below:

In Sect. 2, previous work on preventing animal accidents on railway tracks is presented. Some research has been advantageous in progressing towards the solution while some have shortcomings. In Sect. 3, proposed method is presented. It also presents the CNN model used for the classification of animals on railway tracks.

Section 4 ponders on results and discussions about the difference between the performance of the proposed model and three transfer learning models. It also contains information about datasets used. Section 5 concludes the paper with benefits if the proposed system and also discusses future work to be done to solve this problem.

2 Literature Review

The term accident itself represents a wide range of consequences. Railway accidents cause serious repercussion in terms of damage to the property of railways, hindering the movement of trains and damage the life of humans and animals. These consequential train accidents are becoming one of the major factor to the population of animals residing in the wild. The scholars have tried to reduce these accidents by introducing

state-of-the-arts method based on different technologies. There had been many solutions in the past to eradicate this but with less technology to implement it. Starting solutions included wildlife exclusion fencing [2], but it was detrimental in two ways, first, it was not cost-effective and second, exacerbate low-habitat connectivity.

There was another approach to use different warning signals to sway the animals away. In the proposed method, train warning signals, consisting of flashing lights and bell sounds emitted in the 30 s preceding the arrival of the train, that animals can learn to associate with the arrival of the train [6].

The traditional methods required more human intervention with little success. Hence, with the boom in technology with a large production of sensors and also advances in image processing using machine learning, new solutions were found. For prevention of animal accidents, many infrastructure solutions can be found like most basic solution is to build a fence around the track but it is not possible as it will hinder the movement of animals affecting the nature. Building bridges in forests so that animals can cross easily. These solution does not have any large impact on the problem so more advanced options are pursued.

In [7], cameras are used to monitor railway lines as they run along the track. The cameras, also known as observing units, must be placed in locations where they can easily cover the entire track while keeping the cost as low as possible. The study demonstrates how to position cameras using basic geometry and trigonometry principles.

The use of machine learning in conjunction with IoT can help to reduce these accidents. One study demonstrates this, as [8] proposes wireless sensor network-based hierarchical wild animal detection and notification system, with sensors deployed on the tracks, i.e., detection nodes, which then pass the information to the relay node. The notification is then forwarded to sink nodes by the relay node. Sink nodes warns the driver by notifying; whereas, relay nodes control all the detection nodes or sensors.

According to one study, the use of infrared sensors, also known as break-the-beam devices, reduced accidents by up to 80% during the tourist season in the USA. Panthers were the animals studied in this study. It was more beneficial during the tourist season because the drivers drove faster.

These sensors are typically the same as those found in automotive systems, and they include active sensors like LiDAR, radar and ultrasound, as well as passive sensors like stereo, mono RGB cameras and thermal cameras. Various sensors were analysed in terms of the use of sensor types based on weather/light conditions, as well as the extent of detection distance and cost. All sensors are featured, with some limitations under realistic practical conditions, such as limited use of LiDAR and ultrasound sensors in heavy rain, standard cameras not being able to be used indoors or at night and low-contrast thermal images in high environmental conditions. Regardless of their limitations in real-world applications, active sensors are used for precise and direct measurements of obstacles distance. The advantages of cameras over active sensors are their high data density and visual information, which

allows for the detection of object boundaries and classification of these objects [9]. Geiger et al. [10] provide an overview of on-board sensors for obstacle detection in railways. Advances in computer vision can be effectively utilized to avoid a train-animal collision. Many traditional CV methods and AI methods were used to solve this problem.

Given that the primary goal of object detection in railways is to detect objects on and near rail tracks, almost all traditional CV methods include rail track detection in order to identify the image region of interest (ROI) within which the search for objects that are dangerous to the train should be conducted. Traditional CV obstacle detection algorithms are, therefore, mainly designed to find the rails up until an obstacle.

In recent years, advances in neural network technology have enabled significant improvements in object detection based on AI in road traffic applications, but rail transport research has lagged behind. However, in recent years, the interest in AI-based apps has been increasing such that it can be used in railway systems in order to avoid the use of "hand-crafted" features like those used in traditional CV methods and instead to adaptively extract image features via convolution neural network (CNN) structures. The results obtained in other transportation sectors, primarily automotive, have aided the development of AI in railways. However, unlike the automotive field, where large-scale image datasets such as KITTI [11] are available for the efficient evolution of effective object detection models using road scene images, the railways field has, to the best of our knowledge, only one relevant dataset, which is limited in scope. RailSem19, which was introduced in [12], is the first publicly available dataset designed specifically for semantic railway scene understanding. RailSem19 contains images captured from the perspective of a train and a tram, as well as specific annotations collected for a variety of tasks, such as the classification of trains, switch plates, buffer stops and other objects commonly found in railway scenarios, but not anomalies and obstacles. In the absence of relevant public datasets, the majority of AI-based methods for rail tracks detections and obstacle detection in railways are based on custom made and non-public datasets.

The use of these algorithms can be done only if the images captured can be used efficiently. FoxMask, a new tool for automatically detecting presence of animals in short spans of camera images, was developed by researchers in [13]. FoxMask detects moving objects (most likely animals) with the help of foreground and background estimation algorithm. Further work is done to make the process of capturing the images efficient. A method was proposed in [14], a fast algorithm for image selection without motions is designed. Then, in order to align uneven illumination, the images are processed by a modified Multi-scale Retinex algorithm. Finally, using an adaptive threshold, the background is subtracted from the incoming image. The above method provides animal detection with high probability. Sensors were also used to further speed up the process. Raspberry Pi3 was used in the wildlife environment for detecting wild elephants using image processing [15]. The method was based on the idea of working the model on the location rather than working it on the central hub.

Transfer learning which is going to be discussed in this paper has also been used for the detection of elephants on railway tracks. The proposed end to end system works on a live video surveillance where deep learning strategies are used. This model gives accuracy of about 98.7% and also improves on resource management which is crucial in real-time scenarios [16].

3 Proposed Method

The proposed method consists of a camera placed at a critical location in wildlife where most number of accidents occurs. The feed will be sent to a central server where the model will detect animals on tracks. CNN model used in the paper has five convolution layers and same number of pooling layers. Batch normalization is used after each layer to improve training efficiency. The output is then flattened, and classification is performed using a fully connected layer. Data augmentation is used to ensure that the model is translation, rotation and scaling invariant. Input size of image of (224, 224, 3) is standardized. A batch size of 32 is used for both training and testing. The model is trained for a total of 12 epochs. The SGD optimizer, which is similar to the gradient descent algorithm with momentum, is used. Because the SGD optimizer limits vertical oscillations, the algorithm can take larger steps in the horizontal direction and converge faster. As a loss function, categorical cross entropy is used. It is a measure of the model's accuracy in predicting the desired object in the image. The "Softmax" function is used for classification. Hence, it is used to categorize the image with classes elephant, rhino or buffalo. Drop out is used to limit the parameters in fully connected layers. After image is classified with an animal, an alarm is triggered on the train after which first action would be to slow down the train and then act according to the situation, i.e., either stop the train or keep honking to sway the animal away from tracks (Fig. 1).

The proposed architecture has very less number of parameters compared to the other models used by transfer learning in this experiment. The models used are VGG16, MobileNet and InceptionV3. These models have large numbers of layers hence provide greater accuracy than the proposed model. But at the same time other model are computationally expensive than the presented model. The accuracy shown by the proposed model is 96% which is lower than the average accuracy shown by the three models used, i.e., 98%.

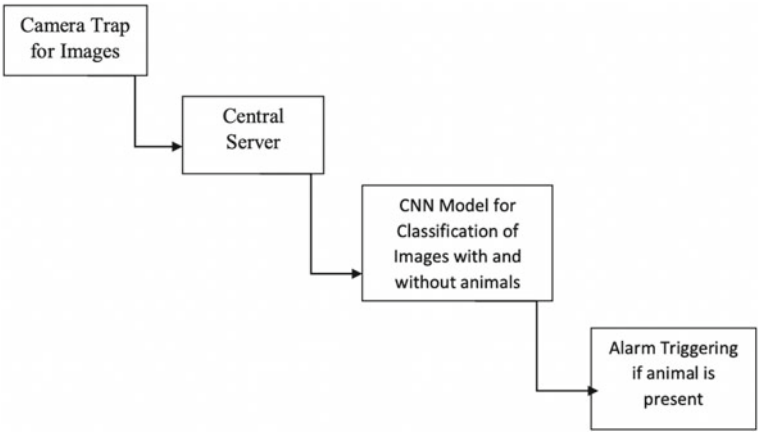

Fig. 1 Proposed accident prevention system

4 Result and Discussion

The following experiment was conducted on images of animals such as elephants, rhino and buffaloes. The main reason to select these three animals is the statistics which shows that the number of accidents on railway tracks are common for these three classes. Two datasets are used [17, 18], for the images of elephants, rhino and buffalo. This paper is based on prevention of accident on railway tracks and as there is no public datasets available for railway track images, the work is done considering the fact that cameras are installed in wildlife so there is less need of semantic understanding of tracks and hence animal detection is done using CNN. Images of elephants are easily accessible and highest number of accidents also belongs to this class of animal; therefore, large percentage of dataset belongs to this class. In total, there are around 2500 images considered. There is less data to be tinkered with so process of data augmentation is used, in which more images are created by applying shifts, rotations and many more transformations to the original image. Both datasets are available on Kaggle for public use and some work has been done on them for animal classification.

Transfer Learning—it is defined as a process where learning of one model is used on another similar problem, i.e., a model trained on related dataset can be used to solve same looking problem [19]. It is a deep learning strategy. The layers in the model trained can be used in making a new model which will be trained on the problem. It is advantageous as it lowers the generalization error and also shortens the time of training which is efficient in terms of computation.

The transfer is done by using the pre-calculated weights which will be given to new model to train on. It is useful if the previous model has more labelled data than the new model, which will give more accuracy. Similar model is used for transfer learning because of the same context it provides.

Table 1 Model comparison

Model	Layers	Parameters	Accuracy (%)
Proposed CNN	7	1,706,083	96.72
VGG16	41	21,138,243	98.58
MobileNet	28	3,360,451	98.36
InceptionV3	48	34,916,396	98.40

In this paper, three transfer learning models are used for comparison, they are VGG16, MobileNet and InceptionV3 (Table 1).

In the experiment done, four CNN models are tested. The proposed CNN model achieved accuracy of 96.72%, and also advantageous as it is light-weighted in comparison with other models. It contains about 17 lakh parameters which makes it computationally efficient. Transfer learning-based models have performed better with an accuracy of 98.40% accuracy of InceptionV3 and MobileNet with accuracy of 98.36%. The VGG16 model gives the accuracy of 98.58%.

Figures 2, 3, 4 and 5 show the comparison between the models:

Evaluating all the models show that VGG16 would be the best serving model. The datasets used in the paper does not contain any images on railway tracks on the basis that cameras are pointing at tracks only. The datasets can be integrated with more images to make the system efficient. To work this system in real time will require more working on the dataset. The model is efficient enough to detect elephants on tracks but more images would be required for Rhino and Buffaloes.

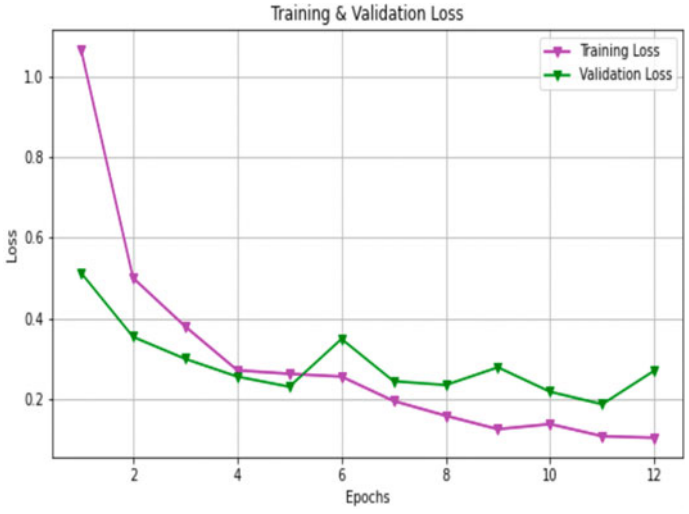

Fig. 2 Proposed model training and validation loss

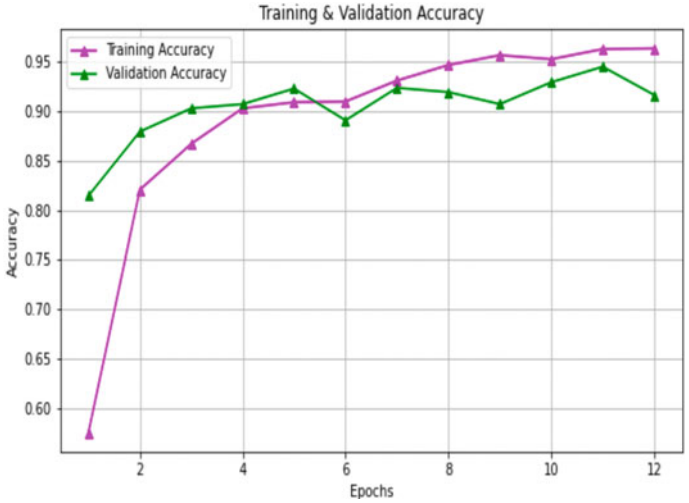

Fig. 3 Proposed model training and validation accuracy

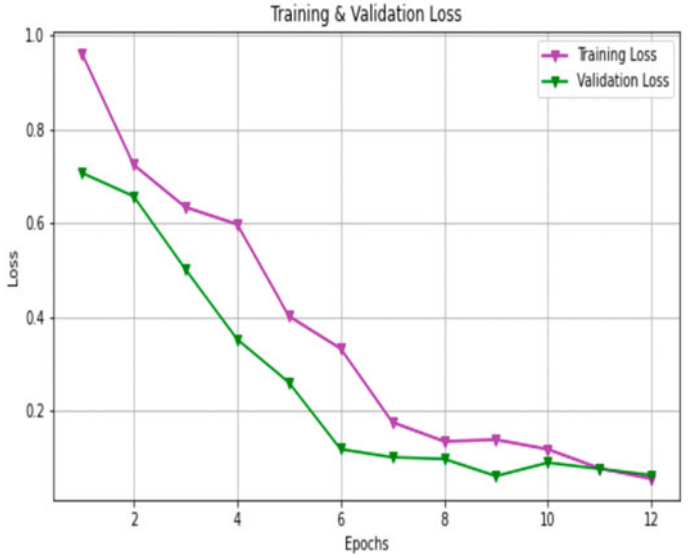

Fig. 4 VGG16 model training and validation loss

5 Conclusion

As a result of human intervention in wildlife, the consequences are visible in the form of animal extinction. A lot of effort is being made these days to conserve animals, and advanced technology can certainly help in this regard. Artificial intelligence and the

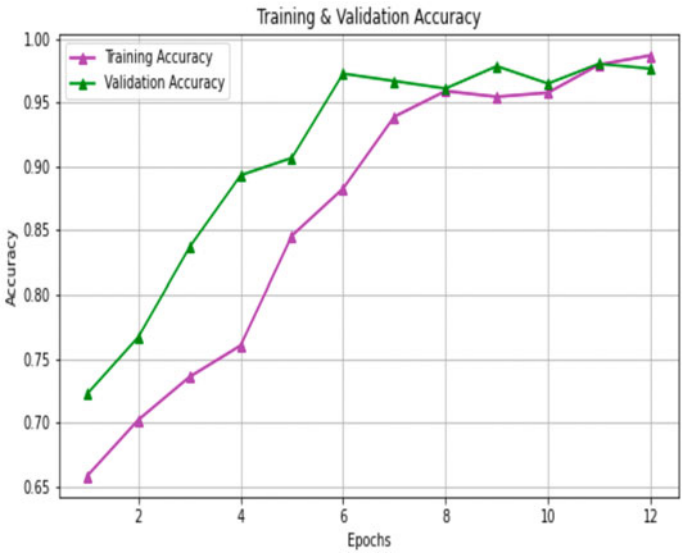

Fig. 5 VGG16 model training and validation accuracy

Internet of Things together can do a lot in this direction. This paper also contributes to the solution for prevention of animal accidents on railway tracks. With the proposed model, three more models based on transfer learning were used and compared. The accuracy and efficiency of these models were shown in result. It is shown that all three models almost gave the same accuracy.

The future prospect includes the intervention of more sensors to calculate the distance of the animals from the tracks to give more accurate information. The model experimented on can efficiently be used in wildlife.

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Chapter 54
Post-Pandemic Effect in Construction Industry in India and Its Remedial Measure

Mayank Dave and Deepanshu Solanki

1 Introduction

Severe acute respiratory syndrome Corona virus (SARS COV) was first detected in Wuhan, China in the month of December 2019. The disease was spread worldwide and was declared as pandemic by World Health Organization, first case in India was reported in January in the towns of Kerala in the medical students who had returned from Wuhan. Prime Minister of India announced a nation wise lockdown on the 24th of March 2020 of 21 days after 14 h of janta curfew. The nation wise lockdown created a major problem amongst the construction sector. Major problem was migration of labours who were rushing to the native towns. Lockdown was increased till 30th of May in parts and after 30th May, it was further extended in only containment zones. Mass movement of labourers were seen, it was also described as Country's largest mass movements since the partition. During pandemic, there was shortage of construction material supply, labourers were migrating, works were stopped and all in site works with major projects were stopped. Globally millions of people lost their jobs and many companies even refused to even pay salaries to their employees. Hence, it is very crucial to investigate that what was the impact of this pandemic to the construction industry. Due to this virus, major projects were stopped and India's GDP was on the back foot. People lost their jobs and many were unemployed because companies started to kick off their employees. Major effect was seen in the construction industry and industries related to it. Raw materials being produced were stopped and transportation industry was also on their knees. This article explains that how corona virus affected the India's economy and how badly construction sector was shaken, adverse effect on employees and labourers.

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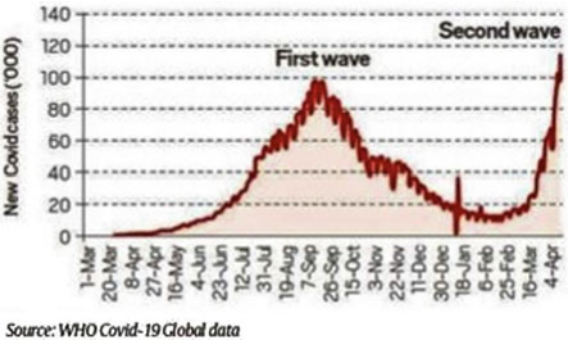

Fig. 1 COVID infection in India. *Source* The outlook

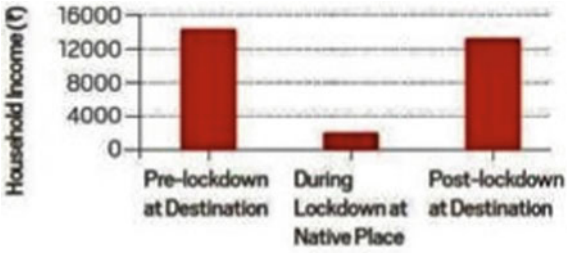

Fig. 2 Impact of the pandemic on the migrant's household income (weighted average of six states). *Source* The outlook

Further article gives the remedial measures to be implemented in the near future and preparation for any kind of pandemic in future of the Country (Figs. 1 and 2).

The first graph indicates the severity of the second wave of the virus which has already topped the maximum inflection point of the first wave indicating more damage to the economy than last year.

2 Impact of Corona Virus on GDP and Construction Sector

The construction industry in India holds the 8% of India's GDP and is second largest after agricultural sector. There are several industries which are dependent on the construction industry like manufacturing equipment industry. In the reports published and from the sources of CREDAI, there were 20,000 ongoing projects in the Country pan with workmen of around 8.5 millions. After the lockdown of around 70 days, led to migration of 1 million workers to the villages and 2 million were staying in the reliefs camps. India's GDP shrank to 24% for the year 2020–21. The impact of the pandemic on India's construction industry was estimated to Rs 30,000 crores everyday and the investment was reduced to 15%.

KPMG has analysed and estimated the impact on investment and the employment with the gross value added. The investment in construction sectors is estimated to reduce by 13, 14, 29 and 30%.

2.1 Mismanagement

In the construction, various materials are required but due to lockdown, they did not reached the sites. Due to non-transportation of vehicles with the require material did not arrive, hence the works were stopped. It severely affected the work life of transporters and also who were to bring materials in their vehicles. It hampered the construction works as factories made the material but it was not sold further, hence loosing lot of money.

2.2 Labour Mismanagement

Due to stoppage of site, workers were workless and were left with no option than to migrate. Transportation was banned so they could not reach the work side, also in the case of short projects, no arrangements were made for the labour class to work, and hence, they migrated to their villages and relief camps.

2.3 Financial Complication

Companies involved in projects sector as well as companies involved in the material construction sector both faced huge loses. Goods which factory produced were not able to reach to the sites and hence incurred big loss. GDP was badly affected due to this. Small-scale contractors also faced huge losses, their equipments and machinery were of no use and they had to pay EMI's without any output, small sites were also stopped and a result there was financial loss to them.

2.4 Unemployment

Companies due to non-profit, started to snatch the jobs of the employees and no plan was given from Government and these companies suffered huge loss with no salaries to pay. Large-scale unemployment was generated, Families of these unemployed workers faced lot of hardships with situation worsening further.

2.5 *Force Majeure*

Central Government recognized COVID as force majeure event under RERA act2016. This resulted in RERA registered projects up to six months giving little bit of relief (Figs. 3, 4, 5 and 6).

Second Wave. No nationwide lockdown was announced in this wave which came in March 2021; however, states implemented lockdown on their part. This wave became the worst COVID-19 surge in the world, young bloods were affected mostly

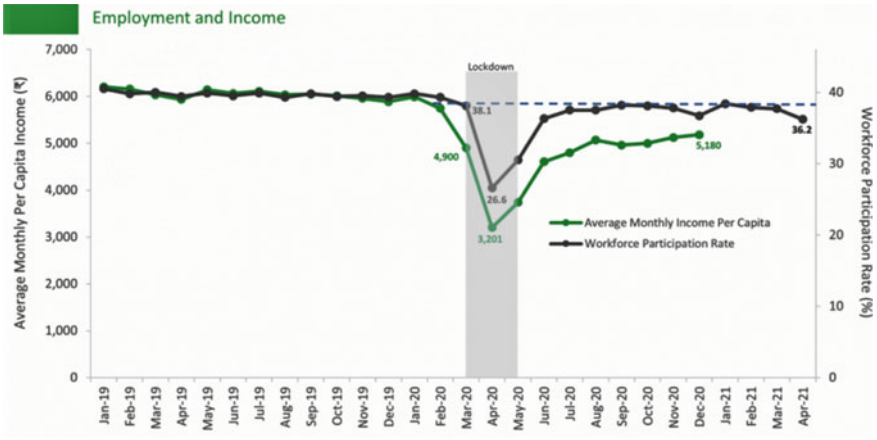

Fig. 3 Average monthly per capita income

Fig. 4 Graph for interaction, income loss and employment loss

Fig. 5 Labour migrating in lockdown. *Source* The Financial Express

Fig. 6 Crowds of labour ready to migrate at Pune station. *Source* The Financial Express

and India's national healthcare system was on its knees. With no beds, no oxygen's and no medicines for any individual were a major problem and havoc was created. Labourers which somehow managed to get back to their work were once again migrating as they did not know the duration of lockdown. Court intervened and ordered Government for their shelters but the numbers were too fewer. Projects in the urban areas like building construction felt a great impact due to restrictions and reverse migration of labourers. The construction sector which somehow managed to grow in last quarter with expected rate of 8.4% fell to contraction to almost 29%. Furthers projects were stopped and hence more loss is expected till the end of this

second wave. Major problem raised in this pandemic was mucormycosis, i.e., black fungus to the patients having diabetes and COVID-19, Indian Government and State Governments declared this disease as pandemic. Picture gets clear in the construction sector and sectors related to it only after the end of this dangerous wave.

Remedial Measures. The uncertainty in construction sector after the second wave, some remedial measures can revive the construction sector:

- Vaccination of all the project workers, officers, labourers and their families on the priority basis.
- After vaccination also, all the steps should be taken into measure to maintain distance, workers can work with shifts to avoid rush. In offices also sufficient distances should be maintained.
- Sanitizers and use of mask can lower down the transmission of disease.
- One large screen with Internet to be arranged for the children of labourers so that their studies do not get affected.
- Provisions should be made by sanitizing the work place every day and keeping the proper hygiene, ongoing and incoming materials should be thoroughly sanitized.
- As suggested for labourers, alternate duties for workers in offices at site would give better results.
- Governments help in allowing trucks with goods in the ongoing projects and proper permit should be issued and proper awareness should be made about pandemic and wearing of masks, using sanitizers.
- Allowing labourers, workers and officers only after thermal scanning, and level of oxygen can be checked using oximeter. Routine alternate check-ups should be regularized by company.
- Workers who can work from home using different software can work easily from their home.
- Government should provide financial assistance to this sector and to resume the work of this sector immediately.

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Chapter 55
Organic Modifiers—Chemically Modified Dimethyltindichloride Organic–Inorganic Hybrid Product: Design and Antimicrobial Activity

Komal Soni, Sanjiv Saxena, and Asha Jain

1 Introduction

An important dimension of the material chemistry is the design and development of organic–inorganic hybrid materials. The hybrid materials [1–4] have developed rapidly due to the possibility of expanding the properties of pure materials. Smart materials or intelligent materials or responsive materials are also designed and highly engineered materials. The reaction of these materials to their environment is smart in nature [5, 6]. The development and use of smart materials have increased many folds in the last few decades owing to their numerous technological applications [7, 8].

These designed materials possess important framework structures and various technological applications. These designed materials demonstrate potential antimicrobial activities [9, 10].

The world has witnessed many advancements in the field of science and technology in the last few decades. The use of computational techniques to elucidate the structure and to study the electronic properties of chemically modified and designed hybrid materials has received attention of the researchers [11, 12]. Some important properties of these designed materials such as optimized topologies, optimized energy, HOMO–LUMO energy gap, dipole moment, optimized bond length, bond angle, etc., can be studied, very efficiently [13–15].

The use of metal–organic frameworks (MOFs) has increased many folds owing to their interesting molecular architecture and large number of applications in semiconductors [16], photo-luminescent materials [16], ceramics [17, 18] catalysis [19–22], etc.

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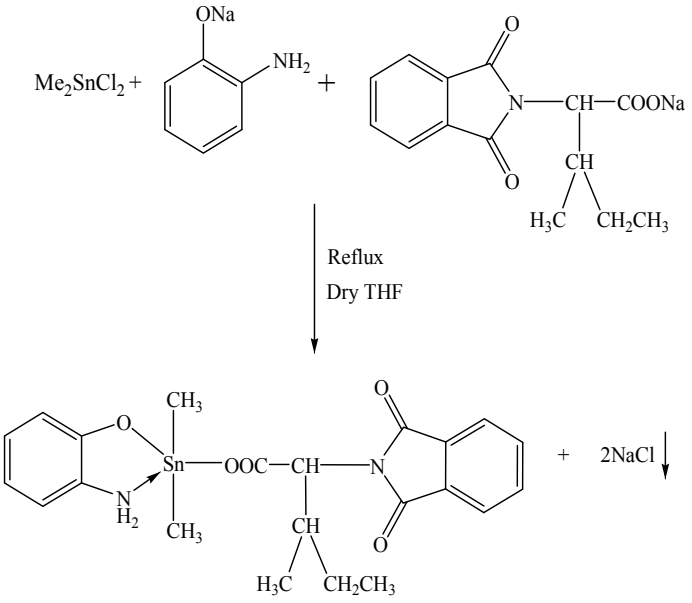
In continuation to our research work for the preparation of hybrid complexes of various metals, we hereby report the preparation, structural elucidation and antimicrobial activity of organic modifiers—chemically modified dimethyltindichloride organic–inorganic hybrid product. This designed material was generated by the reaction of dimethyltindichloride with 2-aminophenol and N-phthaloyl isoleucine.

2 Results and Discussion

2-aminophenol and *N*-phthaloyl isoleucine—chemically modified Me_2SnCl_2 organic–inorganic hybrid product of the general formula Me_2SnLL' (where LH = 2-aminophenol, C_6H_7NO and L′H = $[\overline{C(O)C_6H_4C(O)}NCH(CH(CH_3)(C_2H_5))COOH]$, *N*-phthaloyl isoleucine) was generated by the interaction of dimethyltindichloride with sodium salts of 2-aminophenol and *N*-phthaloyl isoleucine in equimolar ratio in boiling dry tetrahydrofuran (Scheme 1).

The colour of this synthesized complex is black and is sparingly soluble in chloroform and benzene. Repeated washings with pet. ether were used to purify this product. Plausible structure of this moisture sensitive product has been proposed in accordance with the spectroscopic and mass data analysis.



Scheme 1. Preparation of organic modifiers—chemically modified dimethyltindichloride organic–inorganic hybrid product

2.1 Spectroscopic Studies

IR spectrum. A comparative analysis of the IR spectra of the two different organic modifiers and the IR spectrum of the organic modifiers—chemically modified dimethyltindichloride organic–inorganic hybrid product furnished important information about the structure of newly designed hybrid material.

In the infrared spectrum of chemically modified dimethyltindichloride hybrid product, two bands appeared at 628 and 531 cm^{-1} which may be attributed to the formation of Sn–O bonds. The infrared spectrum of 2-aminophenol exhibits two bands at 3303 and at 3375 cm^{-1} which is due to symmetric and asymmetric stretching vibrations of NH_2 group. The OH stretching vibration was observed at 3599 cm^{-1} as a weak band. The absence of this band in the IR spectrum of the organic modifiers—chemically modified Me_2SnCl_2 product suggests the deprotonation of the organic modifiers. A weak band appeared at 442 cm^{-1} which is due to the existence of Sn–N bond.

The infrared spectrum of organic modifiers—chemically modified Me_2SnCl_2 organic–inorganic hybrid product exhibits bands for both types of carboxylate bonding modes, i.e. non-bridging and bridging which suggested the probability of the existence of this product in two forms, i.e. monomeric structure and dimeric structure [23]. The existence of bridging carboxylate bonding in the dimeric product may be suggested with the aid of $\Delta\upsilon$ value which is 197 cm^{-1}. The existence of non-bridging carboxylate bonding in the monomeric product may be corroborated with the help of other $\Delta\upsilon$ value which was found to be 352 cm^{-1}. In the IR spectrum of organic modifiers—chemically modified Me_2SnCl_2 product the band present at 507 cm^{-1} may be assigned to Sn–C vibrations.

^{1}H NMR spectrum. The proton NMR spectrum of 2-aminophenol and *N*-phthaloyl isoleucine—chemically modified Me_2SnCl_2 organic–inorganic hybrid product was recorded in deuterated chloroform and dimethyl sulfoxide solution.

In the ^{1}H NMR spectrum of 2-aminophenol, a broad peak was observed at 8.89 ppm due to phenolic OH group; whereas, a broad peak appeared at 10.62 ppm which may be due to carboxylic OH group of *N*-phthaloyl isoleucine in the ^{1}H NMR spectrum of *N*-phthaloyl isoleucine [24]. These broad peaks were not present in ^{1}H NMR spectrum of organic modifiers—chemically modified Me_2SnCl_2 product. This indicated the generation of Sn–O bond in the hybrid complex of dimethyltin (IV). The proton NMR spectrum of 2-aminophenol exhibits a broad singlet at 4.41 ppm which may be attributed to $–NH_2$ protons. In the proton NMR spectrum of the hybrid product, this broad singlet due to $–NH_2$ group experiences some downfield shift which demonstrates the generation of Sn–N bond in the hybrid product. The aromatic proton signals were observed in the region 6.38–8.10 ppm. The CH_3 protons bonded to tin were observed as a sharp peak at 1.86 ppm.

^{13}C NMR spectrum. The carbon-13 NMR spectrum of 2-aminophenol and *N*-phthaloyl isoleucine—chemically modified Me_2SnCl_2 hybrid product was recorded in deuterated chloroform and dimethyl sulfoxide solution.

The ^{13}C NMR spectrum of chemically modified Me_2SnCl_2 hybrid product demonstrated a carbon signal at 25.84 ppm which may be attributed to –CH_3 carbon directly attached to tin. The carboxylic carbon signal of isoleucine appeared at 174.61 ppm [24]; whereas, this signal was observed at 177.78 ppm in the ^{13}C NMR spectrum of the chemically modified Me_2SnCl_2 hybrid product. Hence, in the ^{13}C NMR spectrum of the hybrid product, the carboxylic carbon signal experiences a downfield shift of 3.17 ppm which indicates the bidentate nature of *N*-phthaloyl isoleucine. The ^{13}C NMR spectrum of the chemically modified Me_2SnCl_2 hybrid product exhibits a carbon signal at 53.13 ppm due to methine carbon attached to nitrogen atom of *N*-phthaloyl isoleucine. Aromatic carbon signals of 2-aminophenol and *N*-phthaloyl isoleucine were observed as a multiplet in the region 116.18–133.94 ppm in the ^{13}C NMR spectrum of the organic–inorganic hybrid product.

^{119}Sn NMR spectrum. The tin-119 NMR spectrum of organic modifiers—chemically modified dimethyltindichloride organic–inorganic hybrid product was recorded in deuterated chloroform and dimethyl sulfoxide solution with the use of Me_4Sn as an internal standard. The ^{119}Sn NMR spectrum of this formulation demonstrates a signal at −272.21 ppm. This indicates that a penta-coordinated tin centre is present in the newly designed hybrid complex [25]. Therefore, this chemically modified Me_2SnCl_2 hybrid product may be assigned a distorted trigonal bipyramidal geometry.

Mass spectrum. The mass spectrum of chemically modified Me_2SnCl_2 hybrid product was recorded. A molecular complexity of 1.69 has been observed for this chemically modified Me_2SnCl_2 hybrid product as revealed by the mass study. The ^{119}Sn NMR data reveals the presence of five-coordinated metal centre in this product. The freshly prepared product is monomer and by the passage of time, the monomer changes towards dimeric structure on ageing.

On the basis of spectroscopic and mass data analysis, the following structures having distorted trigonal bipyramidal geometry (Fig. 1) may be suggested for 2-aminophenol and *N*-phthaloyl isoleucine—chemically modified Me_2SnCl_2 hybrid product involving monomeric and dimeric structures.

2.2 Antimicrobial Activity

Antibacterial activity. 2-Aminophenol and *N*-phthaloyl isoleucine—modified Me_2SnCl_2 organic–inorganic hybrid product—was screened for probable antibacterial potential against *E. coli* (Fig. 2). Antibacterial activity was performed at four different concentrations of sample hybrid product. Ciprofloxacin was used as standard drug for this study.

The organic modifiers—modified Me_2SnCl_2 hybrid product is active against *E. coli* at all the tested concentrations. The antibacterial activity of this hybrid product is concentration dependent and enhances with the increase of concentration [26] (Table 1).

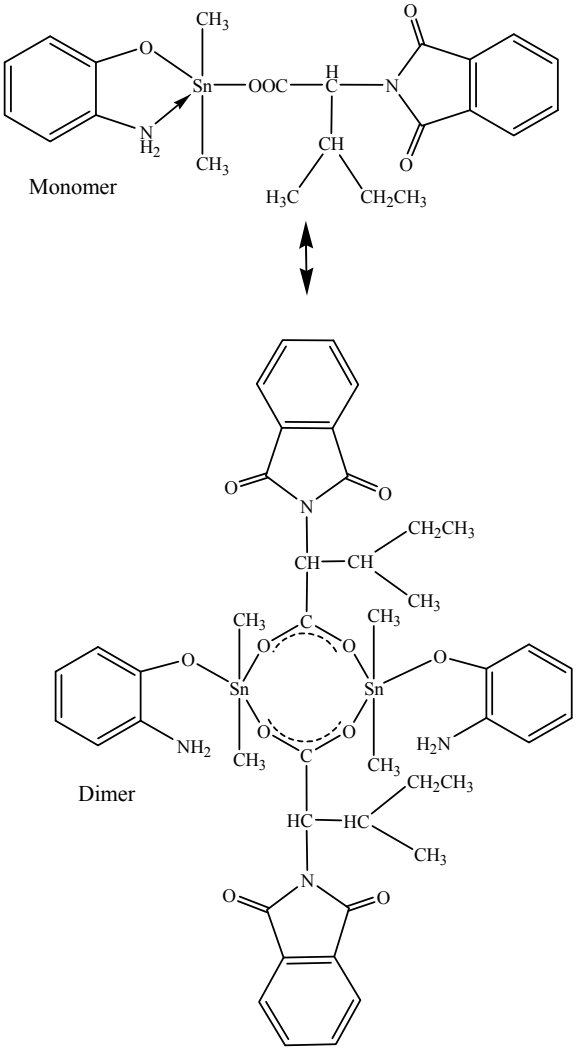


Fig. 1 Structure of 2-aminophenol and *N*-phthaloyl isoleucine—chemically modified Me_2SnCl_2 hybrid product, Me_2SnLL'

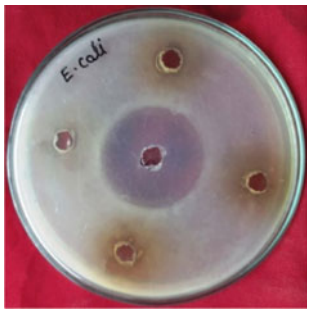


Fig. 2 Growth inhibition zone of the organic modifiers—modified Me_2SnCl_2 hybrid product Me_2SnLL' for antibacterial activity

Table 1 Antibacterial and antifungal activities data of organic modifiers—modified Me_2SnCl_2 organic–inorganic hybrid product Me_2SnLL'—against *E. coli* and *Candida albicans*, respectively

	Inhibition zone (mm)			
Concentration	20 μL	40 μL	60 μL	80 μL
Antibacterial activity	14	15	18	23
Antifungal activity	12	14	18	20

Fig. 3 Growth inhibition zone of the organic modifiers—modified Me_2SnCl_2 hybrid product Me_2SnLL'fv for antifungal activity

Antifungal activity. Organic modifiers—modified Me_2SnCl_2 organic–inorganic hybrid product were screened for possible antifungal potential against *Candida albicans* (Fig. 3) at four different concentrations.

This hybrid product was found to possess antifungal potential against *Candida albicans*. As the concentration of this hybrid product increases, the antifungal activity is found to enhance [27].

The results obtained for antibacterial and antifungal activities of this organic modifiers—modified Me_2SnCl_2 have been shown in Table 1.

3 Experimental

The whole experimental work and the chemical reactions were performed under stringent anhydrous conditions. Dimethyltindichloride and one of the organic modifiers 2-aminophenol are commercially available. The other organic modifier, *N*-phthaloyl isoleucine was prepared by following the reported procedure [28]. The solvents were dried by standard procedures. FTIR spectrum of organic modifiers—chemically modified dimethyltindichloride organic–inorganic hybrid product—was recorded in the range of 4000–400 cm^{-1} on PerkinElmer Spectrum Version 10.4.3 spectrophotometer. Multinuclear NMR (^1H, ^{13}C and ^{119}Sn) of the chemically modified Me_2SnCl_2 hybrid product was recorded in deuterated chloroform and dimethyl sulfoxide solution on JEOL-ECS 400 DELTA 2_NMR spectrometer. The HRMS spectrum of this hybrid product was recorded.

3.1 Synthesis of 2-aminophenol and N-phthaloyl Isoleucine—Chemically Modified Me_2SnCl_2 Organic–Inorganic Hybrid Product, Me_2SnLL'

$$Me_2Sn[C(O)C_6H_4C(O)NCH(CH(CH_3)(C_2H_5))COO][H_2NC_6H_4O]$$

A dry tetrahydrofuran solution of 2-aminophenol, LH [0.259 g, 2.373 mmol] and a dry THF solution of *N*-phthaloyl isoleucine, L′H [0.620 g, 2.373 mmol] were added to a dry methanolic solution of sodium [0.109 g, 4.746 mmol]. The reaction content was refluxed for about 5 h. After this, a dry THF solution of Me_2SnCl_2 [0.521 g, 2.373 mmol] has been added to this reaction mixture. Subsequently, the reaction mixture was further refluxed for 8 h. The precipitated sodium chloride [0.273 g (found), 0.277 g (calc.)] was filtered out and the excess solvent was removed in vacuum conditions. Organic modifiers—chemically modified dimethyltindichloride organic–inorganic hybrid product thus obtained has been purified by repeated washings with pet. ether. This black solid product was moisture sensitive (Yield ~ 69%).

Antibacterial activity. 2-Aminophenol and *N*-phthaloyl isoleucine—chemically modified Me_2SnCl_2 organic–inorganic hybrid product has been tested for possible antibacterial activity against gram negative bacterium, *E. coli*. Ciprofloxacin was used as standard drug for this study.

The antibacterial activity of chemically modified Me_2SnCl_2 hybrid product was performed by following the reported method [9, 29]. Antibacterial potentials have been analysed in terms of diameter of inhibition zones.

Antifungal activity. 2-Aminophenol and *N*-phthaloyl isoleucine—chemically modified Me_2SnCl_2 organic–inorganic hybrid product was tested for probable antifungal potential against *Candida albicans* by following the reported procedure [9, 29]. The diameter of growth inhibition zone may be treated as the measure of the antifungal activity of this chemically modified Me_2SnCl_2 hybrid product. The standard drug used for this analysis was ketoconazole.

4 Conclusion

The design and development of hybrid materials is an important facet of material chemistry. 2-Aminophenol and *N*-phthaloyl isoleucine-—chemically modified Me_2SnCl_2 organic–inorganic hybrid product was prepared by the reaction of dimethyltindichloride with sodium salts of 2-aminophenol and *N*-phthaloyl isoleucine in equimolar ratio in boiling dry tetrahydrofuran. Repeated washings with pet. ether were used to purify this moisture sensitive black hybrid product. This

hybrid product shows a tendency to dimerise on ageing. The existence of this hybrid product in dimeric and monomeric form is suggested. The ^{119}Sn NMR chemical shift value indicates the existence of five-coordinated tin centre in this chemically modified hybrid product. This product was characterized with the help of spectroscopic and mass data analysis. This chemically modified dimethyltindichloride organic–inorganic hybrid product demonstrates potential antimicrobial activities.

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Chapter 56
Wireless Power Transmission via Solar Power Satellite

Pinki Yadav, Mauviz Shahid, Harshit Singh, Sooraj Pandey, and Vishvajit Singh

1 Introduction

Even today half of the electricity resources wasted and according to various reports our present electrical Transmission and distribution system is only 70–74% efficient. So, it becomes necessary that we have to think alternate source to transmit and distribute the electricity and hence power transmission without using wires maybe a very good alternative for Electricity Transmission. Since it is a renewable energy resource and use of renewable energy resources are increasing day by day in future also. This will also change the world energy infrastructure. Wireless power transmission means to deliver the power to an end use device without using contact our wire. This is very old and known Technology. Wires allow devices to receive both power and also communicate with other devices. In now days wireless data applications are increasing very rapidly and hence wireless power transfer Technology has seen a very rapid change.

In wireless power transmission via solar power sat satellites are to be place in geosynchronous Orbit. These will 22,300 miles above Earth equator. Each satellite will be illuminated by sunlight all the day. These satellites will be covered with array of solar cell and the solar cell will convert sunlight from light energy into electrical energy and this will be further changed in to Radio wave frequency by transmitting antenna after that it will be moved to Earth on the receiver site. After that it will be reconverted into electricity by receiving antenna and then further it will be reconverted into electricity by receiving antenna and distributed to distribution network for use on the earth [1–3].

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In the event that paper will examine about assets of power from beginning to work now such countless assets are utilized by the changing time and the principal factor which make them best. Age of power began from wood after than it is discovered that coal is unrivaled than wood and it is utilized till numerous hundreds of years. After that oil is found and utilized as asset to create power. Be that as it may, past all assets of age of power causes some ecological factors, for example, an unnatural weather changes green House impact. At the point when coal consumes it discharges carbon kick the bucket oxide thus numerous ozone harming substances in air. These assets are not environmentally friendly power assets. Thus, time of these assets is slipping by on the grounds that these assets are that kind of assets whenever it is gone it is no more. Henceforth it gets crucial for consider the issue till these assets runs out. Just arrangement of this issue that we utilize environmental friendly power assets to create power. Thus, power age by remote force transmission by means of sun-oriented force satellite can be arrangement around there and furthermore it can most significant energy asset in not so distant future [4].

As we examined issues of ordinary force transmission by means of wire thus, considering above issue we present an outline of remote force transmission utilizing sun-based force satellite idea. We talk about microwave power transmission method in this venture. Further we will introduce significance of remote force transmission by means of sun-based force satellite. We will likewise examine benefits, detriments and difficulties of remote force transmission by means of sun-oriented force satellite idea [5].

2 Wireless Power Transmission

The meaning of Wireless Power Transmission is that transferring the energy without using any wire. It means that no physical connection between transmitter and receiver. In Wireless Power Transmission (WPT) there are using different type of principle for transfer the energy like Inductive, Capacitive and Microwave principle. Wireless Power Transfer is very useful for the electrical equipment and appliances on the other hand interconnected wires are causes hazardous. In WPT there are two sides of this system one is power source side which is connected to the Transmitter and the other side is load side which is connected to the Receiver. When source is applied on the first side of the system the transmitter transmits required amount of energy according their rating and convert the power in electromagnetic field which is a time varying in nature, then the receiver work which is connected on the load side and convert the DC to AC which is used by an electric load. After that the process wireless power transmission is done [6–9].

In the year of 1826 Andre-Marie Ampere introduced a law which ids called Ampere's circulating law, in this law showing that current produced the magnetic field [10]. After that in the year of 1831 the scientist Michael Faraday gave a statement with his law of induction that in any close loop of the electric circuit that the Electromotive Force (EMF) is equal to the rate of magnetic flux [11–13]. But the first time, this

concept was brought by Maxwell and Hertz. In 1873, It was explained by Maxwell that the power could be transmitted from one point to another point in free space in the form of Electromagnetic Waves in his famous book "Treatise on electricity and magnetism", published in 1873 [14].

After 1890s, the inventor Nikola Tesla experimented with the transmission of electrical energy by using inductive and capacitive coupling with resonant transformer. And his resonant inductive coupling is used in electronics devices, and widely uses in short range of wireless power transferring. In the year 1960s there first time in the history of WPT, long distance wireless power transmission was done by the William C. Brown [15]. After many years in the WPT there are uses of Microwaves and lasers because before the World War II the radio signals are used for communication because of low frequencies that was not capable for transferring the power. And for the transferring the power more efficient transmitter and receivers were required so developing the process of the transmitting the energy there was use of lasers and microwaves. The WPT microwave is attained by an unmodified uninterrupted wave signal with 1 Hz bandwidth. The frequency chosen for the WPT microwave was 2.45 GHz because of economic power components. In the band ISM a very low attenuation across the atmosphere. The next proposed band centered in the 5.8 GHz system decreases the transmitter and receiver slots. But this is not used because of high attenuation at large frequency.

Wireless Power Transmission techniques are mainly two types one is Near-Field and the other is Far-Field. In near field techniques, power is transferring over the short range. The power transferring is done by the inductive coupling between wires and coil; it could be done by the capacitive coupling also by the metal electrodes.

Capacitive coupling is less using than the inductive coupling. On the other hand, in far-field techniques power is transferring with the help of beam electromagnetic radiation like microwaves or laser. These techniques are used in long range power transferring and this type of application is Solar Power Satellite and drone aircraft.

Figure 1 show the working of Transmitter and Receiver, here on the side of transmitter oscillator covert the power in time varying and on the other side on receiver the reverse rectifier converts dc to ac electric current [16]. There are some challenges while wireless power transmission like, energy efficiency, coil design,

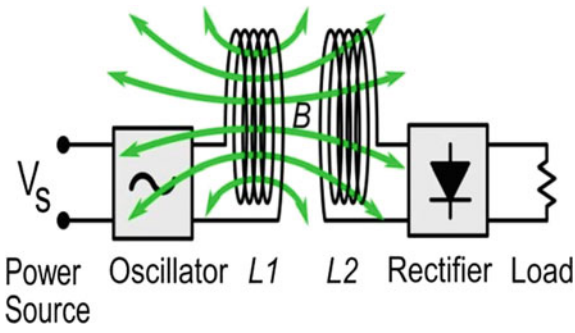

Fig. 1 Wireless power transmission

circuit topology and power control, etc. and one big issue is that the electromagnetic field are involve in these techniques, it could be quite strong and harmful for the human body so human safety has to be taken in this system. There mostly all the WPT techniques are under research to transfer maximum power one side to another side. There is active wide research in the field of transport by which electric buses are going to be charge without wire like London's double-decker buses and electric buses in South Korea and Germany. Wireless Power Transmission is emerging and great technology for the human life and devices or appliances too. According to the Maxwell's Equation whenever the electric power and magnetizing components are involved, the transmitter send some electric energy to the other hand located receiver and it is a form of wireless communication or wireless power transfer [17].

3 Solar Power Satellite

A space-based power satellite, i.e., solar power satellite is the power system, which rotates in space and collect the solar energy from sun in space and transmit this energy to ground. If we talk size of SPS which output is equal to one atomic power plant, we need to design the size of SPS at least few Km. the main disadvantage of this project is high initial cost. Transportation cost covers major part of total cost. Transportation cost of SPS mainly depends on mass of SPS structures. Therefore, we need to use ultra-light weight structures. In few years, possibly fossil fuels will become scare. And there is no renewable energy sources which able to fulfill this huge demand of electrical energy. So, we can consider solar power satellite is an alternative energy source. First time, this concept seen in a science fiction short story "Reason" which was written by Isaac Asimov in 1941 [18]. In this story, a space station transmits solar energy to various planets through Microwave beams. The original solar power satellite was introduced by Dr. Peter Glaser in 1968. He was also called the father of the solar power satellite concept. In 1968, Dr. Glaser was the first who thought to take advantages of solar energy with the help of solar power satellite and after few years, in 1973, he was granted U.S. patent for his SPS concept using microwaves. He thought that a satellite with solar panel and microwave transmitter equipment rotates in Geosynchronous Earth Orbit and it would collect the solar energy from sun and energy would be transmitted to receiving site on earth. The receiving end antenna also called Rectenna would convert the microwave in usable electricity for power consumption. For more study and research in solar power satellite concept NASA signed a contract with Arthur D. Litte (ADL) and four other companies in 1974. They found some major problems in solar power satellite concept like high expense of transportation of required materials of structures in space and lack of experience on this large-scale project in space.

In 1978 and 1986, the Department of energy and NASA jointly work on this concept. NASA/DOE reference model of SPS suggested by NASA and DOE [19, 20] in this reference model large flat panel of photovoltaic arrays and M.W. antenna for transmission used. In 1980, this study was suspended due to two major reasons,

first was the proposed SPS needed large initial investment and second one was the change in government after the 1980s elections US federal. In 1980, when NASA stopped study of SPS, a new research project came in light by a research group at ISAS in Japan called SPS2000. SPS2000 is a 10 MW experimental demonstration in LEO for feasibility of SPS. Again, this concept may be acceptable for experimental purpose but may not be accepted for an operational SPS.

In 1990, NASA restart SPS project and conducted "Freshlook study". Several new concepts of SPS proposed in this study. To examine the feasibility of SBSP. NASA brought a concept of "Sun tower" in this study. The sun tower will be placed in LEO. It has 340 pairs of power modules connected by tether and those arrays were 300 m of diameter connected at the bottom of the tether [21]. After failure of this concept, in Fig. 2 another concept given by NASA's fresh look study. This was named "Solar disc". In this concept solar disc will be placed in GEO. It contains large spin-stabilized solar array and a de-spun phased array antenna. The reason behinds failure of this concept that the reliability of rotary joint between the rotary power generator and the power transmission system because rotary joint must able to bear transmission of huge power. In 1998, NASA started "Space Solar Power definition study" program and another program named "Space Solar Power Exploratory Research and Technology (SERT) program" was conducted during years 1999 to 2000 with cost of 22$M [22].

In 2000, a new concepts of SPS, integrated symmetric concentrator was proposed by NASA in the SERT program. In Fig. 3 it consists of multiple sun pointing solar concentrating mirror. The photovoltaic array and M.W. power antenna are placed on an interconnected structure. Since 1998, National Space Development Agency of Japan was organizing a SPS study project to study microwave-based solar power and laser-based SPS. JAXA (formerly known as NASDA) also given various concepts of microwave solar power satellite and laser-based SPS.

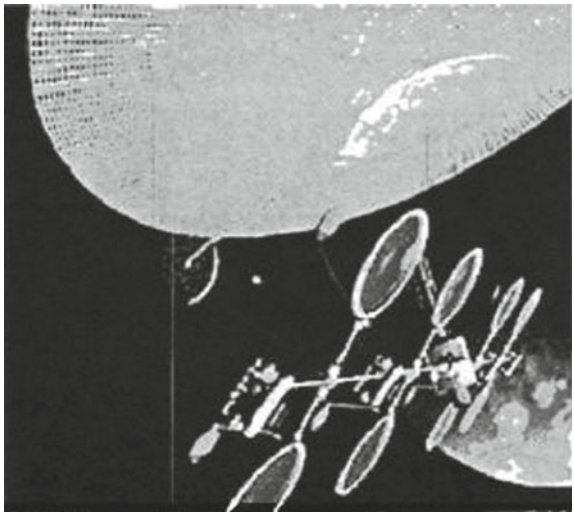

Fig. 2 Solar disc

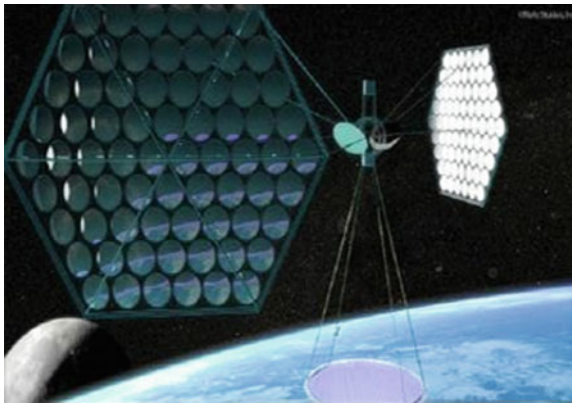

Fig. 3 Integrated symmetric concentrator

In 2001, JAXA proposed a conceptual model. A sandwich type integrated photovoltaic array, power transmitters and microwave antenna are used in this concept. These units installed like sandwich layer and thickness of this layer is less than few ten centimeters. In this concept, photovoltaic arrays cover the upper surface of module and the bottom area is covered by microwave antenna. After 3 years in 2004, JAXA proposed improved concept of the microwave energy transmission for SPS. The major difference between previous 2001 concept and this concept is removal of main structure and rotating joint. These concepts contain two primary mirrors fly separately and have no physical connection with Center segment. This whole system stable in orbit due to solar pressure by sun and orbital mechanism. According to this concept the main Center segment placed in GEO and two primary mirrors placed slightly inclined orbits. In years 2012, China proposed space collaboration with India on visit of "Missile man" and ex-President APJ Abdul Kalam in China and mentioned that may be Space Based Solar Power initiative so that both India and China can work for long term association with proper funding along with other willing space faring nations to bring space solar power to earth [23].

4 Methodology

In Figs. 4 and 5, the circuit has two parts: sending and receiving end. At sending end 4 solar panels of 3 V each connected in series. Therefore, the total voltage received by the solar panel is 12 V. The solar panel is connected to the charging storage device and a battery. The charge storing devices consist of LED, resistor and diode. The rating of the battery is 12 V. The battery receives the voltage from the solar panel and send it to MOSFET, coil and tantalum capacitor. The function of the MOSFET is to amplify the signal and transfer it to the primary of the transformer. The tantalum capacitor is used to reduce the noise. The transformer steps up the voltage from 12 to 50 V. The ceramic capacitor is connected at the secondary of the transformer

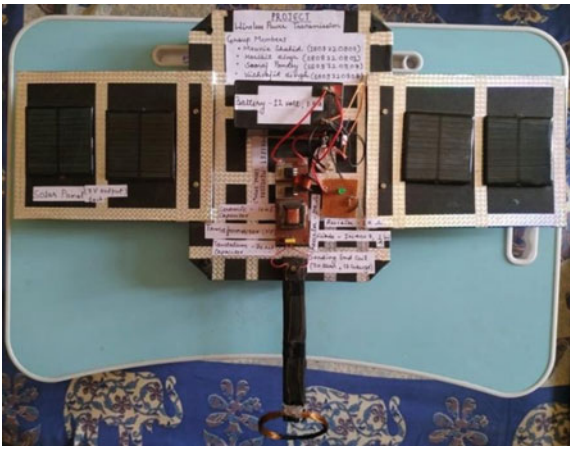

Fig. 4 Sending end

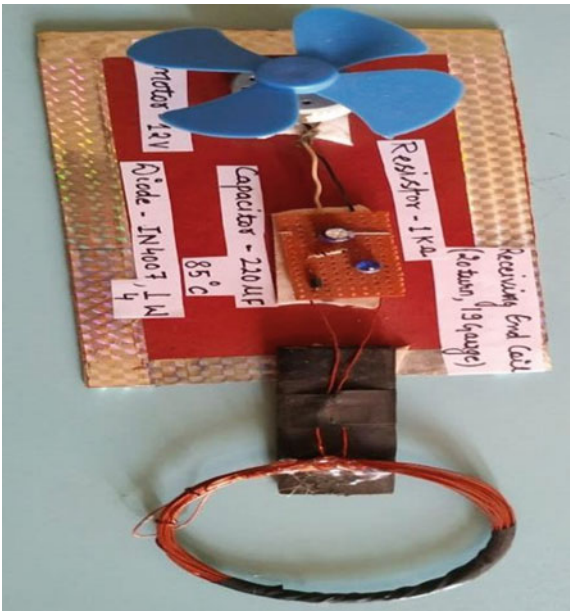

Fig. 5 Receiving end

whose job is to reduce the ripple factor of the signal coming from the transformer and connected to the Copper coil having 30 turns and 17 gauges. The power is wirelessly transferred from the sending end to the receiving end. A Copper coil having 20 turns and 19 gauges is connected at the receiving end. The circuit whose job is to convert the AC signal into DC consist of capacitor, resistor and diode is connected and the output from this circuit is sent to the DC motor whose rating is 12 V and therefore the fan connected with dc motor starts running. The entire operation is performed at 50–60 MHz.

5 Result

At the sending end, 12 V is received from four solar panels of 3 V each connected in series. The charge storing device consists of LED; resistor of 1kΩ, diode and battery is connected to the solar panel. The rating of a battery is 12 V, 3.5A. The battery stores 12 V and the output of the battery is sent to a MOSFET, copper coil and tantalum capacitor. Tantalum capacitor of 70 μF rating reduces the noise. The MEVD1351 MOSFET amplifies the signal and sends it to the primary of the transformer. The 12 V/50 V transformer step up the voltage level from 12 to 50 V. The ceramic capacitor of 10 nF is connected at the secondary of the transformer whose job is to reduce the ripple factor from the signal. The copper coil of 30 turns and 17 gauges is connected to the ceramic capacitor. The power is transferred from the sending end to the receiving end without connecting any wires. At receiving end, copper coil of 20 turns and 19 gauges is connected to the circuit consists of 220 μF capacitor, IN4007 diode and 10 kΩ resistor. The purpose of this circuit AC signal into DC signal and send it to the DC motor of 12 V. The fan connected to the dc motor starts running. The entire operation is performed at 50–60 MHz.

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Chapter 57
A Review on Carpal Tunnel Syndrome Various Terminologies

Nikita Gautam and Amit Shrivastava

1 Introduction

CTS was first diagnosed by Phaget in 1954. At the wrist, the median nerve passes through the tunnel structure which consists of carpal bones and nine flexor tendons covered by fibrous rigid carpal ligament. Pressure on the median nerve creates a neuropathy entrapment that is carpal tunnel syndrome. Repetitive hand movement creates pressure on the median nerve and affects microcirculation of blood. The function of motor nerves is impeded by this affected circulation.

Certainly, no single check ensures an accurate diagnosis of CTS. Behaviour of all the defined checks might be foolhardy. Systematic evaluation had been capable of identify some of assessments with evidence suggesting that they have a few applications, but all had been situation to error.[1]

2 Background

The nerves near the compression site become enlarged due to increased endometrium volume connective tissue, epi-neuriumdema 15 and endometrium space or axoplasmic obstruction Stream 13. Due to the close structure of tendon and median nerve, they significantly affect their mechanical properties and kinematics. Some diseases like diabetes and rheumatoid affect the synovium that may cause secondary CTS. Idiopathic CTS is often accompanied by tendons and synovium [1]. This

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concentrated participation of bilateral CTS may improve the proportion of patients in a non-surgical state after surgery. Carpal tunnel syndrome (CTS) is still confusing and disabled usually introduced to rheumatologists and orthopaedists hand clinicians. Neuropathy induced by pressure is impaired with sensory motor function of the hand. There was no effort to find out the controlling strategies for accuracy or typing speed. There was the possibility that typing rate may influence the CTP, still needing to be assessed [2]. General practitioners are more prone to carpal tunnel syndrome and often manifests as the neurological symptoms of night time pain and paraesthesia distributed along the median nerve. Patients about 20% also showed skin problems (ulcers, blisters, hardening and nails malnutrition) are a severe form of necrotizing CTS [3]. Nail discovery is having big differences, from serious anomalies to such as perigingival/submandibular ulcers, with thickened nails and very mild lesions of discolouration, e.g. Beau line or diphtheria [4].

3 Pathophysiology

See Table 1.

Table 1 Comparison table for pathophysiology

Name of detection method	Normal range	CTS range	Impact
Increased pressure	2–10 mm Hg	• Ten-fold increase in pressure due to extension • 8-fold increase in wrist flexion	Neural dysfunction
Nerve injury		Synovial tissue of flexor tendons gets inflammation	Demyelination
Nerve tethering	9.6 mm		Increase paraesthesia
Ischaemic injury		Injury	• Intrafunicular pressure • Capillary degeneration with leakage • Oedema • Obstruction of arterial flow
Blood nerve barrier breakdown		Proteins and inflammatory cells to build up	Vasculature to collapse
Inflammation			• Rise in fibroblast density • Size of collagen fibre • Vascular proliferation

Table 2 Comparison table for symptoms

Stage	Symptoms
Early stage	Digital numbness, nocturnal and numbness in holding things
Advance stage	Thumb movements are experiencing sensory loss and awkwardness
Severe	Pain in hand

4 Diagnosis of CTS

Combination of physical history, physical examination and test make diagnosis of carpal tunnel syndrome possible. In physical examination, measurement of posture and detail evaluation of the wrist, hand, shoulder and neck is required. Wrists that show signs of tenderness, swelling and deformities will get checked as symptoms of carpal tunnel syndrome. Sensation of finger and muscle strength is also affected by the CTS, so these are also examined by the doctor in the process of diagnosis of CTS. CTS is also checked by the impulse at the wrist end, if nerve impulse is slower than the hand, it means the patient is suffering from carpal tunnel syndrome. Technologies available for CTS detection are as follows.

4.1 Symptoms

Patient's current medical history and clinical findings are important in the diagnosis of CTS. Bilateral CTS is quite common, but symptoms in both hands cannot happen at the same time. Patients may complain of digital numbness, nocturnal symptoms or numbness in the early stages of this disease (Table 2).

4.2 Physical Findings

Joint muscle atrophy occurs during the advanced process stage of disease [5–7]. In carpal tunnel compression, the sensitivity of the test is 75%, and the specificity is 93%, but when testing with wrist expansion, sensitivity and specificities increased to 86 and 95%, respectively [8]. The hand raise test is done by asking the patient to raise the affected hand and hold its location for 1 min. Sensitivity and specificities of the test are 76–88% and 98–99%, respectively (Table 3).

Table 3 Comparison table for different testing methods

Test name	Sensitivity	Specificity
Phalen's	67–83%	40–98%
Tinel's	48–73%	30–94%
Hand elevation test	76–88%	98–99%
Carpal tunnel compression test	75	93

4.3 Neurophysiological Test

NCS is the most common test used to assess median nerve function across the wrist. This test measures the latency of the distal end of exercise, compound muscles action potential, sensory nerve conduction velocity (SCV) and sensory nerve action potential.

4.4 Role of MRI

Although the above test is median nerve function, they cannot reveal the cause of nerve compression or stretch. MRI study of CTS patients provides valuable insights on pathophysiology idiopathic of CTS. Because MRI is expensive, it is usually used for patients with typical symptoms of CTS may not currently be practical. Instead, it can be used to determine the point nerve restraint after CTR failure. Magnetic resonance imaging (MRI) is very suitable to find out rare pathological causes of CTS, such as ganglia, haemangiomas or bone malformations present that may change surgical intervention [9].

4.5 Role of Ultrasonography

The use of ultrasound (US) has involved in diagnose CTS, because the median nerve is thickened. Nerves in the tunnel flatten and bend the flexor retina [10]. A number of studies have concluded that the cross-sectional area is the most predictive measurement for finding CTS. Cross section area of median nerve measures using ultrasound is used in the U.S. for classification of CTS in terms of normal, mild, moderate and severe [11] (Table 4).

Table 4 Diagnostic utility of US versus EDS

Name of the test	Sensitivity (%)
EDS	67.1
US	64.7
EDS and US	76.5

(a) **Small sensory fibre detection for severity of CTS**

In compressive neuropathy, large myelinated nerve fibres are generally considered more susceptible. In this study, we studied small myelin Aδ and unmyelinated C fibre function in patients with mild, moderate and severe carpal tunnel syndrome. As the severity of the disease increases, its characteristics become more obvious. The harm to small myelinated and unmyelinated sensory nerve fibres occurs in the mild and moderate states of CTS, and dysfunctional occurs in severe CTS. Adel fibres cold survey detection became lower in severe CTS, whereas C fibres warm detection increased [12].

Quantitative sensory testing as a method of detection of CTS was questioned in earlier research [13]. Present research found that small-calibre cutaneous fiber loss and quantitative sensory testing exist in mild CTS [13, 14].

5 Treatment

Surgical treatment is better than conservative. However, conservative treatment has fewer complications than surgery. According to the comparison of the parameters of the six-month study, surgery treatment has a greater impact on symptoms and neurophysiological parameters. Decide regarding the choice of treatment, one needs to think carefully, take into account surgical treatment of complications and in some cases, CTS may resolve it spontaneously [15] (Table 5).

Currently, splinting is the first-line non-surgical treatment for CTS put forward by various organizations, together with the British Surgery Society Hand [16]. In endoscopic carpal tunnel release (ECTR), motor branches are normally kept out with experienced tools. When visualizing, it can be easily avoided or converted [17]. ECTR is a safe and effective carpal treatment. It reduces downtime and resumes

Table 5 Comparison table for different treatment

Type	Applicability	Process	Effectiveness
Conservative	Mild-to-moderate symptoms	Oral and transvenous steroids corticosteroids, vitamins B6 and B12 nonsteroidal anti-inflammatory drug (NSAIDs) Ultrasound Yoga Carpal bone mobilization hand splints	Their efficacy in the long term remains unclear Fewer complications
Surgical	Severe symptoms	Cutting of transverse carpal ligament (TCL)	Excellent long-term outcomes

work quickly. The cost is higher, but society may mitigate this factor "The impact of resuming works" [18].

6 Carpal Tunnel Syndrome in Patients with Diabetic Polyneuropathy

Results proved that electro-diagnostic parameters for diabetic and non-diabetic patients placed a limit on NCS in clinical testing of CTS. Without DPN, the parameters are the same for diabetic and non-diabetic patients. Further implications of these outcomes related to choosing subjects DPN is used for research. Suffering from clinical or electrophysiological standards, CTS is usually excluded from clinical trials. The results of this study show that the existence of clinical CTS does not change electrophysiology and measurement of DPN. Therefore, we recommend that CTS standards are not excluded criteria for clinical trials using NCS as a result indicator of DPN [19].

7 Methods

On the enlargement of carpal ligament in CTS, some work has been done towards palmarly directed forces. This study provides a detailed analysis on the structure of hand gestures and wrist movements in order to reduce the CTS. However, this study has the lack of several significant variables in the study. It only consists of the features such as arch area, arch height, TCL length and arch width on CTS for arch width narrowing or TCL elongation [20].

7.1 Elastography

It was obtained that the median nerve was stiffer in patients. Hence, they concluded US elastography is a new technique which can be used as another method for diagnosis of CTS [21]. Computer vision elastography by utilizing the ultrasound sequences with the estimation of specke adaptive motion has the hardware limitations of 30 frames that shows the storage of FT with potentially high trajectory density with every reference template from minimal computation time drift [22].

7.2 Vibrotactile Threshold (VT)

A number of studies were conducted to estimate the vibrotactile thresholds (VTs) came by before and after 10 min of wrist flexion, which is a method to identify CTS in adult subjects. On the given number of specificity, the sensitivity of a vibration measurement taken 10 min after wrist flexion is about twice the sensitivity of the electro-physiologically confirmed CTS before wrist flexion. With a specificity of 70 and 80%, the best sensitivities observed in the vibration measurement results obtained after wrist flexion are 61 and 57%, respectively [23].

7.3 Infrared Thermography

The purpose of this research is to explore the possibility of stimulating infrared thermal imaging technology in the diagnosis of carpal tunnel syndrome. The study involves exciting the patient's hand and analysing its thermal response. The obtained infrared thermogram showed that the hand infected with carpal tunnel syndrome produced different thermal reactions [24].

7.4 Combined Sensory Index Test (CSI) Versus Diagnostic Ultrasonography

For suspicious cases of CTS, if the symptoms are positive and the signs are negative, it means the comprehensive sensory index (CSI) was needed. Ultrasonography was a balancing method not an alternative tool of electro diagnosis test [25] (Table 6).

A compound ultrasound imaging approach is used in CTS diagnosis on the mixture of electrophysiological abnormalities as well as characteristic symptoms. Research presented the adoption of the integrated block sum pyramid and multi-level block matching for the compounding among ultrasound images as well as speckle tracking. The limitation of this work is to consider an assumption of equivalent joint average of a speckle image with the incoherent average of the original object [26].

Table 6 Comparison table for different diagnosis

Name of test	Control group	Symptoms group	Pressure	Sensitivity (%)	Specificity (%)	Accuracy (%)
CSI	0.2–0.8 ms	0.7–1.9 ms	$P < 0.001$	85	100	97.5
Ultrasonography	0.7–1.1	1–1.6	$P < 0.001$	80	75	85

Table 7 Comparison table for different investigation

Classification methods for right/left median nerve and fingers	Median nerve sensory velocity	Fourth finger peak latency difference (statistically significant)	Median nerve motor distal latency (statistically significant)	Detection score in %
Vector machine	NA	($p < 0.001$)	($p < 0.001$)	(89.55)
Naive Bayes	NA	($p < 0.001$)	($p < 0.001$)	Highest (91.04)

Table 8 Comparative table for different nerve

Name of parameters	Distal/Peak latency	Amplitude	Conduction velocity
Median motor NCS	Distal latency $\leq$ 4.4 ms	$\geq$4.0 mV	$\geq$49 m/s
Ulnar motor NCS	Distal latency $\leq$ 3.3 ms	$\geq$ 6.0 mV	$\geq$ 49 m/s
Median sensory NCS	Peak latency $\leq$ 3.5 ms	$\geq$ 20 μV	$\geq$ 50 m/s
Ulnar sensory NCS	Peak latency $\leq$ 3.1 ms	$\geq$ 17 μV	$\geq$ 50 m/s

7.5 Vector Machine/Naive Bayes

To investigate the performance of different classification methods such as vector machines, naive Bayes, classification trees and artificial neural networks, EMG scan data was collected and analysed for different parameters [27] (Table 7).

7.6 Single Fiber Electromyography

Due to the cost of single-fibre electrodes, many laboratories limit the use of SFEMG technology. The introduction of concentric needle electrodes has opened a window of fruitful optimization for the application of this complex technology, and this method has been validated in many studies [28]. For the study of median, ulnar nerve conduction and median-ulnar fingers antidromic sensors standard techniques were used [29]. Abnormalities in APB motor branches can be detected with the SFEMG tool which is difficult to measure by conventional techniques in the early and mild stage of CTS [30] (Table 8).

7.7 Fuzzy Linguistic

Fuzzy linguistics to estimate the CTS risks in an occupational atmosphere. Such an approach consists of the adequate understanding acquisition to estimate as well as classify the holistic set of risk factors involving the organizational, personal and

task-related categories. The main limitation of this research is the deployment of the findings for a greater and more varied study group with equivalent validation assessment [31].

7.8 Thermal Images

The thermal images for CTS diagnosis involve the artificial neural networks. As compared with the previous study, the predictive value rate is 76%. While, most of the cases include the categorization success rates greater than 80%. However, this research has the limitation of including the forty-four images only for the disposal that is a very small number [32].

7.9 Artificial Intelligence

Artificial intelligence techniques involve infrared thermography for CTS diagnosis. There is no beneficial influence of palmar segments on categorization findings; on the other hand, dorsal segments provided the enhanced results with the success rate of classification as over 80%. It involves the median nerve influence of finger segments as the greatest significance. The limitation of this process is to increase further the success rate [33].

8 Biosensors

Research and inventions in the medical field are changing with each passing day. They are only responsible for improving medical care and reducing mortality. Inventions provide new ways to accomplish tasks. In order to improvise medical care, every disease must be eliminated, but it is practically impossible. Therefore, the treatment facilities should be better. This article reviews the activities of smart sensors in the field of biomedical. Innovative development of new therapies and detection of life-threating diseases possibilities increases with the rise in biotechnology [34] (Table 9).

The detection utility of tensity and also pressure estimation of the median nerve in CTS depends on three parameters. Three parameters were examined: median nerve strain, pressure to skin and pressure to strain ratio. For all the parameters, areas under curves were compared between patients and normal. According to results, the patient was having lower median nerve AUC as compared with a normal person, but AUC in normal people for pressure and pressure to strain ratio was higher. Thus, these studies revealed characteristics of a particular method for diagnosis of CTS with application of pressure [35].

Table 9 Comparative table for transducers

Name of transducer	Principle	Material	Remark
Pressure	Capacitive effect	Elastic tube	A quadruple design transducer with four electrodes and four electrodes spaced 0.2 mm apart has the best sensitivity
Electrochemical sensors	Potentiometric	Redox reactions, chemical reactions	• Stability of output increases • Higher sensitivity • Quick response
Piezoelectric sensors	Convert mechanical vibrations in electrical signal	Piezoelectric material	• Convenient • Low cost • Easy to implant
Surface Plasmon resonance (SPR)	Reflection phenomenon	Gold or silver	Nanostructured surface and material of SPR biosensor will be the new invention This will lead to more sensitive sensors

Special emphasis is placed on the use of implantable devices and microsystems to improve healthcare using smart tools. This can be implemented to realize an improvement in the technical design of the equipment. Due to the low cost, fast response biosensors can be used for better results in biomedicine [36]. The wearable implantable technologies are transforming the world of medical inventions and providing reduced healthcare costs with improved healthcare. Materials used in fabrication of these devices to be chosen carefully. Some technical challenges in real-time deployment of these devices are calibration of these devices, required new skill set, proper alignment of devices, etc. [34]. Area under curve for median nerve curve was lower for patients than for controls. Parameters provided by the method of cyclic compression apparatus were more than those provided by morphological assessments as in recent research [37]. The use of a mouse pad with proper wrist rest can reduce the wrist deviation and dorsiflexion [38].

9 Conclusion and Future Scope

CTS is still one of the most famous and common forms of the proportion of the median nerve, accounting for 90% of the total compressive neuropathy. A review of recent literature has outlined this common situation and provides significance on pathophysiology and its relationship with numerous diagnostic methods, including

nerve research, ultrasound and MRI. Despite widespread acceptance that work-related carpal tunnel syndrome (CTS) can be avoided by using wearable technologies which fixes the hand posture in safe range. At present very few reliable and accurate monitoring systems are existing. Most of them are continuous monitoring kind posture modification systems which creates inconvenience in working fields. Development of system for identifying postural habits responsible for carpal tunnel syndrome at early stage remains a prominent research problem. CTS is the most frequent neuropathy entrapment in the form of median nerve entrapment. This literature review discussed techniques for automated diagnosis and production of CTS. Electro-diagnostic studies, ultrasonography, artificial intelligence and machine learning approaches and wearable technology are discussed in the given context. It can be observed that immense attention is paid to electro-diagnostic studies and ultrasonography techniques. The above-cited approaches can only detect the presence of CTS. There are very few studies that focus on risk evaluation for CTS. Developing a predictive approach that can notify users of risk to CTS, after analysing the hand posture is very important and dedicated research is required in this area. Lack of publicly available data sets for detection of CTS is also a key challenge and must be further explored.

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Chapter 58
Deep Learning Approaches for DNA Transcription and Position of Genetic Factor of Bacteria—*Ralstonia solanacearum*

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1 Introduction

The exponential growth of program leading to genome sequencing has generated an enormous data. However, gene expression includes two sequential steps: transcription (DNA to RNA) and translation (RNA to protein) [1]. Transcription process finds an accessible promoter and collects a protein complex to initiate transcription [2], which is the fundamental step that switches the "ON and OFF" of genes and identifies the status of the cell [1]. Information resulting from genomic DNA sequences led to prediction of region transcribed into messenger RNA. The translation of open reading frames (ORFs) when translated leads to proteins from transcribed sequences. The cDNA fragments and expressed sequence tags (ESTs) comparison permitted to assume the amino acids that forms the proteins encoded by these genes. It is essential that annotation should be made for these gene sequences subsequently leading to recognize their roles in cells. This annotation might be easy if the analogous sequences of species that are closely related can be found in a sequence database. In the present scenario, a systematic comparison and classification applying computer-based diagnostic methods in concurrence with analysis and interpretation by biologists are needed for the decryption of genetic information [3, 4].

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The sequencing of DNA is the technique where the nucleotides are arranged in a defined order along chromosomes. It contains the order of the four bases: Adenine (A), Thymine (T), Cytosine (C), and Guanine (G) in a DNA strand [5, 6]. The genome sequence in the form of these nucleotide bases is used as string to be is executed by implementing the bioinformatics tool in MATLAB, through base quality and alignment accuracy is improved [7]. Bioinformatics is an encouraging tool introduce in research area in the twenty-first century. This research gains the understanding the relationship between biology and computation of biological data [8]. Computational technologies, algorithms and basic tools are used to solve the problems like gene structure and classification of gene using ANN.

2 Transcription Process (DNA to RNA)

Only two levels DNA is a double-strand; whereas, single strand serves as a transcription template. This strand is noncoding, and non-template strand is referred as coding strand, as its sequence will be same of new RNA molecule. Mostly DNA serves as the template for some gene and may be non-template strand for others genes within the same chromosomes [10].

Transcript process is copying DNA sequence gene into RNA molecule. This can be achieve by RNA polymerase enzyme, which binds nucleotide to form an RNA strand using DNA as template strand. RNA polymerase binds RNA strand in 5′–3′ direction, resulting in new nucleotide with 3′ strand at end.

Transcription process takes in three steps (1) Initiation (2) Elongation, and (3) Termination.

1. Initiation—is the first step for formation of mRNA, here RNA polymer tries to find promoter. This allows RNA polymer to bind with DNA sequence here referred as promoter. Which is located at the beginning of the gene to form new RNA sequence through a direction from 5′ to 3′ or 3′ to 5′. However, a new single-strand template is formed, when DNA double-stranded template is separated by RNA polymerase. Henceforth, DNA strand opens up for transcription with RNA polymerase.
2. Elongation: A single strand acts as a template for RNA polymerase, as it reads this template one base at a time in the direction of 5′ to 3′ (3-prime), building an RNA molecule out of complementary nucleotides that makes chain grow. Thus RNA single strand is formed, but RNA transcript contains the base Uracil (U) instead of Thymine (T). Adenine (A) tries to bind with Uracil (U), Guanine (G) will binds with Cytosine (C), Thymine (T) will binds with Adenine (A), and Cytosine (C) with Guanine (G). RNA synthesis the complete DNA sequence while it exits the polymerase as a dangling string with is again in form of double helix.
3. Termination is last step, where a sequence calls terminators signal, a RNA transcript is completed. The transcript cause to release from RNA polymerase.

Terminators signal looks for UAA, UAG, and UGA termination code. Finally, RNA polymerase releases DNA sequence and mRNA is released.

```
Pseudo code for Transcription ( )
{
Initiation (x)
{
Promoter=1
If RNA polymerase =1
   {
   Initial code = AUG
  AUG = RNA Polymerase
  X = RNA Synthesis
 A->U;
 G->C;
 T->A;
 C->G;
   }
 Else
    {
    Exit
    }
Elongation (X)
{
Terminator Code = UAA, UAG, UGA;
Do
X = X++;
While (X> Terminator Code)
{
rRNA Sequence
}
Termination(X)
{
RNA Polymerase = 0
DNA Sequence release
mRNA release
}
}
```

3 ANN (Artificial Neural Network)

Neural networks was originated as computational implementation model [9], which depicts the working of brain. The smallest functioning unit neurons are main source

of neural activities. An artificial neural network is built upon the networks; however, several computational networks are building according to the prerequisite output. Networks are inter-connected to several other neurons by dendrites (which act as a messenger) to axons, where the actual processing takes take. As input increase or decrease, the electrical potentials, which in-turn justified at threshold whether the action potential should be pass forwarded or to be rejected. Since, the output of each layer becomes the input to several other neurons.

This paper describes the multilayer perceptron network [10], as it is mention above. These individual units/neurons are connected by links, and these links are provided with associated weights within it. Here, weights are corresponding to long-term memory. On the other hand, the connection between neurons are only feed forward network resulting in feed forward network. The system of using sequence of gene for sequence aligning is being collected from BLAST, the sequence used as string in this work is of bacteria—*R. solanacearum.* Emerging techniques (ANN) are used to solve complex problem-related codon attaching to sequence to the correct interpretation more in refine process, resulting RNA in translation processing.

4 Methodology

Gene sequence of bacteria—*R. solanacearum*, involves the prediction of genetic code in terms of translation. This work comprises of the nucleotide sequence from *R. solanacearum* strain *R. solanacearum*AvrA (avrA) and putative lipoprotein genes, complete cds. (Genbank ACCESSION NO: AY517472) (2330 letters) (DNA sequences). The work covers the base composition approach with the values of Adenines (As), Thymines (Ts), Cytosines (Cs), and Guanines (Gs) in the present strings. Primarily, here these bases are distributed for the taxonomic identification and classification of gene is done. This nucleotide sequences are used as data string in this paper.

This problem is refined by DNA sequences classification system into two groups for training network to identify specific regions in gene. Multilayer perceptron with 2330 inputs, hidden, and output units is the system of classification for protein. Now, the input (2330) sequence is given to form a network comprised of with counts of amino acids pairs. Input vector size range from 2330 units, hidden layer size typically may be 720 to 700 units, and size of output layer changed with the number of protein super families.

Sequence procurement and alignments: Sequence alignment is a method of recognizing homologous nucleotide or amino acid position amid a strain of sequence of bacteria (*R. solanacearum*), because the important of knowing similarities in sequence can be attain, before looking for it. The sequence has to be known correctly with origin nucleotide by density of it as shown in Fig. 1. Representing the alignment of strain and position.

Nevertheless, sequence alignment is shown. Considering only local mutations of the genome, but mutation includes longer pair stands segments of genome. To

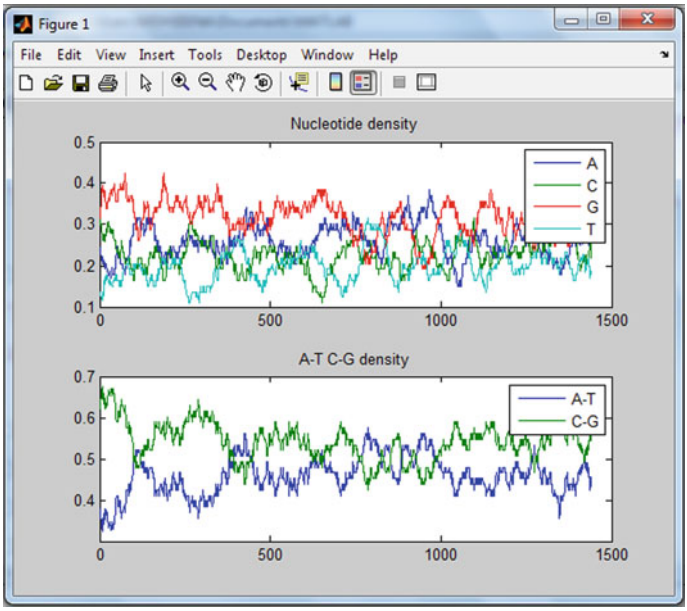

Fig. 1 Density of nucleotide sequence—*R. solanacearum*

determine the order of the amino acid, bases-order should be checked for each stain of DNA (Fig. 2).

Figure 3 illustrates translating of a DNA sequence into a sequence of words. To obtain amino acid (codons), one should look for triple combination of words resulting in 5′ or 3′ nucleotides. Further a window size that equals to 3′ or 5′ progress resultant

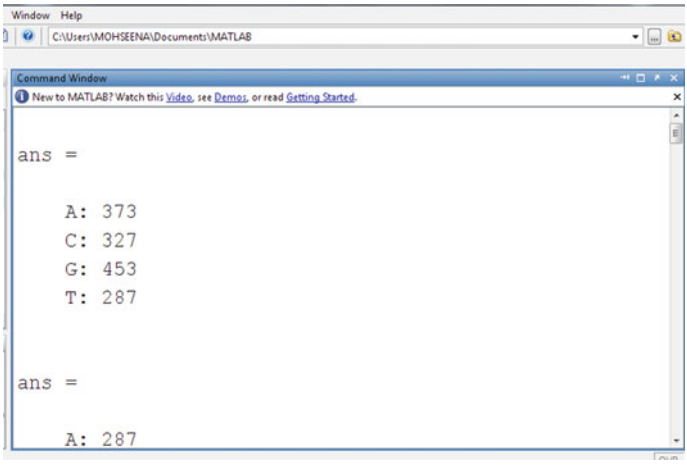

Fig. 2 Bases-order of bacteria (*R. solanacearum*)

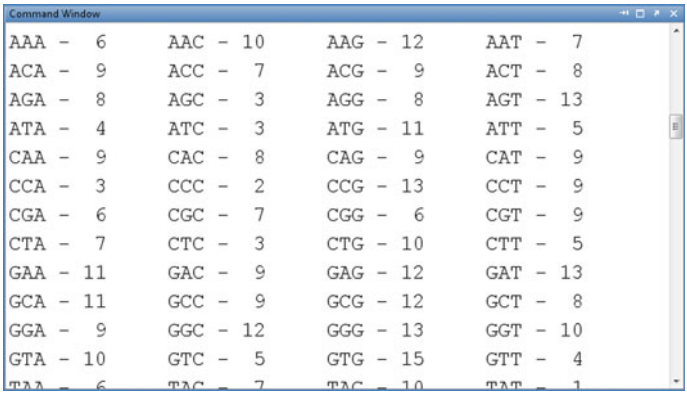

Fig. 3 Amino acid (codons) in sequence

is equal to 1, as each segment is considered as a word and eventually added to the destination sequence. Where resultant is known as rRNA, allowed to move out of the nuclei.

Distinct text data, i.e., sequence of bacteria (*R. solanacearum*), is of successive sequences of letters without any space between them called amino acid in any sequence, in fact it sequence of predefined words for identifying the structure of amino acid or codons. We apply a technic to have complete knowledge of sequence base, i.e., separation of words in the sequence by its representation in the bar and pie-chart as shown Fig. 4.

Figures 1, 2, 3 and 4 are executed in bioinformatics tool in MATLAB, that facilitate get the complete information of sequence alignment with its position and even codons, but it could be difficult to do classification of strain of same bacterial strain, overcome this problem. Artificial neural network was introduced, as per above, we have given a brief working of ANN. In this case, an artificial neural network will provide the solution by classifying given strings of bacteria (*R. solanacearum*) with 2330 strings. Now, bacterial sequence of words representing sequence for text data without losing its position information of each nucleotide in the present sequences is applied for feed forward network with 2330 bacteria (*R. solanacearum*) sequences composing feature with four values. These values correspond to Adenines (As), Thymines (Ts), Cytosines (Cs), and Guanines (Gs). Training the ANN and the sequence 2330 array with the 56 nucleotides attached to each amino acid (codons), since, a codon that encodes an amino acid is comprised of three nucleotides combine as an ANN input. The sequence occurrences present the network output usually a descripted as (+) or (−) occurrence. Though perceptron's network present in Fig. 5, which is identifying the position binding mRNA sequence of each nucleotide in the present bacterial sequence.

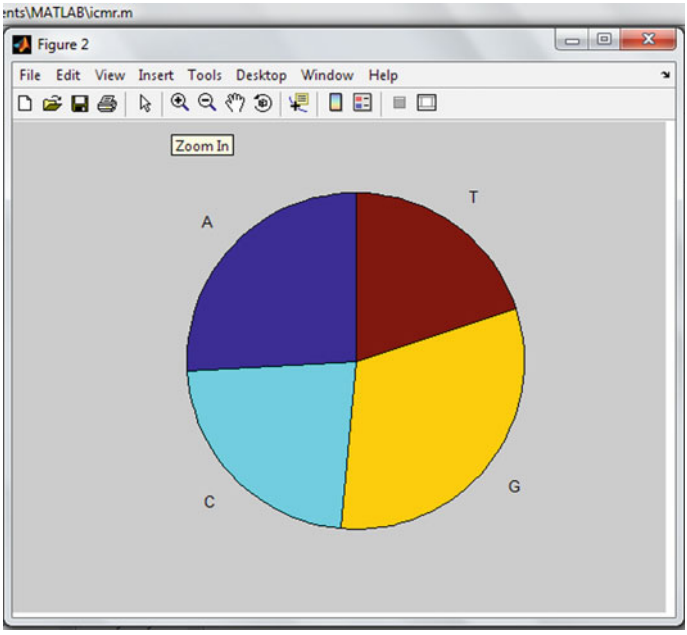

Fig. 4 Graphical representation of sequence

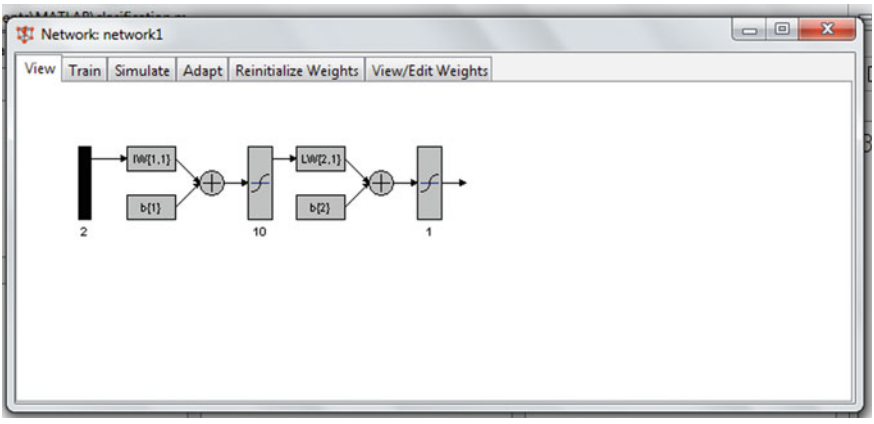

Fig. 5 Feed forward network for bacteria (*R. solanacearum*) with 2330 sequence

5 Results

Attempt to evaluate the position of text in sequences by experiment conducting in two phases.

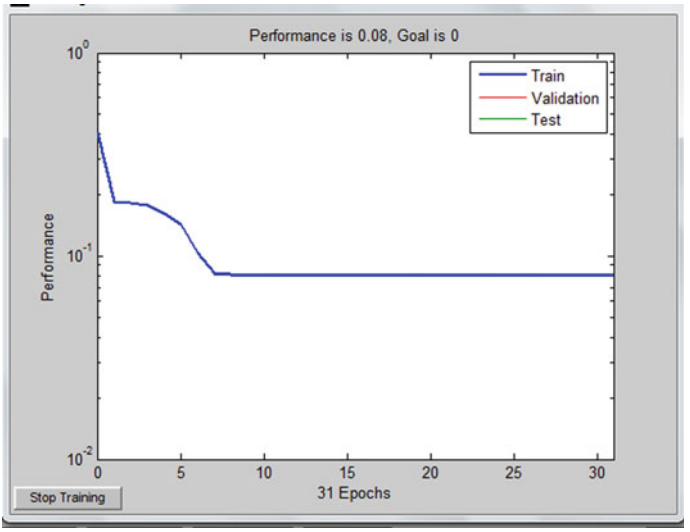

Fig. 6 Feed forward network for bacteria performance is 0.08

1. Attain complete information of sequence position by using bioinformatics tool through base-count and density, which provides clear pictorial image of sequence
2. After attain complete information of sequence, now we are proceeding for classifying the position of four values in strings.

This classification makes sure that an equal ratio of (+) and (−) indication of locations in the sequence of array. Network undergoes the training for series for time, here it has gone for a series fetching only four subsets (A, C, G, and T) Cross-validation was incorporated into the elevation of ANN performance by having the dataset portioned into two sets input array [2330] and output array [2330]. Classifying indicated by (+) and (−) symbols, location for sequence and both (+, −) indicate the presence of same letter in both sequence at the same location or position in their respective sequences with performance = 0.08 achieving the goal (Figs. 6 and 7).

6 Conclusion

Multilayer perceptrons have been effectively functional in problem unravel through classification and function approximation. Characteristically, network built is supervised learning environments where the outcome is identified earlier for the training set of data. The solution or target value is recognized for each input vector where multilayer perceptrons are not suitable. The task is to collect or group objects where the type of clustering groups unknown prior to execution. Other kinds of problems

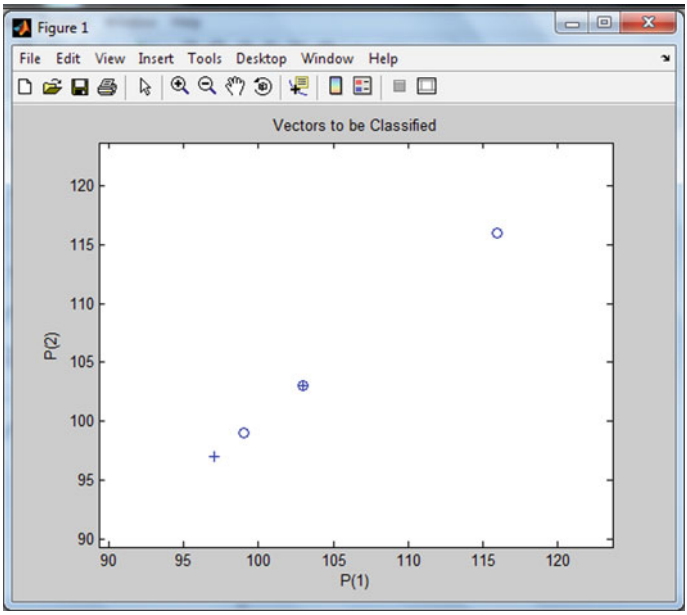

Fig. 7 Classified mRNA sequence at each nucleotide in the same position

for which multilayer perceptrons are necessary to learn from the complete training set and calculating random numbers letters in sequence structure. There are other types of neural network architectures that can be commonly used as neural network in the multilayer perceptron.

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Chapter 59
Pervasive Review of Optic Biosensors-Based on Surface Plasmon Resonance and Its Development

Sandeep Kumar Jain, Garima Mathur, Yogesh C. Sharma, and Sandeep Vyas

1 Introduction

The development of biosensor is motivated by continuous requirement in the field of agriculture, bioprocessing, medical science, food technology, environmental engineering, military applications, etc., for easy, fast, and continuous in-situ monitoring. The biosensor is an integrated device that combines biological structures such as antibodies, tissues, enzymes, microorganisms, and nucleic acids . to detect an analyte and a physico-chemical transducer to produce a measurable signal. Nowadays, optical fibers have played a key role in sensor technology due to their splendid light delivery, low cost, long transmission length, ability to thrill the target molecules, and capture the light from the target.

Generally, optical fiber-based biosensors are divided into two classes: intrinsic and extrinsic sensors based on analyte interaction. In the first case, interaction occurs within fiber with the analyte, whereas in the second situation, fiber is applied to couple the light in the scope where the analyte influenced light beam. Various kinds of spectroscopic techniques like absorption, reflection, phosphorescence, fluorescence, surface plasmon resonance (SPR), etc., are used in optical biosensors. Because of easy handling and accuracy with minimal sample treatment, biosensor based on fiber-optic are useful in surgery, routine tests, intensive care, patient home care, as well as emergencies [1]. This review article has five sections. A brief idea about biosensor and their application in various field, need for optical fiber in the biosensor is given

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in the first section. Different measurement techniques used in optical fiber-based biosensors are discussed along with few research papers in the second section, SPR mechanism in detail in the third section, conventional optical fiber and photonic crystal fiber (PCF)-based SPR biosensors along with recently published research papers are discussed in the fourth section. In the last section, a summary and future scope of fiber-optic biosensors are provided.

2 Measurement Techniques

In fiber-optic biosensors, different types of measurement techniques like absorbance, reflectance, fluorescence, chemiluminescence, bioluminescence, etc., are used.

2.1 Absorbance Measurements

In this technique, the biological compound is put at the distal end of the optical fiber, then the light is passed to the sample through the fiber. At the detector end, using same fiber or another fiber, the change in concentration of analyte is measured which is proportional to the light absorbed by the analyte.

For medical applications, an optical fiber-based pH sensor [2] and oxygen sensor [3] have been developed. In the proposed pH sensor, an absorptive indicator was used with an absorption peak near 625 nm. It shows absorption change is reasonably linear over the pH range of 6.8–7.8, and it is examined by a red pulsed LED and reverts light is split using dichroic mirror into long and short wavelength signals which are detected using photodiodes. It exhibits a response time of 30–40 s and a resolution of 0.01 pH. In the oxygen sensor, after brief UV stimulation, its viologen indicator becomes strongly absorbent, then it reverts to the transparent state. The concentration of local oxygen is proportional to the indicator's rate returns to a transparency state. Indicator absorbance is observed using a red LED. It may be used in vivo and in vitro oxygen measurements.

In the urine samples, the levels of inorganic phosphate are important for the clinical test of hypoparathyroidism, hyperparathyroidism, and Vitamin D deficiency. An enzyme-based fiber-optic biosensor fabrication to estimate the inorganic phosphate in the urine sample is presented by Kulkarni et al. [4]. The conversion of p-nitrophenyl phosphate into a colored p-nitrophenol by acid phosphatase was detected at 405 nm. It has a response time of 20 min, linearity of 20–100 μM and shelf life more than 80 days.

2.2 Reflectance Measurements

Reflectance is defined by the amount of light reflected from the sample to the light being transmitted to the sample along with the fiber. A new concept to detect molecular interactions using colorimetric diffractive grating has been developed by Cunningham et al. [5]. Here, diffractive grating is used as a surface binding element and designed to reflect the light of a single wavelength when it is illuminated with white light.

To perform real-time monitoring of the immunoassay, a high-sensitivity optical fiber-based biosensor has been evolved by Yang et al. [6] applying the multiple-reflection principle. For human consumption, monitoring of fish freshness as the storage conditions and handling process of fish may affect their spoilage patterns. For this, the bienzymatic creatine biosensor has been fabricated by Fazial et al. [7].

2.3 Fluorescence Measurements

This technique is used for the detection of biomolecules (e.g., live cells, nucleotides, antigens, etc.) with remarkable selectivity and sensitivity. The fluorescence measurement system consists of four components: a light source, wavelength filters, fluorophore molecule, and a detector.

Various fiber-optic biosensors have been analyzed based on this technology over the past several decades. An optical fiber-based biosensor that integrates an array of electrical and optical elements with silica fibers and proteins to detect an analyte in the given solution is proposed by Anderson et al. [8]. For DNA hybridization analysis, a biosensor using an optical fiber has been reported by Piunno et al. [9]. A fiber-optic biosensor based on fluorescence measurement for in-situ and real-time measurement of free Cu(II) metal ion in seawater at picomolar levels is reported by Zeng et al. [10].

2.4 Chemiluminescence Measurements

Chemiluminescence is a process in which light is emitted by exciting biomolecules due to chemical reaction (oxidation of O_2 or H_2O_2). For chemiluminescence, external light source is not needed to start the chemical reaction. Chemiluminescence generates with following steps:

$$P \xrightarrow{r_1} Q, \text{ excitation}$$

$$Q \xrightarrow{r_2} h\upsilon, \text{ emission}$$

where $r1$ and $r2$ are the rates of excitation and decay, respectively. The chemiluminescence in a living organism is known as bioluminescence. Various organisms like jellyfish, sea stars, worms, fungi, crustaceans, sharks, etc., can generate bioluminescence for mating, self-protection, signaling, and food hunting.

A fiber-optic biosensor to analyze the injection flow of glucose and lactate has been proposed by Marquette et al. [11, 12]. For antioxidants, a chemiluminescence biosensing system using hematin and luminol co-immobilized on a cellulose membrane disc has been developed by Palaoran et al. [13].

3 Surface Plasmon Resonance

This technique is used to supervise the real-time binding interaction of biomolecules like antibodies, proteins, DNA, RNA, etc., in a label-free manner. In general setup of SPR, biomolecules (ligand) are immobilized on a metal surface (Au, Al, Ag, or Cu) and mobile molecule (analyte) flow across the metal surface constantly as shown in Fig. 1.

When single-wavelength, polarized light is incident at the lower side of a metal surface through a prism. The free electrons (surface plasmons) in the metal absorb some light at a certain angle (resonance angle or SPR-dip) cause minimum intensity (X) at the detector. These electrons are highly sensitive to the environment. Any changes at the metal surface resulting in the resonance angle shift (Y) as depicted in Fig. 2. The resonance angle is dependent on the variation in refractive index at the surface of the metal. When an analyte binds with the ligand at the surface, the refractive index at the metal surface will change. Thus, a shift in resonance angle

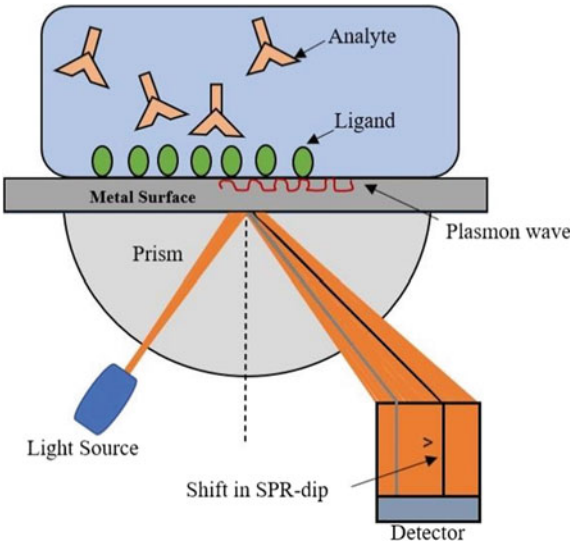

Fig. 1 Mechanism of surface plasmon resonance [14]

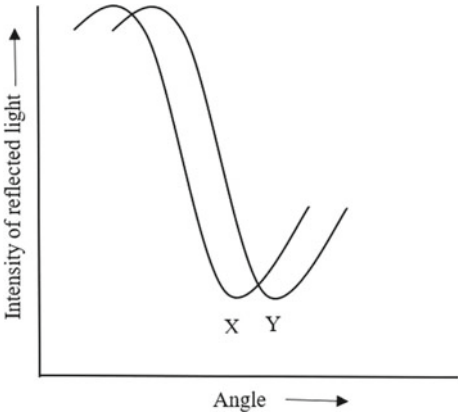

Fig. 2 Shift in resonance angle when analyte binds with ligand [15]

occurs that allows measurement of molecules interaction without labels. To make binding sites available for further reactions, metal surface can be wiped to abolish the bound analyte [14].

When SPR-dip is measured in real time, then a plot is generated between an angle at which SPR-dip is observed and time. This is called a sensorgram as depicted in Fig. 3. Initially, no binding interaction occurs at the metal surface and an SPR-dip is measured at resonance angle (X) which is indicated by baseline in the sensorgram. After injection of an analyte, the ligand will bind with the analyte at the surface, cause the refractive index change at the metal surface and resonance angle shift to position Y (association) at which SPR-dip is observed. This process of adsorption–desorption can be monitored live to measure the amount of adsorbed species. When the sample containing the analyte is swapped with the system buffer then dissociation of the analyte with ligand takes place. Finally, the metal surface can be wiped and reused for subsequent reactions (regeneration) [15].

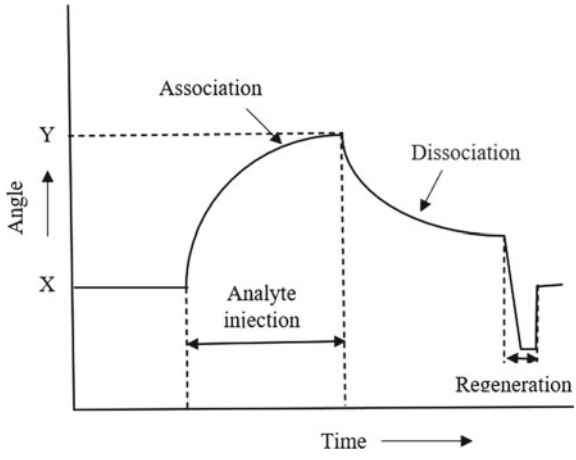

Fig. 3 Schematic of an SPR sensorgram [14]

4 Fiber-Optic SPR Biosensor

In 1983, the first SPR-based sensor for biomolecular interaction monitoring was proposed by Liedberg et al. [16]. However, a prism sensor-based on SPR is used for point-to-point detection due to bulky sensing device. In the SPR biosensor, the use of optical fibers is based on the light guidance in optical fibers using the total internal reflection (TIR). To create TIR in SPR-based sensing system; prism can be replaced by the optical fiber core to make a fiber-optic SPR biosensor. Optical fiber-based sensors also have other advantages such as lightweight, less bulky, long-distance transmission, anti-electromagnetic interference, and so on [17]. In 1993, the first fiber-optic investigation was carried out based on the SPR proposed by Jorgensen et al. [18].

Generally, in a fiber-optic SPR sensor, from a small middle portion of the core of an optical fiber cladding is removed and covered with a metal layer and then covered by a sensing layer as depicted in Fig. 4. If the spectral interrogation method is applied then the light is launched into the core of the fiber at one end from a polychromatic source. The TIR occurs for the rays propagating in the core of the fiber with an angle equal to or greater than the critical angle. As a result, the surface electrons (plasmons) are excited by the generated evanescent field at the interface. The merging of this generated field with plasmons depends on the metal properties, wavelength of light, fiber geometry, and parameters. Finally, after passing by the SPR sensing region, the spectrum of the transmitted light is detected by the detector at the distal end of the fiber [19].

After 27 years of development, SPR-based sensing technology using an optical fiber has been very ripe. In this review, the recent development of SPR based fiber-optic biosensors is presented.

A D-shaped plastic optical fiber based SPR sensor using thin Ag film coated with graphene layers is proposed by Arthur A. Melo et al. [20]. For 16 graphene layers, it exhibits a sensitivity of 5161 nm/RIU. This sensor may be useful for biosensing application for aqueous media. The SPR-based fiber optic biosensor using Tin Selenide (SnSe) allotropes as sensing layer over silver metal for DNA hybridization has been proposed by Rahman et al. [21]. The SPR sensor with Ag-only has a sensitivity of

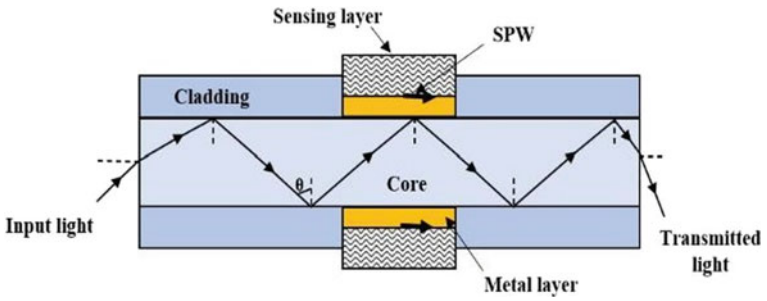

Fig. 4 Illustration of an optical fiber-based SPR sensor [19]

1800 nm/RIU. Tin Selenide allotropes are overlaid on Ag films to increase the sensitivities to 3225 nm/RIU for α-SnSe, 3300 nm/RIU for δ-SnSe, and 3475 nm/RIU for ε-SnSe.

For breast cancer detection, graphene-coated SPR-based fiber-optic biosensor has been reported by Md. Biplob Hossain et al. [22]. To detect early breast cancer, the attenuated total reflection method is used. Two mutations, 916delTT in the BRCA1 and 6174delT in the BRCA2, have been selected for analysis of breast cancer using DNA hybridization. A fiber optic SPR biosensor has been proposed by Li et al. [23] for genetic screening, biomarkers, medical diagnostics, and transcriptional profiling by mean of concentration and time-dependent DNA hybridization. In this design, a D-shaped plastic fiber with a 3D Au/Al_2O_3 multilayer metamaterial structure and graphene film is used. It exhibited high sensitivity of 4461 nm/RIU with good repeatability, linearity, and stability for refractive index detection.

Nowadays, PCF-based SPR sensor is an emerging technology and getting strong acceptance in the biosensing field. However, conventional optical fiber provides high channel capacity and high data rate; it lacks the usage of the full optical spectrum and designing flexibility yet. PCF is a special class of fiber that overcome all the limits of conventional optical fiber. The PCF-SPR sensor technology has a lot of advantages such as smaller size, high sensitivity, high accuracy, larger detection range, and more design flexibilities [24–28].

A PCF-SPR biosensor to detect unknown biological analytes using the wavelength interrogation is proposed by Rifat et al. [29]. It exhibits the maximum sensitivity of 1,000 nm/RIU and sensor resolution 1×10^{-4} RIU. It consists the symmetrical circular air holes with three rings hexagonal PCF structure.

A sensitivity enhanced co-modified PCF-SPR immunosensor by composite graphene oxide and staphylococcal protein A (SPA) has been proposed for human IgG detection by Wang et al. [30]. In this proposed sensor design, using an optical fiber fusion splicer technique, between two sections of multimode fibers, a PCF spliced and sputtered with the Au film, then it was modified by SPA and graphene oxide for further immunosensing. It exhibits a refractive index sensitivity of 4649.8 nm/RIU. Ultra-low loss SPR-based PCF biosensor for organic molecules, biomolecules, and biological substances sensing application has been reported by Sayed Asaduzzaman et al. [31]. The gold (Au) is used in this sensor as a plasmonic material. It exhibits maximum sensitivity of 8500 nm/RIU and sensor resolution of 1.16×10^{-5} RIU for the wavelength range of 0.5–1.20 μm.

An ultrahigh sensitivity PCF-SPR refractive index biosensor with Au-coated circular nano-film has been reported by Abdullah et al. [32]. It exhibits maximum sensitivity of 45,003.05 nm/RIU and birefringence of 1.9×10^2 for Au film thickness of 50 nm and analyte refractive index range of 1.33–1.40. By changing the gold film thickness to 70 nm, it exhibits the sensitivity of 48,269.50 nm/RIU. A butterfly core-shaped SPR based PCF refractive index sensor for real-time biomolecules detection has been developed by Mashrafi et al. [33]. In this design, the analyte detection layer and plasmonic material gold are used on the PCF surface to produce the SPR phenomenon. It shows the maximum sensitivity of 56,000 nm/RIU with an analyte refractive index range of 1.33–1.42 for the wavelength range from 450 to 2100 nm.

5 Conclusion and Future Prospects

In summary, in the advancement of biosensors, optical fiber-based biosensor will play an important role because they can be easily integrated and miniaturized to determine target biomolecule in clinical diagnostics, food processing, and environmental monitoring. This article summarizes the different measurement techniques used in fiber optic biosensor and recent research in the highly promising field of SPR-based fiber-optic biosensors. At present, the existing SPR-based fiber optic biosensors are only used in laboratory environments, successful commercial application is a challenge. Response time and reuse of biosensor are also a lack of concern.

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Chapter 60
Variability Analysis of Public Transit Bus Travel Time Using GPS Logs: A Case Study

B. P. Ashwini and R. Sumathi

1 Introduction

Congested roads are the common problem faced by cities currently. Increased usage of private vehicles is a major contributor to congestion. Congestion increases the travel time and hinders the overall mobility of the city. With the alarming situation of greenhouse gas emissions and global warming, an alternative mode of transport for private vehicle usage has to be promoted. Buses are the most common public transit systems that can serve as an alternative for private modes, but bringing the modal shift among commuters is a challenge. The role of the transit operations planners is significant in bringing the modal shift, as they are responsible for optimizing operations such as scheduling, route and service planning, service monitoring and evaluation, etc. This will make the travel times more reliable, and commuters can be attracted toward the public transit mode and in turn this modal shift can reduce congestion, be an eco-friendly and sustainable alternative for private modes. In tier-2 cities of India, the most commonly used mode of public transit is buses.

Travel time variability reveals the level of variation in the travel time of trips that are repeated in similar conditions over several days. The variations exhibited by the travel time data can aid the transit operations planners to take decisions to improve the performance of the transit service. Variability in travel time is a key factor that commuters judge while making basic travel choices, such as mode, route, and departure time. The pattern of the variability in travel times is well described by travel time distribution. Depending on the traffic dynamics, land use pattern, and

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infrastructure of the city, various researchers in the past have suggested statistical distributions such as normal, logistic, log-normal, log logistic, generalized extreme value (GEV), Weibull, etc.

A tier-2 smart city of India: Tumakuru, is chosen for study, in which the travel times of local public transit services are analyzed. The study is carried out to characterize the variability of travel time of public transit services. The main objectives of the work are to conduct spatial–temporal analysis on GPS logs of the public transit service of Tumakuru city to show the variability and distribution of travel times.

The rest of the sections in the paper is as follows. A literature review of the existing research work in variability analysis of travel times is presented in the next section, followed by Sect. 3 which includes methods for collecting the data, preprocessing the data, and analyzing the variability in the data, along with the results. In Sect. 4, the inferences of the analysis and suggestions to the stakeholders are presented as conclusion.

2 Literature Review

The existing studies on travel time variability are mainly depending on the sources of the data collected. Data were manually collected in [1, 2], in few other works simulated data [3] and videotapes are the main sources for analysis [2]. The advances in Information and communication technology (ICT) and Internet of Things (IoT) have led to the incorporation of GPS equipment [4] in buses, and this has opened a wide opportunity for the researchers to analyze the variability in travel times. In these buses, a GPS device is enabled on the tracking device and location (longitude and latitude), speed, heading, etc., information is sent periodically to the centralized control unit.

Most of the recent studies in this area [3, 5–18] have used automatic vehicle location (AVL) information through GPS device. With the availability of huge current and historical GPS data, various researchers have analyzed the variability in the travel time distributions [1, 13, 19] claim that travel time follows normal and log-normal distributions based on temporal properties, whereas the results of [5] exhibit that Burr distribution suits the best for travel times. Some recent studies in heterogeneous traffic conditions [12, 15] demonstrate that travel time follows generalized extreme value (GEV) distributions. Overall depending on the traffic compositions like homogeneous/heterogeneous, departure time window (DTW), and peak and off-peak hours the distributions of the travel time show variations.

Few works [1, 5, 12, 15, 18, 19] claim that reliability is a major factor to improve the level of service (LoS) of the public transit systems and capturing the variability in travel times finally derive the reliability. Variability in travel times is presented based on the estimations done on the travel times, for which authors [2, 3, 7, 9, 13, 14]have used simple linear models, whereas few others [1, 10, 12, 18] have used statistical parameters such as mean, standard deviation (SD) and coefficient of variance (COV)for the analysis, while few others [6, 8, 11, 14, 16, 17, 19, 20] have

not only captured the variations but also tried forecasting the future travel times using machine learning models such as linear regression analysis, artificial neural networks (ANN), k-nearest neighbor (kNN), k-means clustering. and DBSCAN algorithms.

Few authors consider dwell time and model it [2, 3, 8, 9, 14] individually for the travel time variability analysis. Bus stop location identification is very important for bus travel time variability analysis, most of the existing works consider it as a fixed location before analysis while [14] have tried to automatically identify the bus stop locations during the trip.

3 Methodology

The process of conducting variability analysis is divided into three phases, data collection, data preprocessing, and travel time variability analysis. Each phase of the analysis is discussed in the following sections.

3.1 Data Collection

Tumakuru city service currently operates on fifteen routes varying from 5 to 15 kms of route length. The bus routes of Tumakuru city have road segments of national highways, state highways, and urban arterial and sub-arterial roads. Tumakuru city service buses are equipped with functional onboard GPS that is connected to a common control center maintained by Tumakuru Smart City Limited.

The location data of the buses during November 2020, trip schedule, and bus stop information are shared by Tumakuru smart city limited. Route: 201-Tumakuru bus stand (TBS)—Kyathasandra (KYA) both directions (upstream and downstream) are used for the analysis. Sample data are provided in Table 1. The route information is in Table 2, and the route map is shown in Fig. 1. The intermediate bus icons in Fig. 1 indicate the bus stop locations on the route.

3.2 Preprocessing the Data

The location data of buses are noisy, redundant, erroneous with missed [21] entries that need to be cleaned for further analysis. The missed entries are neglected; redundant off-trip logs are eliminated. The outliers in the extracted data are identified by estimating the mean absolute deviation (MAD) [22] that detects very large and small values in the dataset. The trips involving these outliers are eliminated from the dataset.

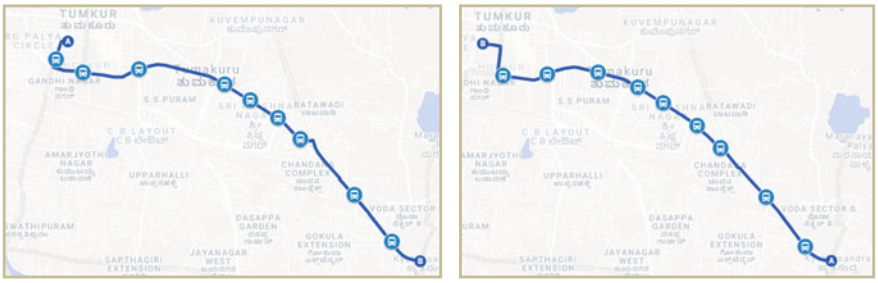
The GPS logs are collected and stored for each bus with respective vehicle registration numbers and device ID. The data required for analysis need to be processed

Table 1 Sample GPS logs of route number 201 TBS-KYA

Vehicle reg. no	Device ID	Received date	Latitude	Longitude	Speed	Odometer	Location
KA-06-F-0752	8.62273E+14	07-11-2020 13:27	13.34239	77.0985	17	4.61	Tumakuru bus Stop
KA-06-F-0752	8.62273E+14	07-11-2020 13:27	13.34182	77.09831	26	4.68	nearby KSRTC bus depot, Ward no. 18, Tumkur, Tumakuru, Karnataka 572101, India
KA-06-F-0752	8.62273E+14	07-11-2020 13:28	13.34117	77.09809	24	4.76	Nearby Masjid-e-Aqsa road, PH colony, P H rich colony, Tumakuru, Karnataka 572101, India
KA-06-F-0752	8.62273E+14	07-11-2020 13:28	13.34062	77.09792	25	4.82	City complex, Jaya Chamarajendra road, Mandipet, Tumakuru, Karnataka 572101, India
KA-06-F-0752	8.62273E+14	07-11-2020 13:28	13.33996	77.09774	23	4.9	Jaya Chamarajendra road, Ward no. 18, Mandipet, Tumakuru, Karnataka 572101, India
KA-06-F-0752	8.62273E+14	07-11-2020 13:28	13.33959	77.09763	13	4.94	Jaya Chamarajendra road, Ward no. 18, Mandipet, Tumakuru, Karnataka 572102, India
KA-06-F-0752	8.62273E+14	07-11-2020 13:28	13.33936	77.09758	9	4.97	21, Jaya Chamarajendra road, Ward no. 18, Mandipet, Tumakuru, Karnataka 572101, India
KA-06-F-0752	8.62273E+14	07-11-2020 13:28	13.33905	77.09753	12	5	Nearby PB no. 129, Railway station road. Tumakuru, Karnataka 572102, India
KA-06-F-0752	8.62273E+14	07-11-2020 13:29	13.33882	77.09776	16	5.04	Call Tax bus stop. Bengaluru—Honnavar road, Ward no. 18, Mandipet, Tumakuru, Karnataka 572102, India
KA-06-F-0752	8.62273E+14	07-11-2020 13:29	13.33869	77.09831	26	5.1	Opp. Govt. General Hospital, B.H. road, Gandhinagar, Tumakuru, 572101, India

Table 2 Route information

Route parameters	Upstream	Downstream
Route number	201	201
Origin–destination (OD)	TBS-KYA	KYA-TBS
Route length	6.9 km	6.6 km
Number of bus stops between OD	9	9
Number of intersections between OD	6	5
Route travel time	20 min	20 min



(a) (b)

Fig. 1 Route map of **a** TBS-KYA and **b** KYA-TBS

route-wise and trip-wise irrespective of vehicle, and hence, the data are segmented as per the requirement for further analysis. GPS logs have to be transformed to trip-wise aggregates where the trip travel time is estimated and stored along with the date, start time, end time, mean speed, and distance traveled during the trip. 600 upstream and downstream trips are selected for analysis.

3.3 Travel Time Variability Analysis

Analysis of the variability in travel time and identifying suitable statistical distribution was conducted at different spatial–temporal scales. Spatially, the variability was analyzed at the route level. The time of the day and peak-off-peak hours are the temporal scales at which analysis was conducted on each route. The basic descriptive statistics including mean, standard deviation, and coefficient of variation (COV) at each aforementioned temporal scale are presented in Table 3.

Travel time based on time of the day: The travel time aggregates between 7:00 and 20:00 for both upstream and downstream routes are plotted in a one hour departure time window (DTW) is shown in Fig. 2. The dotted line at 1200 s in Fig. 2 indicates the allotted travel duration by transit operations planners for the route. It can be observed

Table 3 Descriptive statistics of the route at each temporal scale

DTW:1 h	Sample size	Upstream			Sample size	Downstream		
		MTT (s)	SD	COV (%)		MTT (s)	SD	COV (%)
Time of the day								
7–8	23	990	81	8.2	23	857	96.2	11.2
8–9	23	1126	132	11.7	22	1033	112.6	10.9
9–10	25	1227	121	9.9	24	1140	134.1	11.8
10–11	24	1290	51	4.0	24	1158	78.93	6.8
11–12	23	1225	142	11.6	24	1133	108.4	9.6
12–13	22	1185	57	4.8	23	1110	124.4	11.2
13–14	22	1253	87	6.9	22	1105	108.7	9.8
14–15	24	1296	144	11.2	23	1063	29.2	2.8
15–16	22	1252	104	8.3	24	1068	132	12.4
16–17	23	1302	157	12.1	22	1110	145.7	13.1
17–18	23	1253	148	11.8	23	1122	98.2	8.7
18–19	24	1297	115	8.9	24	1200	90	7.5
19–20	22	1170	63	5.3	22	1058	132.2	12.5
Overall peak hours								
	72	1294	103	8.1	71	1140	66	5.7

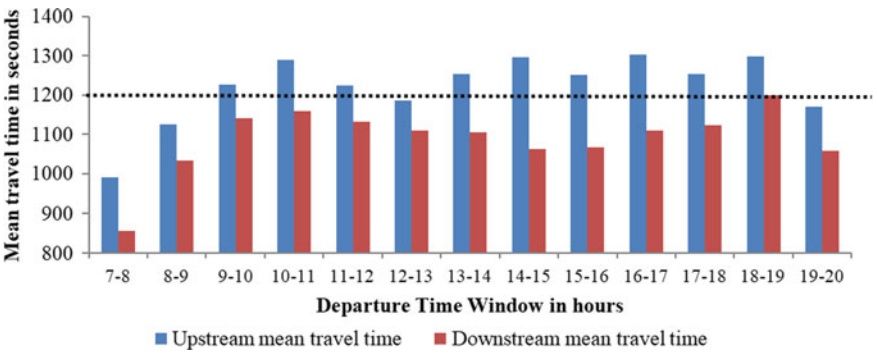


Fig. 2 Travel time in one hour DTW: TBS-KYA (up) and KYA-TBS (down)

in the graph that the upstream travel time is always higher than the downstream travel time throughout the day. The downstream travel times are within the allotted travel duration. The peaks of the DTWs during 10:00 to 11:00, 14:00 to15:00, and 18:00 to 19:00 are identified as morning peak, intermediate peak, and evening peak, respectively, and morning 7:00 to 8:00 is identified as off-peak.

Travel time distributions: A statistical distribution describes the relationship among the observations in a dataset. Data conform to a certain set of distributions and when a

Table 4 Kolmogorov–Smirnov test results (p-values) of the route in one hour departure time window (upstream)

Temporal scale	Sample size	The goodness of fit (KS test)					
		Gamma (2)	GEV	Log-normal	Logistic	Normal	Weibull (2)
7–8	23	0.471	0.231	0.426	0.461	**0.477**	0.291
8–9	23	**0.732**	0.580	0.726	0.724	0.713	0.721
9–10	25	0.736	0.608	**0.770**	0.710	0.664	0.426
10–11	24	**0.617**	0.472	0.546	0.515	0.576	0.566
11–12	23	0.933	0.867	0.918	**0.959**	0.950	0.512
12–13	22	**0.826**	0.188	0.702	0.795	0.716	0.792
13–14	22	0.768	0.479	0.743	**0.904**	0.803	0.846
14–15	24	0.435	0.104	0.427	0.555	0.446	**0.619**
15–16	22	0.813	0.816	0.832	**0.834**	0.763	0.570
16–17	23	0.905	0.142	0.885	**0.996**	0.959	0.973
17–18	23	0.797	0.081	0.760	**0.922**	0.863	0.818
18–19	24	0.790	0.087	0.758	0.939	0.816	**0.976**
19–20	22	0.932	0.858	0.917	0.917	0.934	**0.934**

most suitable distribution is identified, the direction for further analysis is prioritized. In this study, a statistical hypothesis test is conducted with a 5% level of significance to identify the distribution that fits the best for travel time data. The Kolmogorov–Smirnov (KS) test with the maximum likelihood estimation method is conducted for validating the goodness of fit. Through literature survey, gamma (2), GEV, log-normal, logistic, normal, and Weibull (2) distributions are selected for testing the goodness of fit.

The results of the KS test are summarized in Tables 4, 5 and 6, values in the table are the p-values, and the highest p-value of each sample data is highlighted. It is observed that the logistic distribution is the most common statistical distribution that fits the data. The probability density function of the logistic distribution of the upstream and downstream travel time is presented in Figs. 3 and 4, respectively. The top 1 and top 2 best fit distributions for one hour DTW and peak-off-peak hours are summarized in Table 7. It can be observed that the logistic regression is the best fit distribution at all temporal scales both upstream and downstream.

4 Conclusion

The study was conducted to characterize the variability in the public transit travel parameters of city bus service of Tumakuru city, India. The GPS logs of local public transit services were used for the variability analysis. The following observations were made from the analysis. (a) The allotted travel time is fixed and the same for

Table 5 Kolmogorov–Smirnov test results (p-values) of the route in one hour departure time window (downstream)

Temporal scale	Sample size	The goodness of fit (KS test)					
		Gamma (2)	GEV	Log-normal	Logistic	Normal	Weibull (2)
7–8	23	0.623	0.064	0.606	**0.734**	0.659	0.677
8–9	22	0.530	**0.742**	0.530	0.647	0.522	0.651
9–10	24	0.601	0.070	0.561	**0.80**	0.608	0.731
10–11	24	**0.801**	0.002	0.751	0.797	0.791	0.727
11–12	24	0.589	0.084	0.590	0.655	0.627	**0.693**
12–13	23	0.601	0.097	0.594	**0.655**	0.616	0.564
13–14	22	0.441	0.408	0.458	**0.505**	0.407	0.399
14–15	23	0.098	–	0.068	**0.166**	0.081	0.067
15–16	24	**0.952**	0.443	0.950	0.936	0.944	0.853
16–17	22	1.0	0.906	0.989	**1.0**	0.99	0.504
17–18	23	0.801	0.295	0.754	**0.824**	0.755	0.801
18–19	24	0.776	**0.851**	0.778	0.829	0.776	0.804
19–20	22	0.928	**0.960**	0.944	0.923	0.881	0.698

Table 6 Kolmogorov–Smirnov test results (*p*-values) of the route during peak hours

Temporal scale	Sample size	The goodness of fit (KS test)					
		Gamma (2)	GEV	Log-normal	Logistic	Normal	Weibull (2)
Peak hours: upstream							
All peaks	72	0.449	0.408	0.483	**0.714**	0.383	0.110
Peak hours: downstream							
All peaks	71	0.193	0.190	0.188	**0.262**	0.205	0.183

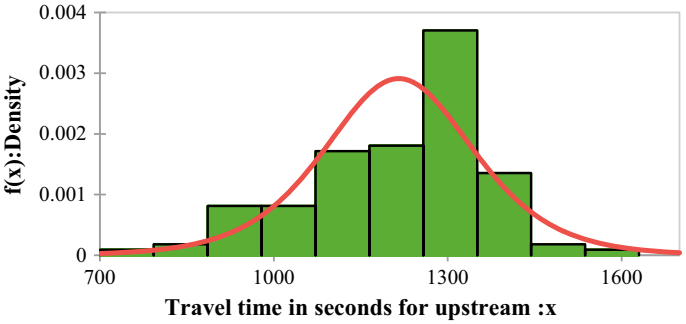


Fig. 3 Probability density function of logistic distribution: upstream

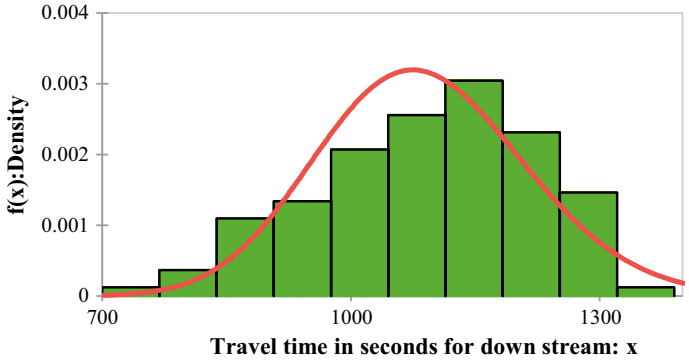


Fig. 4 Probability density function of logistic distribution: downstream

Table 7 Summary of "goodness of fit" test

Spatial–temporal scale	The best fit distribution	
	I	II
One hour departure time window: upstream	Logistic	Weibull(2)
One hour departure time window: downstream	Logistic	GEV
Peak Hours: upstream	Logistic	Log-normal
Peak Hours: downstream	Logistic	Normal

the upstream and downstream routes, while it is observed from the analysis that upstream travel duration does not adhere to, and exceed the allotted duration in most of the DTW. With this inference, transit operation planners can bring variation in the travel duration allotment instead of being fixed, for better utilization of the resources. (b) The coefficient of variation (COV) estimated for one hour DTW and peak-off-peak hours is less than 14%, which demonstrates the travel time is less dispersed from the mean and, if further optimized will make the travel times more reliable. (c) According to Kolmogorov–Smirnov test conducted to test the goodness of fit, logistic distribution is identified as the best fit distribution and it can be concluded that, for further analysis of travel times, models based on logistic function are suitable for Tumakuru city. The findings of the study can help the stakeholders to optimize the existing schedule and other transit operations.

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Chapter 61
Comparative Analysis of Waiting Delay Estimation Models for Signalized Intersections: A Case Study Tumakuru City

R. M. Savithramma and R. Sumathi

1 Introduction

Transportation communication is the most essential part of human society, and road network plays a major role in it. Rapid population growth is the main reason of increase in traffic volume and thereby leading to congestion on roads. This in turn leads to increased travel time for travelers. The time spent in traffic queue at signalized intersections add more for overall journey delay experienced by the travelers within the road network of urban areas.

The extent of heterogeneity in traffic, driver behaviors, road infrastructure, traffic volume, and efficiency of available traffic signal control system (TSCS) at signalized intersection are the major factors affecting the delay parameter. Research is in progress regarding optimization of TSCS. Many researchers across the world have proposed various solutions to improve the efficiency of TSCS with respect to delay mitigation. Some of the recent solutions proposed by applying cutting-edge technologies are summarized by Savithramma and Sumathi [1]. Thus, delay is an important parameter influencing the optimization of TSCS.

Accurate estimation of delay at intersections encountered by individual vehicle is not possible as the exact time of vehicle arrival in not known. With this limitation, many researchers across the world have proposed various average control delay estimation models and some of them are summarized in next section. Different models

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are suitable under different traffic conditions like structured, unstructured, oversaturated, under-saturated, etc. However, consistency is lacking among the models in estimating the delay.

Objective of this article is to present the comparative analysis of selected delay estimation models through case study. In this context, four different delay estimation models, namely Webster [2], HCM [3], modified Webster [4], and modified HCM [4] have been considered for the study. The chosen models are applied to estimate waiting delay at selected intersections. Then, the comparative analysis is conducted on estimated delays by computing different type of statistical errors. Two intersections, Shivakumara Swamiji Circle (SSC) and Townhall Circle (THS) from Tumakuru, Karnataka, India are selected for the study. The essential data is collected from selected intersections by observing the video recordings of an intersection. The collected data is used to estimate the delay, and then, comparison of the used models is presented with reference observed delays.

The remaining sections of the paper is organized as follows: the summary of some of the delay estimation models proposed by various authors is presented in next section. Section 3 gives the details about study area and the data collection. A brief description about the models formulated to estimate the intersection delay and those used in this paper is given in Sect. 4; whereas, the delay estimates obtained through the selected models, and the comparative analysis of the obtained results is presented in Sects. 5 and 6, respectively. Final section concludes with findings of the study.

2 Literature Review

Waiting delay estimation at signalized intersection plays a very important role in optimizing the traffic signal control system. Delay for individual vehicle varies with its arrival time at the intersection. In general, it is not easy to predict the vehicle arrival times as there is no prior information about it. Hence, there is a need for research in this direction in-order to design and develop delay estimation models. Worldwide research is ongoing concerning this issue from decades and proposed various delay estimation models. Some of the models proposed in recent two decades are summarized in this section.

Chen et al. [5] proposed an analytical model to predict the variance in delays that is experienced by the individual vehicle queued at the intersection. The model is developed based on delay evolution pattern under extreme conditions including oversaturated and under-saturated traffic condition. Dion et al. [6] have assessed the consistency among the research carried out with respect to delay estimation methods. Authors have estimated delays for signalized intersection operated with fixed-time signal controller under various traffic conditions like oversaturated and under-saturated using different models and presented the comparative analysis of the study.

A set of variables affecting the control delay at signalized intersection have been determined by Darma and Karim [7]. Transyt-7F, a widely used capacity software and SIDRA has been used by the authors in-order to compute the delay based on HCM method. Akgungor and Bullen [8] have proposed an analytical model for estimating the delay along with new methodology has been presented to estimate delay parameter *k*. Authors have considered the intersections with significant variation in traffic flow rate. The parameter *k* is expressed as degree of saturation.

Hoque and Imran [9], Minh et al. [10], Preethi et al. [11], and Saha et al. [4] have proposed modified version of Webster's delay estimation method in-order to make it suitable for non-lane-based and heterogeneous traffic conditions. Hoque and Imran [9] have considered Dhaka, a city in Bangladesh and Minh et al. [10] have selected Hochiminh, a city in Vietnam as study area, while two cities from Kerala, India are selected for study in [11]; whereas, Saha et al. [4] have considered 15 cities from different parts of India as study area. The authors have proved the potentiality of proposed models in comparison with Webster. Also, Saha et al. [4] have proposed modified version of HCM as well with same study area and proved its superiority over traditional HCM method.

A study presented by Hellinga and Abdy [12] demonstrated that, the significant impact of day-to-day peak-hour volume variability at each approach of intersection on delay experienced by travelers. Ghavami et al. [13] have assessed the performance of three different TSCS algorithms, namely pre-timed, maximum weight (MW) and adaptive MW algorithms, in-terms of average waiting delay experience at the signalized intersections. Through their analysis, authors able to show the superiority of adaptive MW scheduling algorithm over pre-timed algorithm. Prasanna Kumar and Dhinakaran [14] presented a study on various issues associated with waiting delay estimation under heterogeneous traffic conditions in countries like India. Five intersections in Tamilnadu, a city in India, were studied and discussed the methods to overcome the problems enlisted.

An analytical model to study delay variability at isolated signalized intersections controlled by pre-timed scheduler is developed by Chen et al. [15]. The impact of delay in optimizing the traffic signal configuration with actuated controller is presented by Feng et al. [16] through CORSIM simulation. Fawaz and El Khoury [17] have proposed a novel delay model to estimate various delay components including initial queue delay, uniform delay, incremental delay, and control delay. Saw et al. [18] have presented the study on various delay components through probe vehicle. Mohd Amin Shafii et al. [19] have applied HCM delay model to determine the delay at signalized intersection through case study thereby assessing the level of service (LoS) at selected intersections. Cheng et al. [20] have presented a comprehensive review on existing theoretical delay estimation models along with the comparative analysis.

3 Data Collection

Two intersections, SSC and THC in Tumakuru, Karnataka, India, are considered for the study. Both intersections are located on state highway, Bangalore-Honnavara (BH) road with 2.1 km apart from each other. BH road is connecting commercialized area, hospitals, educational organizations railway terminal, and main bus stand. Therefore, always there will be a high traffic flow rate along the BH road. Physical design of both the intersections along with permissible traffic flow phases is shown in Fig. 1 and 2.

Details of study intersection are provided in Table 1. With the development of technology, there exists various methods to collect the traffic data and some of the recent data collection sources and technologies are summarized by Ashwini and Sumathi [21]. Tumakuru is one of tier-II cities in Karnataka, India. It has been considered to be a smart city and currently smart city project is in progress. As a result, six intersections along the BH road are signalized. Each signalized junction is deployed with higher resolution cameras to know the real-time traffic status. The traffic video recordings are gathered from authorities of Tumakuru Smart City Limited. In this study, the required data is extracted through recorded videos on week days from 05/04/2021 to 10/04/2021 during 10:00 am to 12:30 pm. On an average 200 to 300 cycles are observed at study intersections and the aggregates of the data observed are given in Table 2. The data collected is classified as traffic data and signal data.

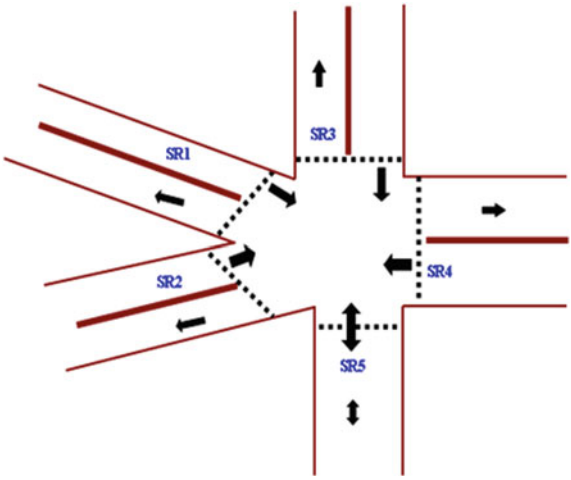

Fig. 1 Shivakumara Swamiji circle

Fig. 2 Townhall circle

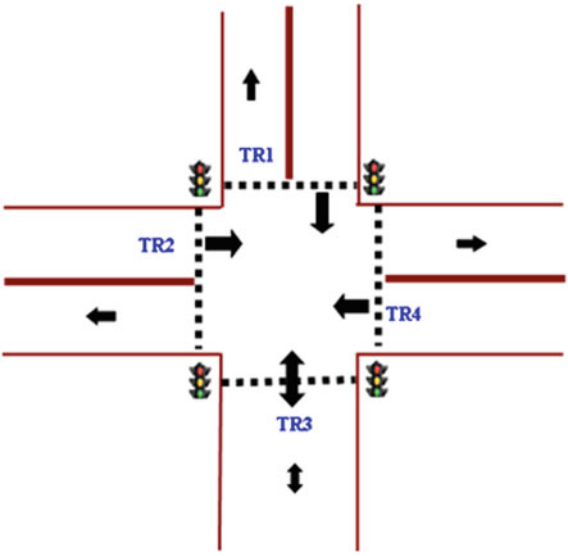

Table 1 Details of intersections under study

S. No.	Intersection	Road ID	Roads approaching from	Road width (m)
1	SS circle	SR1	Sira gate	10.5
		SR2	TH circle	07.0
		SR3	City internal	03.0
		SR4	Batawadi	10.5
		SR5	Stadium	03.0
2	TH circle	TR1	Bus stand	10.5
		TR2	Caltex circle	07.5
		TR3	Municipal corporation	03.0
		TR4	SS Circle	10.5

4 Delay Estimation Models Used

The delay can be either estimated through direct observation of average waiting time of individual vehicle or by applying mathematical models. Researchers are still active in this area to develop mathematical models, that provides accurate delay estimations and suitable for various traffic conditions. Traffic patterns such as volume, composition, volume-to-capacity ratio, and arrival flow rate are the major deciding factors of waiting delay at intersections. In this context, four delay estimation models considered in this study and are briefed in this section.

Table 2 Aggregate of data collected at study intersections SSC and THC

Signal data						Traffic data							
RID	CT (S)	RT (S)	GT (S)	2 W		Auto		Car		LCV		Bus	
SR1	152	120	32	30	23	5	10	12	12	3	4	1	2
SR2	152	117	35	44	33	15	30	10	10	1	1	3	7
SR3	152	140	12	8	6	1	2	2	2	1	1	0	0
SR4	152	107	45	46	35	14	28	18	18	3	4	2	4
SR5	152	124	28	10	7.5	2	4	10	10	1	1	1	2
TR1	119	94	25	16	12	7	14	4	4	3	4	0	0
TR2	119	79	40	40	30	8	16	7	7	4	6	4	8
TR3	119	110	9	10	7	1	1	3	3	3	4	0	0
TR4	119	74	45	50	38	12	25	9	9	5	7	4	8

Road ID (RID); Cycle Time (CT); (Red Time (RT); Green Time (GT); Count (Cnt); Light Commercial Vehicle (LCV)

4.1 HCM Delay Estimation Model

HCM delay estimation model in Eq. (1) is one of traditional models published in TRB-2000. The formulation of this model is based on traffic conditions and traffic rules followed in USA.

$$d_c = d_1(f_{pf}) + d_2 + d_3 \tag{1}$$

where

$$d_1 = 0.5 * C + \frac{\left(1 - \frac{g}{C}\right)^2}{\left(1 - \text{Min}\{\text{X}, 1.0\} * \frac{g}{C}\right)} \tag{2}$$

$$d_2 = 900 * T \left\{ (X - 1) + \sqrt{(X - 1)^2 + \frac{8KIX}{cT}} \right\} \tag{3}$$

$$f_{pf} = \frac{(1 - P) f_p}{1 - \frac{g}{C}} \tag{4}$$

where

d_c: Control delay per vehicle (s/vehicle).

d_1: Uniform control delay (s/vehicle).

f_{pf}: Adjustment factor determining the quality of signal progression for traffic movement.

d_2: Incremental delay caused due to random arrival rate and oversaturation (s/vehicle).

Table 3 Progression adjustment factors

Arrival type (AT)	Type of platoon	Time of platoon arrival	*fp*
AT-1	Dense	Start of red phase	1.00
AT-2	Moderately dense	Middle of red phase	0.93
AT-3	Random	Random arrival	1.00
AT-4	Moderately dense	Middle of green phase	1.15
AT-5	Dense	Start of green phase	1.00
AT-6	Dense	–	1.00

d_3: Initial queue delay (s/vehicle).
C: Cycle length (s).
g: Effective green time (s).
v: Actual traffic volume (Total PCU/h).
c: Maximum volume capacity of road (Total PCU/h).
X: Volume-to-capacity ratio (v/c).
K: Incremental delay factor (0.50 for pre-timed signals).
I: Upstream filtering adjustment factor (1 for an isolated intersection).
T: Analysis time period (h).
P: Proportion of vehicle arriving during green interval.
f_p: Progression adjustment factors as given in Table 3 recommended by TRB 2010.

4.2 Webster Delay Estimation Model

Webster's delay model given in Eq. (5) is another conventional and worldwide used delay estimation model. The model is formulated based on traffic conditions and traffic rules followed in UK.

$$d = \frac{C(1-\lambda)^2}{2(1-\lambda X)} + \frac{X^2}{2V(1-X)} - \frac{0.65C^{(1/3)}}{V^2}x^{2+5\lambda} \tag{5}$$

where
d: Average delay/vehicle for an approach (s).
C: Cycle length (s).
g_e: Effective green time (s).
λ: Effective green time to cycle length ratio for particular phase(g_e/i).

4.3 Modified HCM and Webster Delay Estimation Model

HCM and Webster delay estimation models are developed for scenarios where drivers adhere to the strict lane disciplines and the traffic is homogeneous in nature. However, the traffic conditions in all localities across the world is not same. Therefore, Arpita Saha et al. [4] proposed a modified version of HCM and Webster delay models that suit the traffic scenarios in India. The modified HCM model to compute control delay (d_c) is given in Eq. (6)

$$d_c = d_1 + d_2 + d_3 \tag{6}$$

The first term d_1 is uniform delay computed as in Eq. (2) and the third term d_3 is initial queue delay which is assumed to be zero; whereas, the second term d_2 is incremental delay encountered due to random traffic arrival rate which is computed as in Eq. (7).

$$d_2 = 6.23 - 15.35 * R_p \tag{7}$$

where R_p is the platoon ratio computed as per the Eq. (8)

$$R_p = \frac{PVG}{PTG} \tag{8}$$

where

PVG: Percentage of vehicle arriving during green time.

PTG: Percentage of green time.

The modified Webster model to compute control delay (d_c) is given in Eq. (9)

$$d_c = 6.23 + \frac{0.5 * C * \left(1 - \frac{g}{C}\right)^2}{1 - X * \frac{g}{C}} - 15.35 * R_p \tag{9}$$

5 Results

Travel delay is the additional time spent on road, may be due to congestion or unexpected real-time events or because of waiting at signalized intersections. Various delay estimation models are available among which four models are selected as described in Sect. 4. Average delay estimated at selected intersections using these models is presented in Table 4 along with actual delay observed.

Table 4 Average control delay computed using various methods

Circle name	Road ID	Observed delay (s)	Delay (s) by Webster method	Delay (s) by modified Webster method	Delay (s) by HCM method	Delay (s) by modified HCM method
TH circle	TR1	42.30	44.81	42.44	48.90	48.13
	TR2	44.22	38.20	37.52	49.41	41.32
	TR3	55.30	51.83	45.32	52.42	48.49
	TR4	47.75	34.55	34.02	46.79	39.98
SS circle	SR1	58.60	56.90	50.24	58.21	57.34
	SR2	52.50	56.94	56.42	65.92	59.98
	SR3	65.20	67.12	60.46	66.00	64.34
	SR4	45.80	52.06	52.76	63.61	59.20
	SR5	60.00	63.49	60.51	63.69	65.02

6 Comparative Analysis

Always there is a possibility of error occurrence while performing statistical analysis of any component. Error is the difference between actual and computed values. There are set of ways to measure this error such as mean absolute error (MAE), mean square error (MSE), root mean square error (RMSE), and mean approximate percentage Error (MAPE). All the aforesaid type of error computation strategies are applied in this study in-order to identify the model which produce near correct delay values. The error encountered between observed and estimated delay values is presented in Table 5.

It is clear from the error value table, the Webster and modified HCM are able perform well when compared to other two models. However, all the four models are able to estimate approximately correct delay with 89% accuracy.

Table 5 Difference between observed and estimated delay: error computation

Error type	Webster method	Modified Webster method	HCM method	Modified HCM method
MAE	4.78	6.12	5.75	5.70
MSE	34.04	54.38	65.71	45.80
RMSE	5.83	7.37	8.11	6.77
MAPE	9.69	11.93	11.89	11.59

7 Conclusion

An abstract study of intersection delay estimation models is presented in this article. The study is conducted to perform comparative analysis of different delay estimation models. In this context, two intersections, namely Townhall Circle and Shivakumara Swamiji Circle in Tumakuru, one of tier-II cities in Karnataka, India are considered for the study. The essential data is extracted through recorded videos of selected intersections. Then, the waiting delay for each approach is computed using Webster, HCM, modified Webster [15], and modified HCM [15] models. The estimated delays are compared with observed field delays. Further, the delay estimation models used in this study are validated by computing various types of errors including RMSE, MAE, MSE, and MAPE. Results revealed that, the Webster delay model can estimate delays nearer to observed values than other three models. However, next nearest results are estimated with modified HCM model. However, all four models able to produce correct delay estimations with ≈89% accuracy. Finally, the study inferred that, both models, the Webster and modified HCM [15] delay estimation methods are suitable for Tumakuru in comparison with other two methods.

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Chapter 62
Effect of Different Fine Aggregate Materials in Mechanical Properties of Concrete

Muddana Surya Prasanth, Mahendrakar Hemanth Kumar, and Chadalawada Chandrasekhar

1 Introduction

M-sand obtained from igneous rock will be cubical in shape and has a size less than 4.75 mm. Copper slag and ferrous slag are a by-product of copper ore and steel ore, respectively, which produce large volume of non-metallic dust, soot, and rock. The usage of copper and ferrous slag as fine aggregate increases the strength at 40% replacement [1]. The compressive and flexural strength increase due to toughness of copper slag [2], which also increases the density of concrete. Water absorption of ferrous slag is less than river sand [3]. Moreover, the compressive strength increases by replacing river sand with ferrous slag to 40%. Study on partial replacement of coarse aggregate by iron slag improves compressive strength to 30%. Moreover, flexural strength increases at 20% of partial replacement to coarse aggregate with iron slag [4]. Experimental study on partial replacement of natural sand with M-sand will improve both compressive and tensile strength at 15% replacement [5]. Addition of 2% of steel fibers improves flexural strength along with 50% replacement of GGBFS with normal cement, which also studies mechanical and durability properties of concrete. Also, addition of 1% of steel fibers enhances compressive strength along with 20% replacement of GGBFS with normal cement. 20–40% of iron slag improves strength for self-compacting concrete [6]. Physical properties of cement, river sand,

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Table 1 Mix proportions of different materials

Mix type	Cement (%)	River sand (%)	M-sand (%)	Copper slag (%)	Ferrous slag (%)
M_0	100	100	0	0	0
M_1	100 100	40	25	25	10
M_2	100	30	25	25	20
M_3	100	25	25	25	25

Table 2 Properties of river sand

S. No.	Property	Test result
1	Fineness modulus	2.86
2	Bulk density	1.6687 G/Cc
3	Water absorption	1.76%
4	Specific gravity	2.6

manufactured sand, and coarse aggregates were examined. The destructive and non-destructive tests were conducted on specimens at various combinations (Table 1) of normal cement, GGBS, copper slag, and river sand.

2 Materials and Properties

2.1 Cement

Ordinary portland cement of 53 grade was used in this paper. The normal consistency and specific gravity of OPC were obtained are 32% and 3.12, respectively. Moreover, the initial setting time, final setting time, soundness, and fineness of cement obtained are 185 min, 480 min, 2 mm, and 2%, respectively.

2.2 River Sand

River sand of size less than 4.75 mm was used in this paper (Table 2).

2.3 Coarse Aggregate

The maximum size of coarse aggregate used in this paper is 20 mm (Table 3).

Table 3 Properties of coarse aggregate

S. No	Property	Test result
1	Fineness modulus	2.86
2	Bulk density	1.6948 g/cc
3	Water absorption	0.6%
4	Specific gravity	2.78
5	Flakiness index	20.44%
6	Elongation index	14.57%

Table 4 Properties of M-sand

S. No.	Property	Test result
1	Specific gravity	2.81
2	Fineness modulus	2.8
3	Water absorption	1.24%

Table 5 Properties of ferrous slag

S. No.	Property	Test result
1	Specific gravity	2.9
2	Bulk density (g/cc)	2.8
3	Specific surface area (m^2/kg)	1.03%

2.4 M-Sand

M-sand of cubical shape which has size less than 4.75 mm is used (Table 4).

2.5 Ferrous Slag

Ferrous slag is a by-product formed during the steel melting process. The properties of ferrous slag are mentioned in Table 5.

2.6 Copper Slag

Copper slag is a by-product created during the copper smelting and refining process (Table 6).

Table 6 Properties of copper slag

S. No	Property	Test result
1	Specific gravity	2.8
2	Fineness modulus	2.7
3	Water absorption	1.29%

3 Results

The compressive strength of concrete using destructive tests for 3days, 7days, and 28days is represented in Fig. 1. The strength for mix type M2 increases with increase in age.

The compressive strength of concrete using non-destructive tests for 3days, 7days, and 28days is represented in Fig. 2. The strength for mix type M2 increases with increase in age.

The rebound numbers obtained from non-destructive tests are represented in Fig. 3. The rebound number is maximum for mix type M2 and increases with increase in age.

The pulse velocity for mixes M0, M1, M2, and M3 with respect to 7 and 28 days is more than 4.5 km/s shown in Fig. 4. Moreover, the pulse velocity for mix M1, M2,

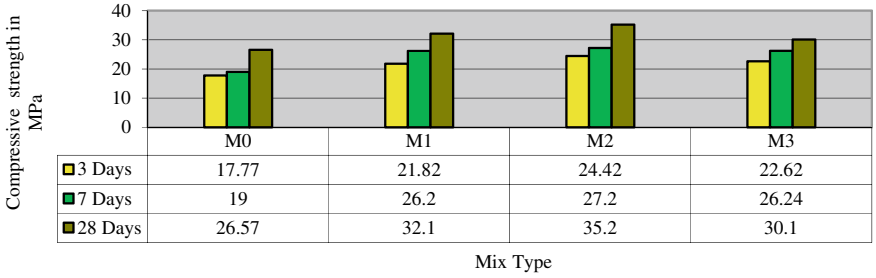


Fig. 1 Compressive strength of concrete using destructive tests

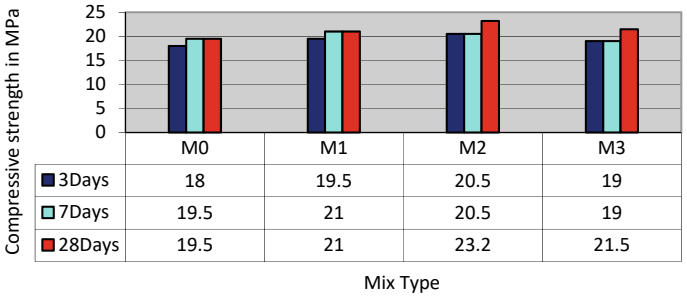


Fig. 2 Compressive strength of concrete using non-destructive tests

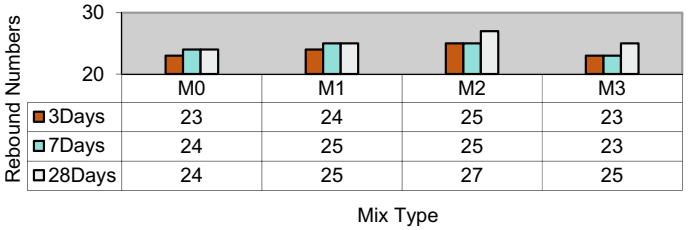


Fig. 3 Rebound numbers using non-destructive tests

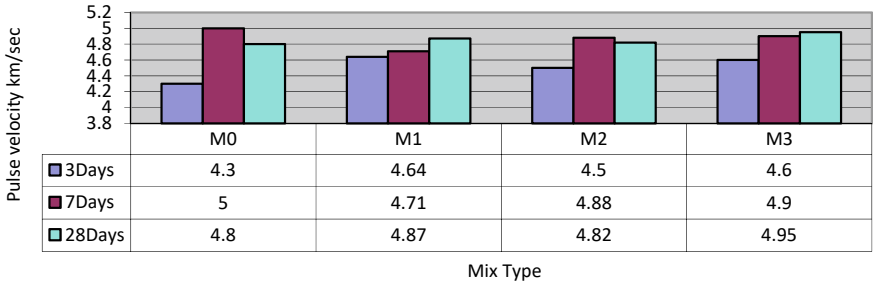
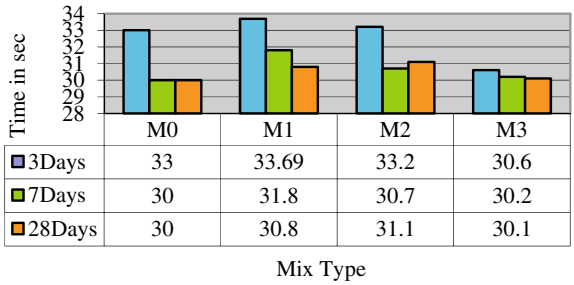


Fig. 4 Ultrasonic pulse velocity of concrete using non-destructive tests

Fig. 5 Time taken by concrete for various mix types using non-destructive tests



and M3 for 3 days is more than 4.5 km/s. As per velocity criteria for concrete quality grading IS:13311 (Part-1) 1992, the quality of concrete is excellent.

The time obtained for different mix types with increase in age is mentioned in Fig. 5.

4 Conclusion

The compressive strength of concrete increases up to mix type M_2 and slightly decreases for mix type M_3. The results obtained from destructive and non-destructive

tests except ultrasonic pulse velocity also gives satisfactory results up to mix type M_2 and decreases for mix type M_3. The ultrasonic pulse velocity is very high for type M3. The usage of copper and ferrous slag should be limited. Moreover, excessive usage of copper and ferrous slag in concrete may reduce the strength as well as stiffness of concrete. Moreover, the increase in percentage of M-sand beyond the limit will not largely affect the compressive strength of concrete.

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Chapter 63
A Critical Analysis on Applications and Impact of Emerging Technologies in Employment and Skills Domain in e-Governance Projects

Yashpal Soni, Geeta Chhabra Gandhi, and Dinesh Goyal

1 Introduction

> The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn—Alvin Toffler

Demographic distribution of India gives an opportunity for fast economic growth. We have bright prospects for resulting growth through planned investments and policies, as the labor force is increasing and the number of children or seniors to depend on decreases. The Indian government is leveraging the existing workforce through vocational education and training programs and implementing new skills programs (Table 1).

The correlation between emerging technologies, employment, and skills has acquired a place of considerable interest in the recent past. The prime reason behind this interest is studies suggesting potential side effects on employment due to growing use of novel information and communication technologies (ICTs), which include artificial intelligence, automation, IoT, etc. Although, several researches have demonstrated that innovation also creates employment in scenarios where cognitive thought process is required. Emerging technologies tend to support some selective skills and making some redundant by lowering the demand for them by industries that adopt such emerging technologies in their business model.

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https://doi.org/10.1007/978-981-19-2065-3_63

Table 1 Workforce of India. Source: Times of India, Feb, 2021

Year	Indian population (Age group 15–59) (%)
2020	62.6 (increasing year-on-year)
2036	~65 (reach its peak)

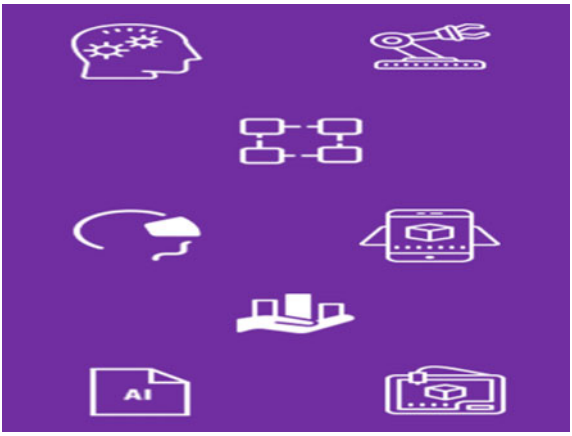

Fig. 1 Technology and governance [2]

In India too, the employment opportunities in mundane jobs have dropped considerably over the last few years in many sectors, regardless of whether the skills required to accomplish these jobs and tasks have a cognitive or a mechanical character [1]. Consequently, the demand for semi-skilled people has reduced, whereas the demand for both high and low skilled human resources has increased. Thus, creating a situation termed as "job polarization." Although, the government is not liable for safeguarding industries from disruptions occurring due to innovations, but the government's duty is to facilitate workforce to adapt and make effective transitions (Fig. 1).

This paper endeavors to highlight the relationship between innovation, emerging technologies, employment, and skills. The paper shall also attempt to showcase potential use cases for implementing emerging technologies in employment and skills domain, more specifically in the context of Rajasthan.

2 Start-ups and Employment

The start-up ecosystem will be more beneficial to those who have access to financial and social capital and the necessary skills to take advantage of emerging technologies. Government and industry are becoming catalyst in the start-up space and are likely to significantly increase investment in emerging technologies over the next decade.

Employment gains from product innovation are a major driver of job growth; however, they come at a cost. New products with greater utility and/or lower prices

Table 2 Sector wise start-up funding in India [3]

Sector	Funding (US $ billions)
e-Commerce	16
Fintech	10
Consumer service	6
Transport tech	5
Enterprise tech	5

Source Rajasthan Patrika; 12th Dec, 2020

will replace existing products offered by the company or its competitors. Therefore, demand for new products may come at the expense of existing "old" products. Product innovation can have two negative effects: first, a negative impact on the innovator itself (called a "cannibalization" effect); and second, a negative impact on competitors (a "stealing business" effect). Both effects may reduce the initial job creation effect of product innovation. Research shows that innovative firms outperform non-innovative firms when it comes to job growth, regardless of the stage of the business cycle; they create more during upswings and booms and reduce jobs during recessions. There are more than 40,000 start-up firms in India, and 34 start-ups have grown to become unicorns (Table 2).

3 Employment and Skills in Rajasthan

With the changing trends in employment, it is evident that we are going through a skills revolution. Technological evolution is continuously impacting organizations, thereby rapidly changing the list of in demand skills, moreover the industries are not able to get the kind of workforce they require to handle this change. Therefore, there is a constant need to upskill and reskill the workforce to ensure their employability in the coming time [2].

In Rajasthan, to better focus on skills development and entrepreneurship, the Rajasthan government has created a new ministry of skills, employment and entrepreneurship, integrating the verticals of ITI, employment exchange, RSLDC, and apprenticeships.

Important organizations:

- Skill, Employment and Entrepreneurship
- Rajasthan Skill and Livelihoods Development Corporation (RSLDC)
- Rajasthan ILD Skilled University (RISU)
- Labor Department, Rajasthan

To address and minimize the skill gap, the RSLDC is forging partnerships with industries and identifying skills needed for a more demand-based approach. The RSLDC is also taking cognizance of the district level skill gap to ascertain and find

Fig. 2 Details of youth trained through RSLDC [2]

local employment opportunities that can be catered through suitable courses and programs.

The RSLDC's ambitious vision is based on skilling, reskilling, and upskilling of individuals to participate in the global knowledge economy driven by emerging technologies. It is also considered to be a central pillar of employability, employment of workers, and sustainable enterprise development (Fig. 2).

Government of Rajasthan has also implemented pioneering applications like Raj Kaushal to bring all the job seekers (labors and other manpower) and employers on the same platform.

The impact of emerging technologies on the future of work needs to be assessed in terms of unemployment and changing employment conditions. Employment conditions may include job security, social security, and a safe work environment. The survey is particularly relevant in the context of Rajasthan.

Another related question is to explore strategies on how to leverage emerging technologies in the complex socioeconomic and cultural employment environment of Rajasthan.

3.1 Use Cases of Emerging Technologies

Occupations and jobs include a variety of tasks that require a combination of specific dexterity and skills. Therefore, the feasibility of automation needs to be assessed accordingly, keeping in mind the technical expertise required to automate these tasks. With the adoption of emerging technologies, the ease and scope of automating routine and rules-based tasks, both manual and cognitive, will rapidly increase [4]. However, it will be challenging to automate unconventional tasks. NSSO data says only 20% of Indian population is highly skilled for working in cognitive domain (Social Science Research Network, 2017) (Fig. 3).

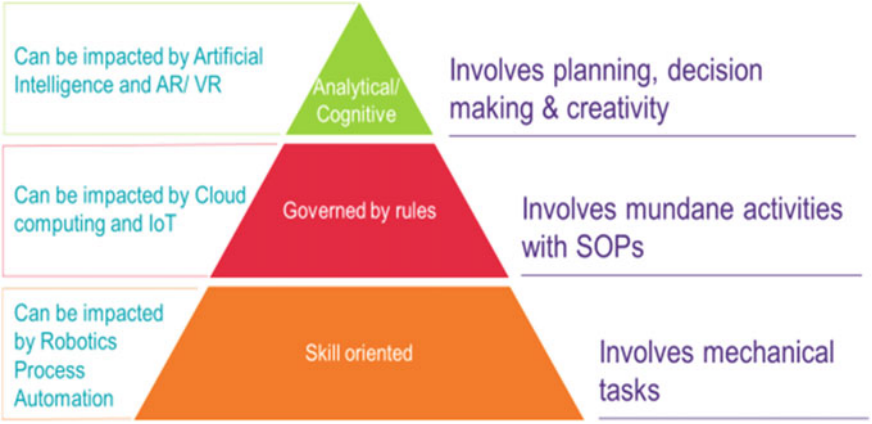

Fig. 3 Impact of emerging technologies on jobs [5]

Fig. 4 Technologies of 4IR (https://viaafrika.com/what-is-4ir/)

The 4th Industrial Revolution (4IR), can be characterized by the convergence of above mentioned technologies and will be involving in business models, production processes, service delivery and frameworks for employment relations, and social protection [6].

Although, the initial adoption of these technologies will be in niche areas of the organized manufacturing and service sectors. Workflows in service departments, especially those involving routine and repetitive tasks, have a high potential for automation. Certain industries like finance, legal, and IT services will see higher adoption rates [7].

In view of the above following use cases (but not limited to) have been identified, which are likely to have an impact in the in employment and skills domain.

3.1.1 Blockchain

Blockchain is a digital ledger technology, wherein non-cash transactions are being recorded digitally and are made available over a computer networks, enabling the decentralized generation, storage, and transmission of information. Although still in its early stages of spread and development, blockchain technology is already being used for currencies (such as Bitcoin), shipping, and supply chain integration, etc. Blockchain can be adopted in the employment field to verify the following:

Employer's perspective

- Employment history
- Education records
- Identity documents
- Projects completed

Employee's perspective

- Job authenticity
- Rewards and incentives

3.1.2 Data Analytics

Data analytics-based approaches can reflect trends in strategic management in business and talent. Companies in developed countries are assessing "learnability" of the prospective employees using analytics base digital recruitment tools. These tools may be either online gaming-based assessment tools that capture the competence, curiosity, and other personality traits in form of video analytics for judging communication skills.

- Skill mapping and job recommendations
- Trend analysis and forecasting

3.1.3 3D Printing

In India, the use of 3D printing is for manufacturing and is growing rapidly and now local manufacturers sell 3D printers locally. 3D printing has emerged as a service, and is most popular among automakers, health care and infrastructure. It is very fast, but still is not public and viable for masses, which requires sophisticated software's in open access and technology training, both of which are currently lacking in India.

- Creating artifacts and handcraft products

3.1.4 IoT

The "Internet of Things" (IoT) refers to the concept of communicating with devices over Internet, resulting in data flow from one device to another and being shared and

used for various objectives, including analytics. IoT use technologies like sensors, processors, cloud computing, and ubiquitous connectivity.

- **Internet of behavior (IoB)** gives the opportunity to organizations so that they can invest in their employees by monitoring the behavior of its employees or consumers and take respective actions to facilitate more efficiently. Some of the effective technology tools used in IoB are big data, location tracking, and facial recognition
- Training and testing of candidates by the skills development center
- Smart factory technologies, from sensor-embedded systems to artificial intelligence, platforms that help operate connected machines
- Farmers use a connected network of agricultural object sensors to help them control and manage equipment based on real-time information. IoT devices have also been proposed to exchange information between farmers.

3.1.5 Artificial Intelligence

Artificial intelligence is a domain in computer engineering/science that enables machines to perform tasks like humans, like learning and decision-making. AI has a variety of applications, like intelligent system for crop monitoring conditions (weather and soil analysis). Combined with artificial intelligence, IoT becomes important to help farmers maximize and protect their crop yields.

- Robotics process automation (RPA) for document scrutiny
- Automation of hiring process
- ChatBot for applicants
- Jobs like cashiers, receptionists, legal aids, and travel agents are thus most vulnerable to the impact of automation.

3.1.6 Robotics

The term "robot" refers to a machine/hardware that can be programed to perform a variety of tasks, with limited or no operator input.

The automotive industry is leading the way in the use of industrial robotics, with established automakers increasingly using robotics to replace manual labor. Nearly 550 robots work at Ford plants, 400 at Hyundai plants, and another 4200 at Honda and Suzuki plants (Robotics Business Review, 2015). In case of agriculture, the productivity is dependent on various factors including soil, weather, moisture, weeds, pests, labor, and energy. These require continuous monitoring and proper measures at right time, which can be done by using robotics. Dripping, application of weedicide and pesticide, and sowing are some functions which can be managed by robotics.

3.1.7 Augmented Reality and Virtual Reality

Augmented reality (AR) uses digital elements to enable the live view, usually by using the camera on a smartphone. Virtual reality (VR) means a fully immersive experience that mingles with the physical world. AR/VR benefits people with disabilities, making their daily activities easy. Augmented reality's sensing capabilities could make workplaces, schools, and public spaces more accessible to people with a variety of conditions.

3.1.8 Learning Management Systems (LMS)

LMS is a software-based tool/platform that helps educators and administrators manage and organize educational materials and track student progress. It is also used for content design and facilitates online learning. Over the time at school/higher education and training level, offering of pure online/hybrid mode of offering courses has increased a lot. Also, online course called massive open online course (MOOC) has proliferated in recent years. Vocational training systems use the Open University platform and MOOCs to expand their outreach, taking full advantage of their potential to revolutionize education delivery [8].

Features of LMS are content management, reporting, student progress tracking, grading, feedback, collaboration tools, assessment creation, and management. LMS supports component-based approach. The component-based engineering is very common trend in the IT industry. In this approach, reusable components assemble the software. These components are created earlier and store in its repository, then they are used for software development (Fig. 5).

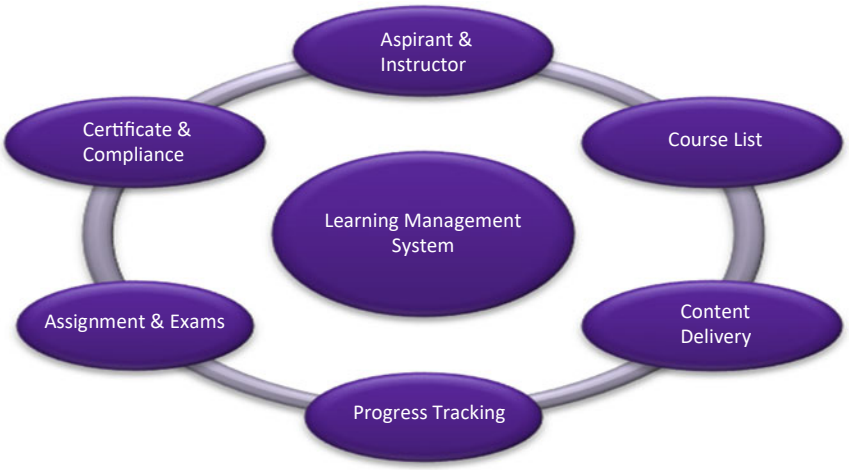

Fig. 5 Key components of LMS [9]

LMS platforms are available in various forms such as cloud-based LMS, SaaS, open-source LMS, free LMS, etc. It can be used in multiple sectors such as government organizations, educational institutes (school and universities), almost all corporates and organizations, and private tuition and institutions. And requirement of the organization will decide the selection of LMS type. For example, Google Classroom is a cloud-based LMS tool while Moodle offers both, cloud based on premises services. "Some other example of LMS tools are Mindflash, Skyprep, Moodle, Canvas, Blackboard, etc."

Learning through LMS can be broadly classified into two categories, i.e.,

- **Synchronous Learning:** Synchronous learning gives opportunity to provide the traditional classroom learning in an online format where participant can do the learning from anywhere. It is the type of learning where group of people do the real-time interaction. This kind of learning is useful for new training/online course along with web conference tool.
- **Asynchronous Learning**: In this type of learning, aspirant and other people do not take part in the learning cycle at the same time. Aspirant do not take part in any real-time interaction with the other people or trainer. Such kind of learning is useful when aspirant want to schedule their learning according to their availability/suitability. Example of asynchronous learning are, pre-recorded videos for creation of online content.

4 Challenges

With the fast pace changing of technology, the existing workforce in the country may be not prepared and will have skill issues as new ways of working and tools needs to be quickly imbibed for the industry for effective delivery. If we critically analyze the age factor and learning curve, people in middle age will take time to adapt with the new ways of working of emerging technologies, while young blood, is properly mentored may quickly adapt with the new emerging tools. In next era of revolution, people tend to evolve learning capability by behavior, by observing and or by becoming part of the implementation teams, which will evolve new job prospects.

We as a country need to strengthen the ecosystem for the next industrial revolution in the country in terms of penetration of internet till grass root level, extending quality power supply, and water availability till the remote levels.

5 Conclusion/Recommendations

The transformation in the ways of working has cascading impact on the development of the able workforce. The demand of emerging technologies will increase at multiple

levels resulting in crunch of the skilled manpower in the ecosystem. All continuous processes will be replaced by automation and many jobs will be redundant in times to come. Government may take this an opportunity to train new workforce by way of various flagship programs in emerging technologies for sustainable growth. Skill development and Fintech universities will play a pivotal role in shaping skill set in the state as well as national level. The recommendation for technology strategy may include strategies to incentivizing various emerging technologies and at the same time formulating policies and standards so that the same may not be misused specially in the area of cryptography trajectory. This will not only maintain policy standards but also enable new comer who wants to excel their learning curve at a very fast pace as per the requirement of the job market.

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Chapter 64
Risk and Challenges in Intelligent Systems

Akshita Rastogi, Shivam, and Rekha Jain

1 Introduction

AI is the basis of computer science applications. The main purpose of intelligent machines is to copy human activities to be used to enhance their natural abilities or to simplify their lives. Other major AI-based software includes Google Cloud Machine Learning Engine, TensorFlow, Azure Machine Learning Studio, Cortana, IBM Watson, etc. However, if you look at the bright side of an object, you have to admit that there is a dark side to it. Similarly, apart from several benefits offered by AI, it also has some problems that we cannot ignore. Most investigators agree that intelligent AI is unlikely to express human feelings like respect, disobey, and that there is no reason to expect AI to be kind or coercive. Instead, when taken into consideration how dangerous or destructive AI can be, experts consider two possible scenarios:

1.1 AI is Created to Do Something Dangerous

Independent weapons are artificial intelligence systems designed to kill. In the hands of the wrong person, these weapons can easily injure many people. In addition, the AI arms race can lead to an unintentional AI battle and lead to many casualties. To avoid being distracted by the enemy, these weapons would be designed to be extremely difficult to simply "close up," so people would be losing control of the situation. This danger is the one that exists even in the smallest AI, but it grows as the levels of AI intelligence and independence grow.

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1.2 Artificial Intelligence Is Designed to Build an Asset, But It Favors a Wrong Approach to Achieving Its Aim

The reason is because whenever all lack to fully assign artificial intelligence goals with ours, which is surprisingly complex. If you have question like you tell to a smart listening car to take you to the airport as fast as possible, they may find you when you are fired by helicopters and blocked by repatriation, do not do what you want but what you have actually asked for. If a highly smart system is given the problem of intelligent geo-engineering project, it could be a serious problem to our ecosystem as a side effect, and view human efforts to prevent it as a threat to be met.

As these above examples show, the concern for advanced artificial intelligence is not violence but power. Extremely smart artificial intelligence will be effective at achieving its goals, and if those goals do not match ours, that means our artificial intelligence is not accurate. You are probably not the person who hates the evil ant that treads on ants for evil, but if you have a green energy project and there is an ant in the region that should be flooded, it is very bad for ants. The main purpose of artificial intelligence security research is to never put humanity in the position of those ants.

2 Risk in Intelligent System

2.1 Automation-Promoting Job Losses

Work automation is considered a major problem. It is not just a case of whether artificial intelligence will restore and contain similar functions, yet at which level. In lot of productions—especially yet not just the one where employees perform similar operation every day or detectable task—disruptions continue. According to a 2019 Brookings Institution study, there are 36 million people who work in jobs with "high exposure" to automated machines, which means that at least 70% of their jobs—from retail sales and market analysis to hospitality and storage—will be automate using intelligence. A new Brookings report says that suit and tie worker could actually be at automate of high risk. And with a 2018 report from McKinsey & Company, African American workers will be severely beaten. The dangers of artificial intelligence "The reason we have a low unemployment rate, which does not catch job-seekers, especially because low-wage jobs are very well created by the economy," future expert Martin Ford (left) told Built In. "I don't think that will continue".

2.2 The Emerge of "DEEPFAKES"

As loss of work is nowadays most critical issue associated with artificial intelligence disruption, it is just one of many potential risks. A paper entitled "Misuse of Artificial Intelligence: Predicting, Preventing, and Reducing," in a February 2018 says, 26 investigators from 14 institutions (educational, social, and industrial) listed many other risks that could pose a serious risk—else we can say that least, propagate little disruption—in not more than 5 years. "Artificial intelligence abuse", "A report of 100 pages which states, that it could harm cyber safety (e.g., by using burglary hackers or victims of social engineering at human or human superpower levels), physical safety (e.g., using consumer weapons), and political security. In addition to the prevailing threat, Ford is focused on how artificial intelligence will affect cyber safety. A good case, he said, is about China's "Orwellian" utilization of face recognition automation in organization workplace, education institutes and elsewhere. However, this is the only region. The "whole environment" of organizations is focused on the same technology and sells them globally. The only thing we can predict after this is whether that technology until becomes commonplace. As in network of network worlds, in which all are relentlessly dedicating our processed data to a simple shrine, will we work day and night, can AI-controlled surveillance one day be seen as a fair trade to increase precautions in spite of being abused by bad players? "The dictatorships use it or will apply it," Ford said. "The question is, how much does it affect Western countries, democracies, and what challenges do we face?" Artificial intelligence in addition, develop a "personality" that is almost a platform for communication that is very complex to distinguish from the original, said by Ford. Posted frugally and to a degree on Twitter, Facebook, or Instagram, they can impact the choice.

2.3 Artificial Intelligence Unfairness and Inequality

The widening of economic inequality caused by artificial intelligence-driven job losses is another problem. Jobs has extended been an operator of public portability. Although, if it comes to a particular type of job—an unexpected, monotonous type of artificial intelligence-based approach—experiments have resulted that one who in the cold find themselves that they are less likely to look for re-training to those in higher-income positions. (Also, not everyone believes that.) Different types of artificial intelligence choices are dangerous, too. Talking about what happens frequently to the New York Times, Princeton's professor of CS Olga Russakovsky said that gender and race go hand in hand. In count to data and algorithmic bias (the latter cannot be a real "magnification"), artificial intelligence is developed by humans and people are prone to something else. Artificial intelligence. "The investigators are mainly men, from certain backgrounds, have prohibitive -income regions, especially humans with disabilities," said Russellakovsky. "We are the same people, so it is a challenge to think critically about the world's problems." In a similar article, TimnitGebru,

a Google researcher stated that the cause of social ambiguity, not technology, and called researchers like him "the most dangerous people in the world because we have this view of indifference." And technology experts are not alone in notifying about the conceivable financial and economic problems of artificial intelligence. According to reporters and politicians, Popkerisks intelligence Francis (right) also speaks—not only Sanctus whistles. Then in a conference in last of September at the Vatican entitled "The Common Good in the Digital Age," Francis notified that artificial intelligence has the power "to spread extremist propaganda and false information that can poison public debates and even exploit the views of millions of people, to the point of compromising institutions that there is a peaceful coexistence." He added, "If it is just said that technological advancement was the unfriendly of public interest, this may result to the improbable repetition of another variations of paganism defined by the rule of the superpowers."

3 Challenges in Artificial Intelligence

The main title (on the first page) should begin 1–3/8 inches (3.49 cm) from the top edge of the page, centered, and in Times 14-point, boldface type. Capitalize the first letter of nouns, pronouns, verbs, adjectives, and adverbs; do not capitalize articles, coordinate conjunctions, or prepositions (unless the title begins with such a word). Leave two blank lines after the title.

3.1 Conjecture Power

The widening of economic inequality caused by artificial intelligence-driven job losses is another problem. Jobs has extended been an operator of public portability. Although, if it comes to a particular type of job—an unexpected, monotonous type of artificial intelligence-based approach—experiments have resulted that one who in the cold find themselves that they are less likely to look for re-training to those in higher-income positions. (Also, not everyone believes that.) Different types of artificial intelligence choices are dangerous, too. Talking about what happen frequently to the New York Times, Princeton's professor of CS Olga Russakovsky said that gender and race go hand in hand. In count to data and algorithmic bias (the latter cannot be a real "magnification"), artificial intelligence is developed by humans and people are prone to something else. Artificial intelligence. "The investigators are mainly men, from certain backgrounds, have prohibitive -income regions, especially humans with disabilities," said Russellakovsky.

"We are the same people, so it is a challenge to think critically about the world's problems." In a similar article, TimnitGebru, a Google researcher stated that the cause of social ambiguity, not technology, and called researchers like him "the most dangerous people in the world because we have this view of indifference." And

technology experts are not alone in notifying about the conceivable financial and economic problems of artificial intelligence. According to reporters and politicians, Popkerisks intelligence Francis (right) also speaks—not only Sanctus whistles. Then in a conference in last of September at the Vatican entitled "The Common Good in the Digital Age," Francis notified that artificial intelligence has the power to spread extremist propaganda and false information that can poison public debates and even exploit the views of millions of people, to the point of compromising institutions.

That there is a peaceful coexistence. He added, "If it is just said that technological advancement was the unfriendly of public interest, this may result to the improbable repetition of another variations of paganism defined by the rule of the superpowers."

3.2 Trust Loss

The primary elements that can bring about the concern for artificial intelligence are the undefined characteristics or lack of knowledge about how DL take the decisions. How a train and test feed the raw data that can develop a decision for a variety of issues is hard to get for the average person. Most people do not even know about existence of AI, and how it is connected to day-to-day life, for example smart phones, smart TVs, banking, Tesla car, etc.

3.3 Individual Level

This is prominent challenging issue in AI, which has kept experimenters at the edge of artificial intelligence services in organization and start-ups. These organizations may boast of more than 91% accuracy, but people can do better in all of these situations. For example, suppose a model that can take decision whether an image is fruit or vegetable. One can predict the correct output almost always, eliminating an astonishing accuracy of more than 99%. For an in-DL predictor the same task that would require uncommon funding, the use of a hyperparameter, a large database, and a best algorithm, as well as powerful computer power, good training in train data and testing data. That looks like good amount of work, and which is very complex as it seems.

3.4 Data Privacy and Security

A key area in which all in-depth learning models and machines are based on data acquisition and training resources. Yes, we have very huge amount of data, but it is collected from worldwide users, there is a possibility that data could be utilized for malicious applications. For example, let a service provider which deals in medicines

provides services to 2 billion people in a region, and as a result of computational-attacks, the information they provide about themselves is spread over the black Web. It includes health problems, diseases, medical history, etc. To make situation problematic, we are now working with huge data.

As there is lot of information and data coming in from all sides, they will suffering and facing issues like some data leaks. Some organizations have begun to work smarter than ever before. They train data on intelligent machines, so it is not returned to servers, only a trained model is returned to the companies.

3.5 The Bias Problem

The good or bad of an AI system depends largely on the amount of data they are trained on. Therefore, the ability to get good data is a solution for good AI programs in the future. But, in reality, the day-to-day information that organizations collect is insignificant and has no value. They are biased, and somehow define nature and the definition of a limited number of people with similar interests in terms of religion, race, gender, society, and other racial prejudices. Real change can only be brought about by defining other algorithms that can better track these problems.

3.6 Information Security

Such big organizations like Google, Facebook, and Apple are having issues related to the illegal use of data generated by the consumer most of the regions like India use strict information technology laws to limited travel. Therefore, organizations like these are now facing the challenge of utilizing general data to improve global apps, and that could lead to overcrowding. The main feature of artificial intelligence is data, and clean data is used to train equipment to read and take decisions.

Most of the organization are making efforts to create and focus on building artificial intelligence models which can provide accurate results in spite of the lack of data. With biased and partial data, the whole machine may have errors.

4 Conclusion

While the challenges and risks discussed in AI appear to be extremely oppressive and destructive to humanity, with human effort, we can bring about these changes with great success. Challenges and risks must be handled carefully so that the accuracy of a smart plan must be maintained. This can be done by finding appropriate solutions to the problems that exist in the field of AI. In the future, when the advantages and disadvantages are “uncountable,” this will be how people select to use technology

that determines whether it is great or not. In order to use the strength and wellness of AI, we need to decide what machine should learn, and what output we want from them. It is very important that AI controls and objectives are set, and that more promotional work needs to be done to gain clarity of the objective (AI) plans to be developed, and what standards the equipment should have. Once this has been done, it will give an idea of what elements should be included in the control framework, regardless of whether the existing control structures have sufficient capacity. These risk and challenges must be minimized to get the better result in intelligent systems.

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Chapter 65
1–4D Protein Structures Prediction Using Machine Learning and Deep Learning from Amino Acid Sequences

Atrakesh Pandey and Rekha Jain

1 Introduction

The protein is a polymeric macromolecule consisting of building blocks of amino acids which organized in a sequential links that joined by the peptide bonds. The chain of linear polypeptides is named the primary protein structure. The primary structure is typically represented by a sequence of letters over the twenty-letter alphabets associated with the twenty available amino acids.

In its local climate, the chain of amino acids (or buildups) of a protein folds into neighborhood optional structures including alpha helices, beta strands, and no regular curls [1, 2]. The auxiliary structure is indicated by a succession grouping every amino corrosive into the comparing optional structure component (Fig. 1).

Artificial intelligent are larger field which make computer to behave as human. By training some data on it, it treated as machine as learning. There are some Artificial intelligence work that imitates the operations of the human cerebrum in preparing information for use in distinguishing objects, perceiving discourse, deciphering dialects, and settling on choices known as deep learning. In deep learning man-made intelligence can learn without human oversight, drawing from information that is both unstructured and unlabeled.

Study moves like Amino acids sequences to structure prediction then by applying it moves forward to finding function of protein and more one step forward gives disease recognitions (Table 1).

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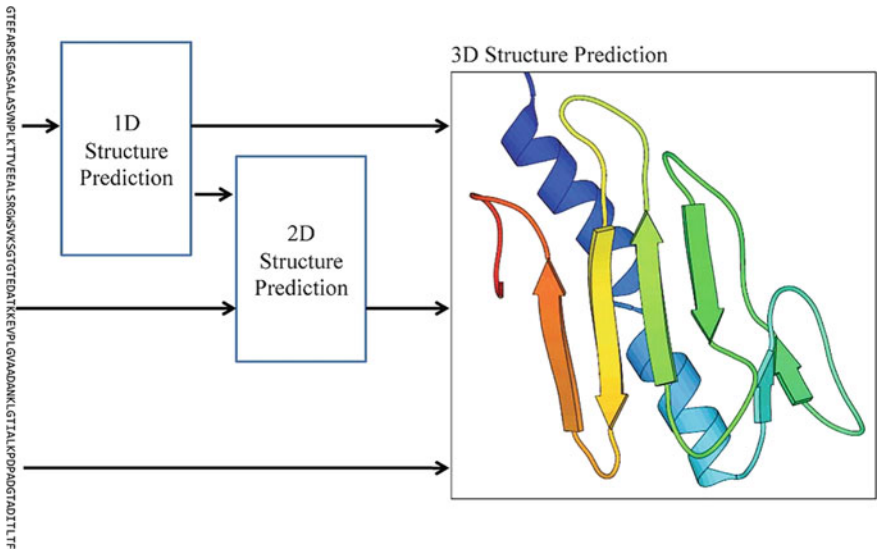

Fig. 1 Shows these alphabets sequences form protein: A, R, N, D, C, E, Q, G, H, I, L, K, M, F, P, S, T, W, Y, V

Table 1 Available methods for predicting 1–4-D protein structure

Methods	1-D protein structure prediction	2-D protein structure prediction	3-D protein structure prediction	4-D protein structure prediction
AI methods	Available	Available	Available	Available
ML methods	Available	Available	Available	Available
DL methods	Available	Available	Available	Not available
Agent-based methods	Available	Available	Not available	Not available

2 Literature Survey

As author introduce various approaches for predicting out the structure of protein by sequence of amino acids. After studying papers author focuses only 3 and 4 dimensional structure of protein by using machine learning approaches and deep learning approaches.

2.1 Model Quality Assessment Programs (MQAPs) Are in Protein Tertiary Structure Prediction

The final structural models are often used to select them from a pool of candidate models generated. Multiple templates and methods of prediction. The 3-dimensional neural convolution network (3DCNN) is a 2DCNN expansion and has been used in a number of fields, including Recognition of Objects. For MQA tasks, 3DCNN is also used, but the efficiency is poor. Because of many technical shortcomings related to protein tertiary structures, such as orientation, Lineup, Alignment. A new single-model MQA method based on the quality of the local structure was proposed.

Evaluation using a deep neural network with layers of 3DCNN. The suggested methodology. The quality of local structures for each waste is first assessed and the quality of each residue is then assessed. Through the incorporation of all systems of calculated local characteristics. We evaluated the model using CASP11, CASP12, and 3-D-Robot datasets and compared the performance of the model with that of the previous 3DCNN method is centered on entire protein structures. Compared to the previous 3DCNN method, the suggested method showed a substantial change.

The state of the art in critical assessment of structure prediction (CASP) assesses the state-of-the-art in Modeling of amino acid sequence protein structure. The Most Recent Experiment (CASP13 held in 2018) saw dramatic developments in the modeling of systems without the use of (historically "ab initio" modeling) structural templates. Progress was inspired by the success of to predict inter-residue distances, the application of deep learning techniques. In fact, these observations have led to significant changes in the accuracy of three-dimensional structures.

The new techniques effectively solve the long-standing problem of predicting the fold topology of nonnumeric proteins, provided that a sufficient number of sequences are identified for the protein family. In addition, the number of sequences needed in the alignment has dropped significantly. In the accuracy of template-based models, there is also considerable progress. Other areas have again provided interesting results, such as model refinement, accuracy estimation, and the structure of protein assemblies. CASP13 put greater focus on the sparse use of Data, SAXS, and NMR, together with modeling and chemical cross linking, all provided more mature results. This paper summarizes CASP13's primary findings. The Special Issue of PROTEINS includes papers discussing the evaluations of CASP13 in each modeling group and the participants' contributions.

Protein structure prediction techniques can be used to determine the three-dimensional form of a protein from the sequences of amino acid. This issue is of vital importance as its function is essentially determined by the structure of a protein, 2 but it can be difficult to experimentally determine protein structures. Recently, substantial progress has been made by using genetic knowledge. By studying co variation in homologous sequences, which helps in the prediction of protein structures, it is possible to conclude which amino acid residues are in touch.

2.2 Machine Learning Methods for 4-Diamensional Structure Prediction

Tant's situation in expectations of the 1-D to 4-D protein structure, just as a few other pertinent issues. AI approaches are utilized, for instance, to anticipate protein solubility [3], protein stability [4], protein signal peptides [5, 6], cell protein localization [5], post-interpretation protein alteration destinations, for example, phosphorylation sites [7], and protein epitopes [8]. Here, we have endeavored to incorporate a chosen and nonexh, causative portrayal of a portion of the uses of AI strategies to issues in the forecast of protein structure.

2.3 Deep Learning Methods

Feed forward neural organizations: A fake neural network [9] having no cycles is a Feed Forward Neural Network (FFNN). Specifically, layered FFNN will be FFNN, the hubs of which can be partitioned into gatherings (layers) requested and in which layer I yields are contributors (1) The primary layer is alluded to as the information layer, the last as the yield layer, and any layer in the middle of is a concealed layer whose units structure a halfway portrayal of an occurrence. Layered FFNN, which has been appeared to have general estimation properties [8] and can be prepared from models utilizing the back propagation algorithm [10], has been utilized to foresee 1D PSA [6–8] after the 80s. In their purported "windowed" variant, these organizations have generally been utilized, in which each fragment of a fixed number of amino acids in a grouping is treated as the contribution for a different model, with the objective for the portion being the PSA of interest for one of the amino acids in the section (normally the focal one).

Profound Learning [11] is a sub-field of fake neural organization-based AI that accentuates the utilization of various connected layers to transform contributions to highlights equipped for foreseeing comparing yields. A preparation calculation can be utilized to naturally take in the planning from contributions to yields by tuning a bunch of boundaries at any layer in the organization, given an adequately huge dataset of info yield sets. In specific cases, FFNN or related rudimentary cells are the rudimentary structure squares of a deep learning framework. This design flexibility empowers deep learning models to be improved for a particular type of information, joined into profound stacks utilizing diverse network designs. When all is said in done, profound learning models can be prepared by back-spread on examples [4], which prompts fruitful interior portrayals of the information being found out for an errand. This robotized learning of highlights adequately kills the requirement for manual element designing, an arduous and possibly relentless activity. A blunder inclined strategy that requires master information on the field and is required in other AI draws near.

Convolution neural networks (CNN) [8]: It is an information handling design that is organized with typical spatial reliance, (for example, tokens in a grouping or pixels in an arrangement). By applying a similar arrangement of neighborhood convolution channels across positions in the information, a CNN layer exploits this routineness.

The info layer and dimensionality of the following layer, and it is invariant for translation In general, a CNN module comprises a few back to back CNN layers with the goal that the hubs have bigger open fields at ensuing layers and can encode more perplexing qualities. It ought to be noticed that the previously mentioned "windowed" FFNN can be viewed as a particular, shallow, variant of CNN, yet in this investigation we will keep on alluding to them as FFNN to suit the verifiable adaptation of CNN.

Recurrent neural networks (RNN) [11] from consecutive information, they are intended to learn worldwide qualities. A RNN module utilizes an inward state vector when handling an information grouping to sum up the data from the prepared arrangement components: it has a defined sub-module that takes the past interior state vector and the current info component as sources of info. Grouping for producing the current inside state vector; the whole info succession will be summed up by the last state vector. A progression of RNN modules effectively experiences the ill effects of the issue of angle vanishing or inclination explosion [12] when the back proliferation calculation is applied to prepare them. To mitigate these issues, gated intermittent neural organization modules, for example, Long Short-Term Memory (LSTM) [13] or Gated Recurrent Unit (GRU) [4] are planned. Bidirectional variants of RNNs (BRNNs) [5] are likewise conceivable and are particularly reasonable for PSA expectations where information cases are utilized. Arrangements in time are not successions, however in space and proliferation, logical information in the two ways is alluring. Despite the fact that the profundity of a deep learning model upgrades its profundity, expressiveness, expanding profundity, as angles vanish or burst, likewise makes streamlining network loads more troublesome. It was proposed to determine leftover organizations in [6]. A Residual Network is initialized to be close to the personality work by adding a skip association starting with one layer then onto the next, consequently forestalling huge multiplicative co-operations in the inclination stream. Also, skip associations go about as "easy routes", giving more limited information yield ways to the slope to stream in any case profound organizations.

3 Research Gaps in Present Work

The accompanying exploration holes discovered to be done from the writing study to improve the accuracy of 3-D protein structure forecast utilizing profound learning.

1. Growth in the size of the preparation sets accessible, joined with the contrast between the quantity of groupings and the quantity of structures tackled, remains a solid help for additional turn of events. Furthermore, contrasted with different methodologies, AI strategies are generally quick by and large. Profound learning strategies contribute a lot of their time, which can be accomplished disconnected,

in the learning cycle. A pre-prepared feed forward neural organization, for instance, may create expectations rapidly in the "creation" mode. As genomic, proteomic, and protein designing undertakings keep on producing significant difficulties and openings in this field, both exactness and speed contemplations are probably going to stay important.

2. In the group of AI applications, protein and RNA 3-D structure expectation is an exceptionally troublesome issue. Its difficulties incorporate that it is a primary learning issue, its target work is non-raised, and it is as yet meager and expensive to get the dataset of preparing tests. The macromolecular 3-D structure has numerous impediments as a primary learning issue, for example, actual clash limitations, which refuse various iota's to involve a similar spot in space, and electrostatic inclination between particles. The 3-D structure's target work is a measurement between an imitation and its local structure. Most metrics, including RMSD, GDT-score, and TM-score, are not arched, which bring trouble to design a calculation to utilize the last measurement as an enhancement target. The development of homologous information, which is exhibited as a significant element in many grouping related issues, is another difficult side of the issue. The homologous framework is profoundly reliant on the information base, which is developing with the development of innovation, with all the successions that individuals have found. The info capacity will contrast if another information base is utilized to build the capacity. An alternate capacity likewise comes about because of changing the calculation boundary of the various arrangement. There are not many attempts to investigate the connection between homologous pursuit calculation and structure forecast effectiveness.
3. The existing strategies for expectation of the 3-D structure can barely demonstrate and the models can reinforce by permitting multidimensional input.
4. Using profound learning, there is insignificant work on 4-D protein structure expectation.

4 Objectives of Proposed Research Work

To fill the holes in the current work in the field of 3-D protein structure forecast by utilizing deep learning, the accompanying objectives were set for the examination work.

1. Expectation accuracy quality issues study.
2. Construct a model for numerical displaying and new/adjusted model creation.
3. Production of an improved technique/calculation to precisely deliver our fundamental expectation.
4. Attempting to interface the expectation of middle states and the forecast of the 3-D structure together by utilizing the examples found.

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Chapter 66
Health Assistant Using Natural Language Processing

Shubham Singh Dagur, Pooja Sharma, and Rekha Jain

1 Introduction

1.1 Area with Applications

Artificial Intelligence (AI) refers to the combination of human and machine that shows how machine understands human language. The machine acts sort of like a human and shows the solutions.

Applications

Machine Translation, Speech recognition, Sentiment Analysis, Question Answering, Automatic Summarization, ChatBots, Market Intelligence, Text Classification, Character Recognition, and Spell Checking.

1.2 History

It is the mixture of Artificial Intelligence and linguistics that began in 1950. Alan published an article in 1950 titled "Computing Machinery and Intelligence" is called

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Test of Turing. In 1960 and 1970 public health departments invented time and money for research in Telehealth.

1.3 Description and Significance of Topic

Natural Language Processing makes computers ready to communicate with humans in their language and measures other language-related tasks. It is a subset of Artificial intelligence. It refers to the analysis of speech and text of a conversation.

It has two parts:

NLU (Natural Language Understanding)
NLG (Natural Language Generation).

It is the computer participation to deploy human results. AI implements most telemedicine applications. Natural Language Processing gives a new perspective to human language.

2 Technology Specification

For IDE I use Google Colab because it is more useful it has its own installed libraries they are already preinstalled so not to install any library.

Tools in our project for the patient:

Registration: A patient can register by their data by mobile phone or any other social network.
Patient profile: It has its profile to see and he can edit by itself.
Search: This server has a search option to search the doctors and medicine.
Communication: It has better communication performance.
Geolocation: To locate the doctor's address by using a pin-code.
Payment: To pay for a doctor.
Alerts: To alert the patient for its medicines and appointments.
Review and ratings: To review the profile and rating the doctor.
Provide Medicines, prescriptions, and doctors: We provide these things to our patients for better usage. Providing diet: We provide a diet for our patients.
Appointment: We make an appointment with the doctor when our patient is ready.

Python Language is used to perform the functions. Natural Language Toolkit (NLTK) it is a Tool kit that has a natural language kit that is used to build python programs to work with human data. Import NLTK is used to import the library.

3 Literature Survey

1. **Health Assistant Bot: A Personal Health Assistant for the Italian Language** [1]

A Health Assistant is used to support the patients in their daily life to cure them. Nowadays people face many health problems as they suffer more from their disease [1]. It manages the profile of the patient and stores their data including medical records like name, disease, age, doctor appointment, and other data. When a patient provides its disease then the assistant understands the symptoms and provides medicine to cure them and also recommends the best doctor for a specific disease for patient relief. Also, provide a review for the doctor.

2. **Virtual Telemedicine Using Natural Language Processing** [2]**:**

The Research paper published by Imran explores the technique which is used to develop an assistant by "Rule-Based Approach". It is the best way to create the assistant according to rules implemented by this Approach to represent human behavior. The Rule-Based Approach has four modes: GUI, Knowledge base, Inference engine, and module.

3. **A Virtual Telehealth Framework: Applications and Technical Considerations** [3]**:**

Telemedicine has emerged from two sectors telecommunication and Technology. In rural areas, there are no health facilities then in that areas this technology is efficiently more working. When any patient having health issues then he or she may use this mode of communication in their way without any restrictions not waiting for standing in a long line of persons with their difficulty. All this is done by the Clinical Decision Support system.

4. **Med bot: Conversational Artificial Intelligence Powered Chatbot for Delivering Telehealth after COVID-19** [4]**:**

By Telehealth a Med bot has to be created which enables to cure patients, advise them, having reminders, educate them, monitoring them, and have a conversation like a doctor. It is having a large data set of doctors, medicines, and symptoms. It is a conversational agent that communicates with users using natural language processing. The Architecture of the Conversational Bot is the complete architecture of "Aapka Chikitsak".

5. **Sia: An Interactive Medical Assistant using Natural Language Processing** [5]**:**

Sia is a more interactive medical assistant who proposed a voice-based medical system. Having 5 building keywords are there: Question creation, Medical term identifier, preprocessing, normalization, and natural language processing. This proposed method increases health assistance among rural people which cannot afford medical help in their way.

6. **Speech-Based Voice Recognition System for Natural Language Processing** [6]**:**

This paper explains about the recognition system which is voice-based to talk with their patients and understands their problem and suggest them solution like a doctor. The feature excerption phase contains Mel-frequency cepstral coefficient and the feature matching module using the algorithm to make a solution matching statement.

7. **Clinical Decision Support System-based Virtual Telemedicine** [7]**:**

According to this paper by Shazia Karim et al. Virtual Telemedicine is a new concept that works faster than traditional telemedicine systems and has better performance. It includes Clinical Decision Support System (CDSS).

The designed ruled based system has the following major components:

a. Data management system
b. Module system
c. Knowledge source
d. Graphical User Interface
e. Preprocessing.

8. **Advertisements based on natural language processing of voice-based input:**

Voice-based input is like an assistant to solve problems based on advertisements using natural language processing [8]. It is an assistant to display advertisements according to their choice on any display to advertise something also voice input by speaking anything using natural language processing.

9. **A PDA-based electrocardiogram/blood pressure telemonitor for telemedicine:**

This personal telemedicine-based virtual assistant helps to monitor the patient blood pressure, cardiography, and many monitoring things to understand their problem. It always works. It cannot stop, this is a very big advantage in telemedicine assistants that they never feel tired they never stop they are always in a working phase [9].

10. **Implementation of a WAP-based telemedicine system for patient monitoring:**

Telemedicine is wireless which is the evolution of technology so if any user is having any type of health-related issue then this technology is always there. An example is wireless application protocol (WAP) devices. WAP will be the future of telecommunication to investigate in the telehealth sector to provide an emerging sector [10].

A	B	C	D	E	F	G	H	I
Pregnanci	Glucose	BloodPres	SkinThickr	Insulin	BMI	DiabetesP	Age	Outcome
6	148	72	35	0	33.6	0.627	50	1
1	85	66	29	0	26.6	0.351	31	0
8	183	64	0	0	23.3	0.672	32	1
1	89	66	23	94	28.1	0.167	21	0
0	137	40	35	168	43.1	2.288	33	1
5	116	74	0	0	25.6	0.201	30	0
3	78	50	32	88	31	0.248	26	1
10	115	0	0	0	35.3	0.134	29	0
2	197	70	45	543	30.5	0.158	53	1
8	125	96	0	0	0	0.232	54	1
4	110	92	0	0	37.6	0.191	30	0
10	168	74	0	0	38	0.537	34	1
10	139	80	0	0	27.1	1.441	57	0
1	189	60	23	846	30.1	0.398	59	1
5	166	72	19	175	25.8	0.587	51	1
7	100	0	0	0	30	0.484	32	1
0	118	84	47	230	45.8	0.551	31	1
7	107	74	0	0	29.6	0.254	31	1
1	103	30	38	83	43.3	0.183	33	0
1	115	70	30	96	34.6	0.529	32	1
3	126	88	41	235	39.3	0.704	27	0
8	99	84	0	0	35.4	0.388	50	0

diabetes

Fig. 1 Diabetes dataset [11]

4 Data Set and Preprocessing

4.1 Dataset Description

The data set includes the dataset of doctors, prescriptions, and symptoms (Fig. 1).

1. Mount google drive.
2. Import libraries.
3. Read file and print info.
4. Count total no. in data set.
5. Diabetes data set:

4.2 Data Preprocessing

Steps in NLP

1. Preprocessing:

(a) Tokenization—It works as the starter of preprocessing and when we are working with raw data, we need to perform various preprocessing on the data before we make a machine learning training and testing data include the bag-of-words model. Tokenizing is the first and basic thing that you have to do on raw data.

It is the process of making small tokens of each part of a sentence specified by the user. Example: Tokenization is the first step in NLP.

(b) Stemming: Stemming is the process of reducing a tokenized word form into its suffixes and prefixes and roots of words known as a lemma. Remove *s*, es, and put at root word.

(c) Lemmatization: Lemmatization is the process of converting a word into a form called "lemma". Pickle is used to store the file and dump is used to use the stored data file in the future without any restrictions. Objects which we will use in the algorithm while predicting a dataset to form its accuracy. Lemma = nltk.text.Lemmatize()
print ("lemmatized words", words) pickle.Dump().

(d) Chunking: Chunking is the process of extracting words from the disordered text of a sentence, which means analyzing a sentence to identify the grammatical constituents (Noun, verb, and groups, etc.). It does not specify their internal structure in the main sentence. It works on Parts-of-speech (POS) tagging.

2. Bag-of-Words Model:

A model is used to process the text so that it can fit classification algorithms to classify the text. Machine learning algorithms cannot work with the raw text directly firstly they must be converted the text into numbers called Encoding and then apply algorithms.

A corpus of documents can be represented by a matrix with a minimum of one row and one column.

The bag-of-words model has two steps: Tokenization and counting the occurrence of each word.

In this model, we create a bag-like structure that contains many rows and many columns which is having a sheet-like structure in which all words that are pre-processed by using tokenization, lemmatization, and stemming are placed and these are from our data set or our data. All data are placed in a different box and different data not of any same data is present. One word one box. That structure is known as corpus. This is very useful to classify the data.

The bag-of-words model has also been used for computer vision to visualize the structure of the data set properly.

The bag-of-words model is commonly used in document classification where each token occurrence frequency is treated as a feature.

3. Applying Machine Learning Algorithm

Removing stop words:

A stop word is a commonly used word that is filtered before and after the processing of natural language text. Some tools especially avoid removing these stop words for phrase search. It uses most commonly (a, an) like words.

We have to remove these kinds of words to clean the data set and use this a well-properly mannered. We can easily remove these kinds of stop words by using some packages. Python has Natural Language Toolkit (NLTK) library and stores different kinds of keywords and we also remove stop words by using NLTK. Download package from nltk_data directory.

RE (Regular expression):

It is the "instruction" to match or replace a set of strings or sentences in what way and how to do and used to clean the text by using a loop.

A regular expression is a set of characters (pattern) that is used to find sub-strings in a given string.

Syntax in RE:

1. Brackets [] are used to specify a split of the characters.
2. Dash (-) explains a range the for *a–z* have all small characters.
3. caret (^) can be used for the negation of word.
4. question mark (?) marks choices between two sentences.
5. Anchors: try something in the string.
6. POSIX characters are used to specify a specific class for characters.

It defines a pattern for search.

Serialization:

To save the data on a disk that can be used further. It is the process in which the data or information or object into a format that can be stored on disk and resurrected later on the same environment. The process of serializing or deflating an object is known as serialization. In Python, we used the Pickle module for serialization.

Deserialization:

For Deserialization Dump Module is used in python. To use for future purposes. It is the opposite operation of serialization to extract the data structure from a series of bytes. It is also known as inflating or unmarshalling.

Pickle.dump() creates a new data structure that is equal to original data.
Shell = "A".
Import pickle.
M = pickle.dump().

5 Algorithms Applied/Process Model/Methods

I created a project on Telemedicine-Based Virtual Assistant Using Natural Language Processing. NLP is open source, free, and Community-driven. It contains a bunch of processing libraries for lemmatization, tokenization, and stemming.

For This, I use Naïve Bayes Algorithm which is best suited for human–computer interface projects.

Naïve Bayes Algorithm:

1. Mostly used in NLP problems.
2. Predict the tag of text.
3. Calculate the probability of each tag and give the highest output one.

4. Classify whether the selected data is positive or negative.
5. Removing Stop words.
6. Resolves Ambiguity.

Some algorithms are used in NLP: Support Vector Machine (SVM), Bayesian Networks, and Maximum Entropy.

These are typically based on machine learning algorithms that make a trained data set having perfect accuracy.

Not of writing large codes natural language processing use ML algorithms to make a set of rules and a corpus of documents like a book and make statistical analysis.

- Fitting Decision tree to Training data set.
- Split the processed data set into training and testing data.
- Predict the result: y_pred = classifier.predict(x_test).
- Make Confusion Matrix.
- Calculate Accuracy.
- Calculate Precision.
- Calculate Recall.
- Calculate F-Measure:

So for this our project is used by the patient: When he registered himself and log in its profile then an Interface is here to communicate with the patient for its communication. In NLP we use Speech to text and Text to speech for communication between humans and machines. Our patient whether speaks or he can also write in the chat window. He says about its disease then our Assistant takes more information about its specific disease, then it provides him medicine and provides a perfect diet. If our patient wants an appointment with a doctor then our Smart Assistant makes an Appointment with the doctor and makes its regular data. In this way, it solves the problem of any patient anyway.

We have Four Modules:

1. Speech to text.
2. Data Preprocessing.
3. Data Training and Testing.
4. Text to speech.

For Predict the response we create a Graphical User Interface (GUI) using Tkinter (Fig. 2).

Speech to text:

In this, we convert our patient's speech to text for machine understanding.

First of all, we have to install the Speech Recognition library. pip install Speech Recognition.

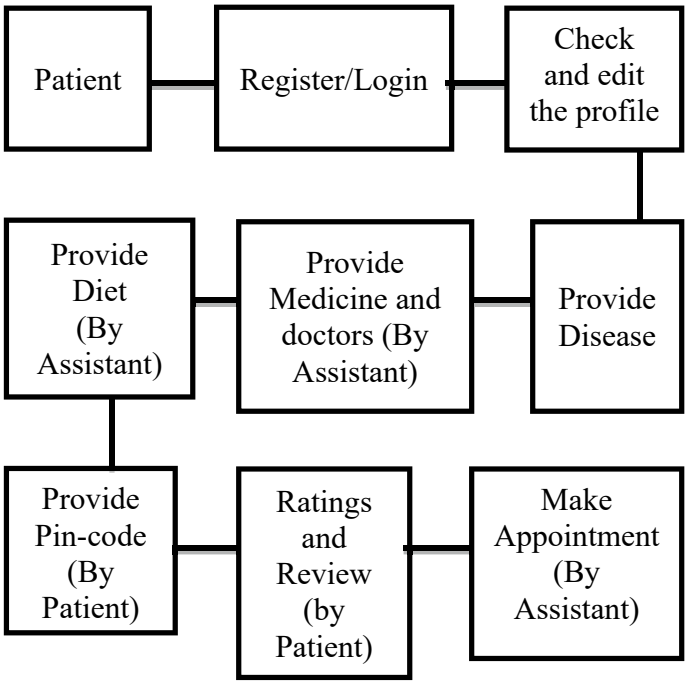

Fig. 2 Block diagram

Text to speech:

In this, we convert text to speech for human comfort. Assistant speaks whatever display on the screen to our patient. For this, we have to install Pyaudio by pip install Pyaudio.

Resolve Ambiguity: Ambiguity means a word or anything which has more than one meaning. It is the ability to be understood in more than one way. We have to resolve ambiguity in our project. So that our assistant understands what the patient says, it can easily classify what he said.

It has four parts:

1. Lexical ambiguity: Ambiguity of single word.

   e.g.: The tank was full of water.

2. Syntactic ambiguity: Sentence level (Structure of sentences).

   e.g.: young boys and girls were taken to the beach for enjoyment.

3. Semantic ambiguity: Related to meaning.

   e.g.: The car hit the pole while it was moving. (What was moving?).

4. Pragmatic ambiguity: Different interpretations.

e.g.: The police are coming. (For whom?).
Non-Standard Language.
More Complex Language (Fig. 3).

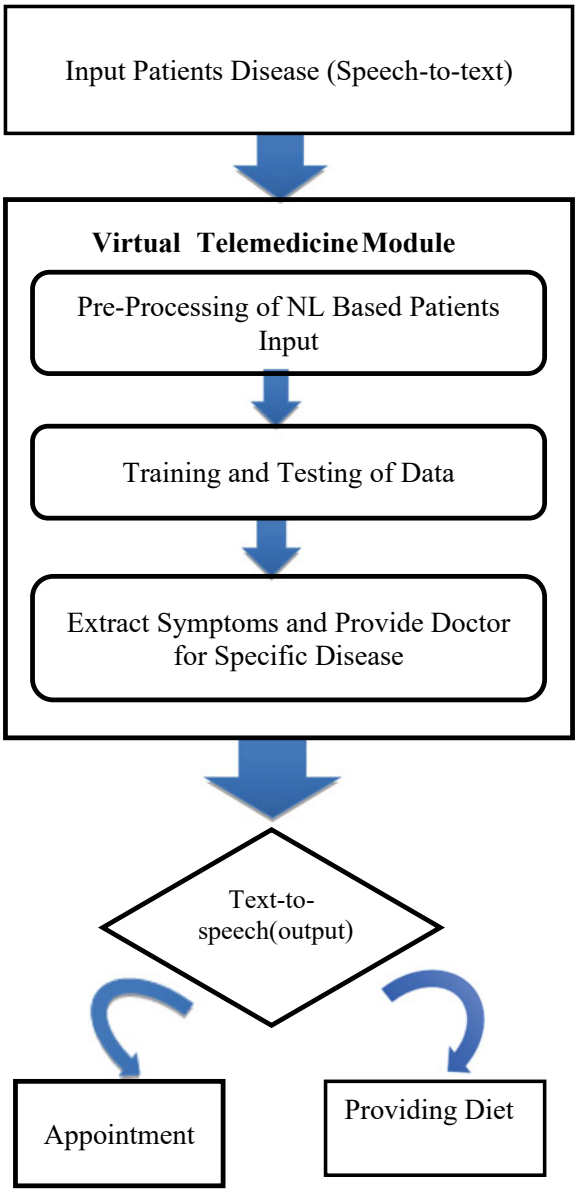

Fig. 3 System flow diagram

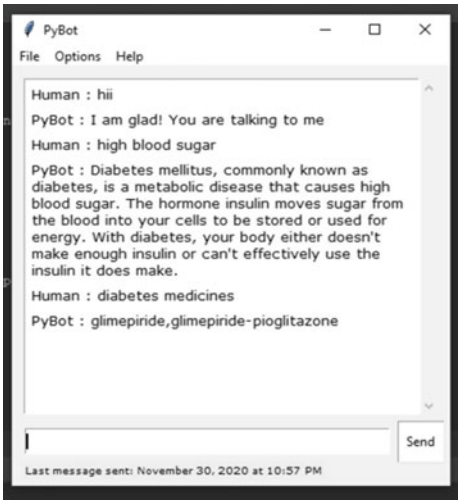

Fig. 4 Result

6 Results

See Fig. 4.

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Chapter 67
A Comparative Study of E-Learning Applications

Tanya Garg and Ruchi Goyal

1 Introduction

India is a country which is full of millions of youngsters who are keen on seeking knowledge in order to move beyond their limits. So, now it is important to get a fully-fledged education system in India to prepare for the future. There are many teachers, students, and schools in the country but due to certain variation in some factors such as background of parents, students, training programs, different delivery method of educators, etc., it drives the need for Web-based e-learning (WBeL). The term WBeL's core meaning includes W—World Wide Web, easy medium of conveying data throughout the world very smoothly, B—based on W media, E—electronic medium, and L—learning of various data and facts of W. Internet is considered as ocean of knowledge and that is why it is important that this ocean should be available for swimming to all the students as soon as possible. This is only possible by improving information technology (IT) or World Wide Web (WWW) as the medium for education. World Wide Web is a network which is available globally and provides a global classroom where students and educators can interact with each other from any place, at any time [1]. Many online apps, Websites, and programs are available online which can be accessed by any student and educator. Advancements in technology led to the development of mobile technology. Mobile learning plays a prominent role in process of learning. This is the next and advanced step of e-learning with various features such as easy accessibility, cost effectiveness, convenience, etc. For example, government of U.S., encouraging students and teachers in schools to transit from traditional paper-based textbooks to digitalized textbooks.

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https://doi.org/10.1007/978-981-19-2065-3_67

1.1 Use of Internet in Non-school Contexts

Earlier, it was believed that there has been an inequality between the socio-economic status of the family whose children are studying in the Information Communication Technology affiliated schools and who are not [2]. But nowadays, this gap has been narrowed as ICT has become more popular and less expensive. There are large variations in the use of ICT by students at schools and outside the schools. Many schools making great efforts in supporting use of Internet at schools as well as home. Subsequently, the use of Internet has become more popular in younger children, especially in developed and developing countries.

2 E-Learning Applications for Enriching Skills

With the increase in studies based on technology interventions such as mobile technologies, the support for technology at primary level for students is also increasing. For getting a promising personal as well as academic life for a student, more focus is directed toward the use of technology accessing the cognitive skills and learning of a student. As technology started to spread through educational programming, trainers or practitioners in schools need to find out the helpful tools which can be organized within classroom in context of supporting the learning of students [3].

Enjoyment and fun are a motivational factor for students of all age group, for example, games. Education based on some gaming programs or gaming techniques has been used by many different institutions. It is an easier way of understanding and learning. According to a survey, 54% students prefer gaming-based learning at primary level.

Another tool which is used by parents these days for learning process is iPad applications for improving academic skills of their children. Few results showed that iPad applications have practical significance as it improves literacy skill of a kid by enhancing number concept and spelling knowledge [4].

With the advancement wireless communication, there is increase in studies concerning m-learning, where students can learn with the help of mobile devices without any limitation of time in some situation. Although this approach is interesting for students, but researchers felt the need of well-designed system of learning so that it can improve learning achievements of student. Therefore, it is important to develop various tools to support the students in learning via m-learning environment.

Fig. 1 E-learning of students for enriching skills

3 Literature Review

Peters [5] stated that e-learning is unique in its own way as it is flexible with time and location and it also embraces certain features like communication and multimedia content.

Clark and Mayer [6] defined e-learning as tool for individual learning along with the learning of technicalities. Burka and Yuen [7] considered that m-learning is the advanced version of e-learning using mobile technology.

Rideout et al. [8] provided a new perspective on the Internet and the use of TV. According to the finding primary level, students go online not only primarily for entertainment but also for learning and social interaction. There is a close competition between the use of TV and Internet, and now, there is a need for new perspective for old media and new media.

Schools should try to find out or to count what is the actual use of technology for learning purpose as every activity on the Internet cannot be considered as for learning purpose.

Science and technology are very important at primary level of education as technology is used on every field including educational sector. Education system is very important for development; therefore, there has been pressure to improve technology in this sector so that future generation can be prepared for skills and knowledge required I upcoming years.

Sun and Chen [9] believed that the effective online learning depends on certain factors such as,

a. a well-designed course
b. interactive session between students and teachers
c. efficient and knowledgeable educators
d. online community
e. dynamic technology.

The virtual learning process helps the student to get success in a class as it provides tutoring environment to the student,

1. Virtual tutoring provides various opportunities for the development of the students.
2. It includes development of citation, ideas, and information.

Tokareva et al. [10] believe that digital platform or digital education is a complete package of enhancing teachers technical knowledge, running various education programs, technical support, innovative ideas, learning and educating, etc. This develops the overall quality of education. It also improves learning outcomes.

Homavazir and Gopal [11] expressed that e-learning is a new wave in education industry as it not only helps students but also the teachers, decision makers, and society. At present, e-learning is considered as one of the most important developments in the education field. It reduces extra costs related to education and increase productivity simultaneously. Moreover, the accessibility to e-learning is quite flexible as data are divided in small chunks according to convenience of the users.

Viberg and Mavroudi [12], learning analytics improve learning outcomes, support teaching if taken up and used widely, including deployment at scale and it should be used in ethical way.

Nambiar [13], online learning and classes are increasingly becoming part of education system worldwide. Online channel has made education convenient and easily accessible by one and all. This new introduction of online classes has been equally challenging for teachers, who are also struggling to learn this new way or methodology of teaching.

Adoption is also influenced by the availability of a technology and the infrastructure it depends on. Attitudes to change, positive or negative, may influence technology adoption. The adoption of learning technologies is also a political process which involves differential interests and expectations.

Valverde-Berrocoso et al. [14], the future of e-learning must be built on principles of openness and equality with an education in digital competence. The three pillars of sustainable e-learning are (a) resource management (cost of e-learning), (b) educational attainment (measures of student achievement, retention rates, skill acquisition, and personal development), and (c) professional development and innovation (strategies for adapting to change).

Affouneh et al. [15], education leaders and policy makers in both public and higher education need to learn new lessons about education in crisis to develop their e-learning systems. The eight dimensions of this e-learning framework are '(1) institutional, (2) pedagogical, (3) technological, (4) interface design, (5) evaluation, (6) management, (7) resource support, and (8) ethics'.

The schools and colleges are dependent on these platforms for content delivery and face-to-face interaction between student and teacher.

4 Problem Statement

In the context of above study, it has been observed that not much study has been provided regarding comparison between different online educational apps.

In existing literatures and research, there is no crucial comparison between these apps which makes the parents, educators as well as students confuse, which app to use and which is more fruitful. As there are so many apps and Websites are available online, therefore it become ambiguous to select one, that to best one. And no clear pros and cons are available for understanding of this platform.

This study would help to reduce this confusion to certain extent as in this study only best e-learning apps are listed which provide maximum benefits to the users. Research is also flexible as it includes both qualitative and quantitative aspect which will help to exploring various factors of this platform. It will be also reliable in effective selection.

5 Research Methodology

Research is based on secondary data mostly; a less part includes primary data. In this study, existing data are analyzed and interpreted accordingly. Data are both qualitative and quantitative as it focuses on words and meanings as well as it contain statistics and numbers. The research is descriptive in nature as it studies various variables of the e-leaning applications.

Sampling method which is used here is non-probability sampling method as conclusion has been drawn on the basis of selected applications only. The study is based on several points of time which makes it longitudinal study. Research design is flexible as aspects developed through the process of collection of data.

5.1 Factors Related to Teachers' Internet Use

Individual factors

Most recent studies reported that there is difference in the use of Internet based on gender. It has been identified that boys spend more time on computer as compared to girls; as a result, boys are having more updated computer skills. Furthermore, there is difference in the online activities of boys and girls, usually boys are engaged in computer games and watching videos while girls spend their time on social networks. But this gender difference is less in younger counterparts.

Context factors

This factor examines the socio-economic status of the families. It is believed that the income of the family can be related to access to Internet at home. According to a

study of 2004, around 88% of middle class family children have access to Internet at home; while in working class family children, this data are only 61%. However, this gap is very less as ICT is more affordable now. In 2008, one explanation showed that the poor families find Internet more feasible for their children than the extracurricular activities.

It is usually believed that traditional and new media area always in competition. Initially, when TV came, educators and parents were worried about their children reading pattern and similar concern on Internet and other activities also. It has been also reported that, the children are becoming more interactive with the friends and family by sharing videos or pictures on social networks, which opens a new channel of communication for them.

6 Online Learning Applications

1. **Unacademy**—It is an ICT education Indian company from Bangalore. Originally, it was created as YouTube channel in the year 2010. The founders of this company are Roman Saini, Gaurav Munjal, and Hemesh Singh. It includes a network of 18,000 educators, and it provides study materials, live classes to the students free of cost or with subscription.
2. **Byju's—**It was founded by Byju Raveendran in 2011 as an online tutoring firm. It offers education contents to the students from standard 4–12, but in 2019, they started program for standard 1–3 also. All academic concepts are available in animated digital videos. In 2019 the company announced to launch the app in respective regional languages for the better understanding of the students. It also introduced a new app, i.e., Early Learn App, which is for kindergarten.
3. **Vedantu**—It is an interactive platform for online tutoring where tuitions are provided to the students by the teachers over Internet, through using a real-time virtual learning pattern naming Whiteboard Audio Video Environment (WAVE). Here, students and teachers can discover, browse, and learn.
4. **Extramarks**—It is a digital platform for learning for students, and it helps the teachers as well as students to learn from engaging animation and videos and clear their doubts. It also makes studying and teaching easier and effective as it provides various assignments, tests, projects, homeworks, etc. It also contains all subjects' solutions including all the classes of CBSE and ICSE boards.

7 A Comparative Study of Top 4—Learning Applications

Key points	Unacademy	Byju's	Vedantu	Extramarks
Founded	2015	2011	2011	2009
Founder	Gaurav Munjal, Roman Saini	Byju Raveendran	Vamsi Krishna Pulkit Jain Sourabh Saxena Anand Prakash	Atul Kulshreshtha
Area served	Multinational	Multinational	National	Multinational
Headquarters	Bangalore	Bangalore, Karnataka	Bangalore	Noida, India
Revenue	Rs. 82 crore	Rs. 520 crore	100 million USD	Rs. 200 crore
Users	30 million	70 million	24 million	1.1 million

Learning applications	Advantages	Disadvantages
Unacademy	1. Scheduled and structured classes 2. Personalized learning and doubt resolution 3. Disciplined mode	1. Lack of infrastructure 2. Lack of transparency 3. Passing of share
Byju's	1. Active and efficient learning 2. Regulated learning 3. Flexible and convenient	1. Lack of natural voice 2. Lack of touch with the pupils

(continued)

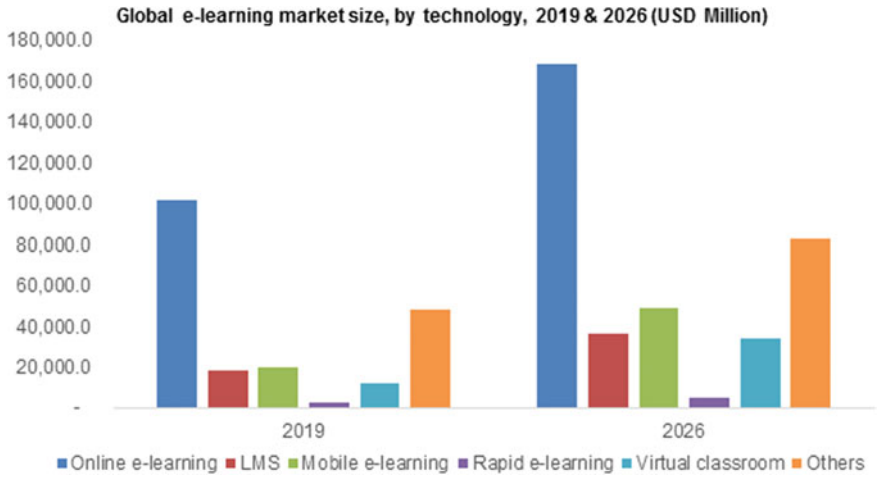

Fig. 2 Aspects of E-Learning *Source* www.gminsights.com

(continued)

Learning applications	Advantages	Disadvantages
Vedantu	1. Interactive 2. Personalized education 3. Provides a platform	1. Not proper customer care service 2. Costly courses 3. Improper explanation
Extramarks	1. Also serves Hindi medium students 2. Great content 3. Smooth and glitch functioning	1. Not economically feasible 2. Completely based on NCERT

8 General Limitations of Online Learning Applications

1. **A Solo Act—**As we all know online learning is convenient and flexible, but sometimes, it becomes solo act. It is not possible for all learners to be comfortable with virtual educators and classmates; they need personalized contact with their respective educators in order to learn in a better way [16]. And learners may feel less supportive.
2. **Impersonal**—It does not matter how close the world is connected virtually, but still, it lacks human contact. Online communication cannot overtake natural human relationship between educators and learners.
3. **Too Much Time on Computer can Proved to be Harmful**—Being constantly in front of computer or tablets can lead to various health issues at early age such as strain injuries, poor vision, and other problems.
4. **Lack of Control**—In e-learning courses, many a times there are chances that messages do not get across. As well as educators cannot guarantee complete control over the class and students. Sometimes, learners do not pay attention to the learning material.

9 Suggestive Measures for Online Learning Applications

1. **Effective Approach**—In order to obtain desired result of learning efficiency, it is important to focus on resources, time, and money [17]. It is believed that learning can be made better with less time and less expenses; in other words, a formula for an effective approach is being both productive and efficient at the same time.
2. **Videos Empowered Courses**—These days video-based learning is very popular among students and educators as it is convenient and versatile and it also improves digital proficiency.
3. **Embrace Communication—**Communication is the very important factor in online learning. At present time, all the courses should have the potential of

communication through various channels such as chat groups, emails, and more. It gives a medium through which students and teachers can interact with each other.

4. **Flexibility of Lesson Plans**—It is important that lesson plans should be flexible and curate accordingly or in other words as per the need of respective student so that the learner need not to struggle for long for a single topic [18]. Breaking of difficult topics in different and smaller units will lead to better understanding and less time consuming.
5. **Skilled and Competent Teachers**—The process of e-learning eventually backed by a group of skilled and efficient educators who are experiences and competent in their working plus they make modules and courses according to the requirement of the students. While moving from tradition form to online form of learning, having a qualified faculty is must.

10 Benefits of Online Applications

10.1 To Teachers or Educators

1. **Practicality**: With the help of online methods, teaching can be made incredible. Educators can create various tests, quizzes, etc., by using question bank. It also helps teachers to track assignments of the students.
2. **Training**: Online teaching or teaching through an app helps in updating and honing of teaching approach. While teaching teachers can get the students' feedback which constantly modify their teaching methodology. As a result, they can deliver remarkable lectures to the learners.
3. **Assessing Students**: It gives liberty to the educators to arrange tests with detailed analyzed result. As a result, educators do not have to worry about the method adopted by them is suitable for the children or not.

10.2 To the Students

1. **Interaction**: Irrespective of location these online apps provides a face-to-face live interaction between students and teachers. Both parties do not feel isolated, and this adds value to the entire concept. It also has a feature through which students can ask and clear their queries and doubts whenever they want.
2. **Availability**: Unlike schools, these learning apps are available 24/7, so students need not to worry about missing any class as they can record and revisit any lecture at any time for better understanding. It provides a relaxed environment to the students without any restriction of time.

3. **Systematic Learning**: The way lectures are delivered online with all related study materials including notes, videos, audios, pictures, diagrams, etc., make the study more effective than a traditional classroom.

11 Conclusion

Online education plays a crucial role in saving the planet by reducing the use of paper-based society or by decreasing deforestation, but simultaneously, it is also empowering students and the educators. Teachers are getting more knowledgeable and learning new skills, which ultimately helping them to grab more opportunities. These online applications provide flexibility, skills, learning environment to the teachers. On the top, it is cost effective also.

Not only this, technology also made the learning more fun as students are getting opportunities to learn from educators worldwide.

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Chapter 68
Application of Ontologies in the Enterprise—Overview and Critical Analysis

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1 Introduction

Over time, companies gathered large amount of digitized data and accessed it using dedicated applications. Often, data was processed by separate units within a company, resulting in data silos. For instance, the HR department processed data independently from the finance department, even though collected data, and used terminologies, overlapped. Upon reflection, it became clear that to deliver actionable knowledge, from *all* available data, cross-institutional analytics is needed [1, 2]. However, for a variety of reasons (e.g. history of IT system development, including "authorship" of applications), data owned by different "entities" may have been represented differently, in terms of syntax and/or semantics. Moreover, large number of mergers and acquisitions, involving companies of all sizes, took (and take) place [3]. They result(ed) in the need to support data processing in newly formed conglomerates. Here, some companies selected one system and "scratched" the others, while combining data was also tried [4, 5].

Separately, note that data needs to be exchanged between enterprises (including data generated in the Internet of Things) [6]. Therefore, data interoperability, without loosing flexibility, has to be addressed. Moreover, as the number of data sources

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increases, so does (1) data heterogeneity increase, (2) unstructured data is collected and (3) all data needs to be jointly analysed to capture actionable knowledge. Obviously, this requires flexible and adaptable data models.

In this context, let us consider ontologies understood as a formal way of representing knowledge [7]. Here, an ontology consists of a vocabulary, defining the meaning of terms, and a set of axioms that constrain the interpretation and well-formed use of terms [8]. Ontologies allow representation of entities, their properties and relations. Moreover, they allow deduction of "implicit knowledge". This is achieved by application of reasoning (and reasoners [9]).

Hence, let us assume that: (1) enterprises have to deal with data silos; (2) ontologies and semantic technologies may provide foundation for (knowledge management) applications, which can overcome data heterogeneity. Here, the main questions are: (i) what resources can be used today to bring semantics to the enterprise? and (ii) what technologies are actually available?

To assess this, first, we consider accessibility of business-related ontologies. Second, we report on application of semantic technologies to data workflow management. Finally, we overview work concerning semantic interoperability.

1.1 Problem Formulation

Enterprise data is characterized by heterogeneity and complexity. Therefore, one of key challenges arises from differences between individual data models. For instance, products and features might differ across geographies, to accommodate regional consumer preferences; while packaging might vary across business units, based on legal requirements, or regional preferences. Note that relational modelling has restrictions, e.g. schema complexity, no standards for common concepts, need to model "everything" up-front, inability to handle complex queries across heterogeneous data. Here, committing to an ontology forces organizations to understand and document its domain(s), while enterprise ontologies can become part of master data management and serve as a reference models [10].

Authors of [11, 12] outline the applicability of semantics in master data management. In [13], benefits of ontologies for enterprise applications are discussed. However, development of enterprise ontologies is time consuming and complex. To address data heterogeneity, it is possible to apply semantic interoperability [14]. However, here, one needs to define comprehensive translation rules [15].

Note also that business workflows are a part of the enterprise [16], but processes in different entities may have different formal representations. Therefore, it may be semantics that can accommodate differences in data specification.

Besides theoretical applicability of semantic technologies to the enterprise data, actual ontologies are needed. The good practise is to try to reuse, if possible, existing ontologies [17]. Here, let us stress that developing ontologies from scratch is a cumbersome task that requires an advanced knowledge on semantics. However, number of available "ontology engineers" remains very small.

In this context, we have decided to overview state of the art of existing ontologies (ready to be applied in the business domain) and proven ontology uses.

2 Ontologies for Business Use—Critical Overview

First, let us note that, the core enabler to model different aspects of business is a precisely defined method for semantic enterprise modelling, which involves abstract representation, definition of the structure, processes, information and resources of a business, government body or an organization [18]. This needs knowledge about the enterprise, and/or previous reference models and may include domain ontologies. Semantic modelling requires the right level of abstraction [19]. Proposed model should be flexible to include and/or remove concepts/instances and/or represent their changes. Hence, in what follows, the key ontologies and initiatives in this area (dating back to 1990s) are presented.

2.1 Business Model Ontologies

Toronto Virtual Enterprise (*TOVE* [20]) project started in early 1990s and aimed at developing a comprehensive ontological framework for enterprise integration. A Website exists, while ontologies are found in publications (sources are not available). Developed ontologies captured activities, resources, organizations, products and requirements, compliance to the ISO 9000 standards and costs, and were implemented in Prologue. However, *TOVE* is no longer active.

Enterprise Ontology (*EO*; [21]) was developed around 1998. It is an integrated system of ontologies capturing: activities, processes, organization, strategy and marketing. *EO* sources are available, with the last version from 2003.

Business Model Ontology (*BMO*; [22]) was developed around 2004. The *BMO* model consists of: product, infrastructure management, customer interface and financial aspects made of nine building blocks, including: value proposition as an organization objects for an actor, value configuration as a necessary action, and resources for value creation, consumer, distribution channel, relationship mechanism, capability, partnership, cost structure and revenue stream. No ontology sources could be found, and there are no mention of real-life applications. However, it is used by the *BMC*, described below.

Interestingly, in [23], authors proposed merging the three aforementioned ontologies, to create a Unified Business Model Vocabulary. However, no activity in this direction followed.

BMO served as a basis for *Business Model Canvas* (*BMC*; Ph.D. Thesis [24])—a template for developing business models and documenting existing ones. The *BMC* is a textual technique, designed to illustrate a high-level view of a company and its

collaborators, and to capture creation of value. Moreover, *BMC* tools allow model mapping. However, *BMC* did not advance past the dissertation.

Resource Event Agent (*REA*; [25]) model is a domain-specific ontology, for accounting and business management. It was developed in 1982. Around 2000, it was extended into a full-grown business ontology, while in 2008 it was re-engineered (in the dissertation [26]) into an OWL representation. It is focused on economic agents, events, resources and their relations. *REA* was extended with economic contracts and policy infrastructure. There is no source of *REA* ontology, and the last news about it (on its WWW site) is from 2014.

The *Business Object Reference Ontology* (*BORO*[1]) provides a core ontology and supporting tools, i.e. BORO-UML modelling tool, data loading tools, etc. It was designed for information systems re-engineering, or to mine semantics from the existing systems, and to support semantic interoperability. Development was completed in 2005, and there are no traces of its use in modern enterprises.

The *Unified Foundational Ontology* (*UFO*; [27]) was to provide ontological foundations for various domains. *UFO* upper ontology consists of ontologies of: UFO-A—objects, UFO-B—events and UFO-C—entities. UFO-C specializes the other two. The *UFO* website provides documentation of all ontology classes. Interestingly, *UFO* is a foundation ontology for *OntoUML*,[2] a conceptual extension of UML. Publications from 2010 to 2015 illustrate attempts at using *OntoUML* in the industry. However, no publications past 2015 have been found.

Unified Enterprise Modelling Language (*UEML*; [28]) was proposed to support integrated use of heterogeneous enterprise models. The *UEML* includes the Unified Enterprise Modelling Ontology (UEMO), expressed in OWL, which captures definitions from variety of enterprise modelling languages. Core publications, related to UEML/UEMO, are dated from around 2010, with no follow-up.

e3value is a business model ontology [29]. Here, the developed models link multiple organizations, and include: actors, value activities and transfer of resources through services. Overall, a large vocabulary, for modelling value-oriented models, is provided. The *e3value* ontology is still available and includes documentation, toolset and publications. However, the last update is from 2006.

Finally, creation of an ontology, based on unification of *REA*, *BMO* and *e3value*, is suggested in [30]. However, also this work does not continue.

2.2 Domain-Specific Ontologies

Let us now consider ontologies addressing specific business domains, knowledge subfields or tasks. In a semantic system, they should be combined with enterprise ontologies. However, since no general enterprise ontology was widely adopted, they started to be considered and applied in their targeted use cases.

[1] BORO Solutions http://www.borosolutions.net.

[2] OntoUML https://ontouml.org/.

2.2.1 Services and Contracts

GoodRelations Ontology (*GR*; [31]) was developed in 2001, capturing business-related goods and services, e.g. products, offers, prices, terms and conditions. In 2012, it was integrated into *Schema.org* [32] and became supported by Google, Yahoo, Bing and Yandex [31]. It is available as OWL2, and can be used in all RDF syntaxes, Microdata, etc.

The *Public Contracts Ontology* (*PCO*; [33]) delivers structured data to model public procurement. The *PCO* builds on, among others, *Payments Ontology* for spending description (see Sect. 2.2), and *GR* to describe business entities. *PCO* is an OWL ontology. Its last version was published in 2017.

The Agreements Ontology (*AGR-O*; [34]) was developed in 2016. It can be used to model agreements and includes licences, laws, contracts, etc. It is publicly available (last version from 2018) and well-documented. However, no application examples were found.

Finally, *The Public Procurement Ontology* (*PPROC*; [35]) defines terms related to procurement and contracts. In addition to core terms, e.g. contracts, tenders, deadlines, objectives, etc., it captures the procurement process, from contract publication to termination. It connects other ontologies, e.g.: *Public Contracts Ontology* [33], *W3C Organization Ontology* [36], *Schema.org* [37], *Simple Knowledge Organization System* (SKOS; [38]), *GoodRelations Ontology* [31] and *Dublin Core Metadata Terms* [39]. The available version is from 2014.

2.2.2 Invoices, Payments and Product

Payments Ontology [40] has been developed as a general vocabulary for a representation of a financial flow within an organization and between organizations. Its main modules are: payer, organizational unit, supplier and date of payment. Ontology source cannot be located.

A *Purchase-To-Pay-Ontology* (*P2P-O*; [41]) enables organizations to create semantic invoices following linked data principles. It captures commercial invoice, contract, formal organization, order, payment process and more. It is compatible with the core invoice model of EN 16931-1:2017 [42] standard. Ontology sources are available in OWL. Papers on *P2P-O* are from 2021 [43]. Hence, it is a bit too early to predict if it will become popular.

The *Product Types Ontology* (*PTO*; [44]) extends *Schema.org* and *GR* ontologies and provides definitions for types of products/services. Specifically, high-precision identifiers for product types are based on Wikipedia entries. *PTO* classes are represented in OWL DL/OWL2 DL.

The *Financial Industry Business Ontology* (*FIBO*; see Sect. 2.4) is a large initiative, delivering a set of enterprise-related ontologies. One of them, named *Payments and Schedules Ontology* [45], contains payment-related concepts. It defines basic concepts such as payment, payer and payment schedule, extending the scheduling concepts from the dates and times module. It is represented with OWL2, available

after registration, and well-documented. This ontology seems to be the most mature and popular, out of discussed financial ontologies.

2.2.3 Transactions

Open-edi Business Transaction Ontology (*OeBTO*; [47]), developed in 2007, extends *REA* ontology, specifying concepts and relationships from business collaborations. Those concepts are representing a legally enforceable agreement. However, sources of *OeBTO* cannot be located.

2.3 Semantic Workflow and Process Management

The best known method for a formalization of business processes is the Business Process Model and Notation (BPMN, [48]). Its most recent version is from 2014. The core concepts of BPMN are: event, activity and gateway, flow and data object. Around 2014, a BPMN ontology [49], which formalizes, in OWL2 DL, structural components of BPMN was proposed. Unfortunately, the actual ontology resources could not have been located.

Another approach to provide semantic representation for business processes is a BPMN-based ontology (*BBO*; [50–52]). *BBO* is claimed to be designed for Industry 4.0. The core element of *BBO* is a formalization of Chapter 10 of BPMN 2.0 specification. The last version is from 2019, with no signs of applications.

In [53], a Process Mining Ontology and an Events Ontology were proposed. However, their source files could not be found.

Finally, there exist publications [54–58] that describe ontologies representing business processes. However, sources of these ontologies cannot be found, and work seems to be a purely academic effort, with no real-life applications.

2.4 Promotion of Business Use of Semantics

Proposing ontologies and semantic solutions is important. However, without promotion and justification, it may be not enough. Here, we briefly summarize most important actions undertaken to popularize semantics in business.

Financial Industry Business Ontology (*FIBO*; [59]) defines entities related to financial business applications, among them OWL ontologies, vocabularies and data dictionaries. *FIBO* is hosted and sponsored by the Enterprise Data Management Council (EDMC) and standardized by the Object Management Group. The EDMC is working in collaboration with many companies to offer open, easy access to *FIBO* content and to promote its usage. *FIBO* is a broad set of ontologies, organized in a hierarchical structure, following division into domains, subdomains, modules and

individual ontologies. Domains cover: business entities, business process, corporate actions and events, derivatives, financial business and commerce, foundations, indices and indicators, loans, market data and securities. FIBO is accessible online through its repository [60].

National Center for Ontological Research (*NCOR*[3]) was established in 2005 and aims at promoting ontology-related research activities. NCOR provides quick start for ontologies for business [61], including training and technology guidelines. However, it does not point to existing solutions that can be explored.

Finally, *Global University Alliance* (*GUA*[4]) was founded in 2004 and provides a collaborative platform for academic research, analysis and development including a *Business Ontology* [62]. It is an extensive ontology with terms organized in a top-level domain and multiple intersecting subdomains (e.g. business competency, business process and infrastructure). According to the website, various enterprise and industry standards have been developed based on the Business Ontology [63, 64]. However, no publications older than 2016 could have been located, and the ontology sources are not available.

2.5 Summary of Findings Concerning Ontologies for Enterprise Modelling

In summary, a number of attempts to develop an *ontology of business*, conceptualized from different angles, have been recorded. Majority of them have been tried in the 2005–15. However, almost none of them seem to remain active. Moreover, most of them have not been deployed/tried in real life. Note that, these ontologies had ambitions to be become general enterprise ontologies, and model "as much as possible". Hence, it can be stipulated that, in general, this may be one of important reasons for their lack of success.

It can be observed that domain-specific ontologies have proven to be slightly more successful. They are more often (re)used and adopted. The reason may be that it is easier to model (and agree on) a narrow fragment of knowledge, than on a complete domain model. Moreover, such ontologies are easier to understand.

Even though there exist ontologies representing business processes, those were mostly academic efforts, focused on the design of the ontology itself, with no real-world justification for their existence. There is no trace (even anecdotal) of adoption/exploitation of these ontologies by actual businesses.

The initiatives to promote semantic technologies in business have been visible and have resulted in specific products. However, there are no proofs of adaptation of such products to address problems in real-life deployment(s).

[3] https://ubwp.buffalo.edu/ncor/.

[4] Global University Alliance https://www.globaluniversityalliance.org/.

3 Semantic Interoperability in Enterprises

So far we have found that, (1) big ontologies "do not work", (2) domain-specific ontologies generate more interest and stay alive "longer" (though only a few are still in use) and finally, (3) there are no standards among both large and small ontologies. Hence, semantic interoperability becomes a crucial challenge.

While adaptation of enterprise ontologies was not particularly successful, numerous ontologies are used in business in task-specific applications [65, 66]. Moreover, besides formal ontologies, other data models, with different levels of expressivity are used, e.g. taxonomies, thesauri. Nevertheless, let us now assume that the problem of semantic knowledge representation has been successfully addressed [67]. However, since there are no standard ontologies, it *cannot* be assumed that organizations will use the same semantic models. This brings the question: how data can be exchanged between organizations? Moreover, how can it be interconnected and analysed across systems/silos?

One of possible approaches is ontology modularization. It means that separate sub-ontologies are linked together with defined relationships. Here, the following structure is considered: top-level ontologies—cover general concepts and domain or task ontologies—provide needed specialization. For example, *BORO* and *UFO* could be the top-level ontologies, while *TOVE* and *BMO* could be used as domain ontologies, while *Payments Ontology* can be used as an application ontology. The crucial task is to propose an appropriate ontology mapping, to relate the vocabulary of two (or more) ontologies.

Semantic interoperability is particularly applicable in business domain, where joining data from different sources, for common analysis, may be of strategic importance. In [68], authors noticed continuous problems with interoperability and proposed an ontology-based framework to support enterprises. The idea is to apply ontologies on different layers of data processing. This is a straightforward approach; however, "bringing data to ontologies" is a very cumbersome task.

Two alternative approaches applied to deliver interoperability are: (a) semantic translation (often of streaming data) and (b) semantic query rewriting. In both approaches, it is not required to modify data representation. What is needed is semantic-based in-between mechanism that facilitates communication.

For the first approach, let us note that semantic interoperability was addressed in several Horizon 2020 projects [69]. Here, in the INTER-IoT project, an Inter Platform Semantic Mediation (*IPSM*; [15, 70, 71]), for streaming semantic translations, has been designed and implemented. *IPSM* semantically translates incoming messages, according to rules defined using an alignment format. An alignment is where the mappings between data models of source and target messages are defined.

For the second approach, a commercial solution exists. It was proposed by Eccenca.[5] This approach follows the query rewriting method. Here, the knowledge graph-based platform is used for managing rules, constraints, capabilities, configu-

[5] Eccenca Corporate Memory https://eccenca.com.

rations and data in a single application. Eccenca offers also Silk,[6] an open source framework for integrating heterogeneous data sources. Proposed use cases include: generating links between data lakes, setting RDF links between data sources and applying data transformations to structured data sources.

In summary, semantic interoperability can deliver results without need to modify existing data models, while annotating them semantically, when necessary. The proposed approaches work both for streaming data translation and combining static repositories. Moreover, typically, they do not require to model the enterprise as a whole, but focus on specific fragments of data models, crucial for the exchange/combination of information.

4 Concluding Remarks

Even though ontologies can bring a number of benefits, there are very few real-world, production-scale, ontology-based systems, exploiting their expressivity, possibility of reasoning and adaptability. Moreover, while many ontologies have been developed, few have been "standardized". Furthermore, even standardized ontologies are not adopted. Let us outline some reasons of this situation.

Authors of [72] claim that one of roadblocks is lack of understanding how to model knowledge, resulting in multiple interpretations. Here, problems arise also from insufficient specifications or lack of comments. Naturally, the larger the scope of the ontology, the more visible is the problem. Consequently, numerous, possibly conflicting, definitions materialize. Moreover, since it is hard to reuse ontologies, new (duplicated) ones are created, introducing "chaos" to their domains. Even though there are repositories that try to organize available ontologies, the problem lies also in the quality of ontologies stored there.

Complexity of modelling is related also to limitations of existing tools. Open source tools have been tried in academic examples not in real-world applications. Moreover, updates to many of them have been discontinued.

These facts contribute to the lack of semantics-based business solutions. However, the situation is likely to change. First, there is a tendency to use semantics as a part of proprietary solutions and not global shared standards. This brings flexibility in a closed world environment, which characterizes many businesses, and allows gathering experience in use of semantics. Second, more focus is put on providing interoperability based on semantic technologies, rather than replacing existing models and standards with ontology-based ones. Finally, European Commission is mentioning semantics and ontologies in more and more project calls. Having this in mind, it can be claimed that semantics in business still has bright future to be realized.

[6] http://silkframework.org/.

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