Lecture Notes in Electrical Engineering 709

Pradeep Kumar Mallick
Akash Kumar Bhoi
Gyoo-Soo Chae
Kanak Kalita *Editors*

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Preface

The 2nd International Conference on Emerging Trends and Advances in Electrical Engineering and Renewable Energy (ETAEERE 2020) which was held at Kalinga Institute of Industrial Technology (KIIT) Deemed to be University, Bhubaneswar, Odisha, from March 5th to 6th, 2020, brings together the latest research in smart grid, renewable energy and management, electronics, communication, computing, systems, control and automations. The aim of the conference was to provide a platform for researchers, engineers, academicians and industry professionals to present their recent research works and to explore future trends in various areas of engineering and management. The conference also brings together both novice and experienced scientists and developers, to explore newer scopes, collect new ideas and establish new cooperation between research groups and exchange ideas, information, techniques and applications in the field of electrical, renewable energy, electronics and computing.

The aim of this book (*Advances in Electronics, Communication and Computing*) is to discuss the basic and advanced concepts in the field of electronics, communication and computing including design procedure and recent applications; to address the recent challenges and analyze various aspects of technological trends in electronics, communication and computing; and to attract more interest and address the major issues in semiconductor device modeling, wireless communications and Cloud computing.

Our sincere thanks to School of Computer Engineering and School of Electrical Engineering of KIIT Deemed to be University for the combined effort for making this ETAEERE 2020 as a successful event, and we would like to record our appreciation to the whole committee members of ETAEERE 2020. We are also thankful to all the participants and our keynote speakers, who have presented scientific knowledge and foresight scope for different tracks.

We have received more than 450+ research articles, and thanks to our peer-reviewing team for selecting quality papers for each volume. The participants have presented their work in four main tracks, i.e., systems, control and automations, smart grid, renewable energy and management, electronics, communication and computing and advanced computing.

We would also like to acknowledge our technical partners, i.e., Sikkim Manipal Institute of Technology, India, and Baekseok University, South Korea, for the continuous technical support throughout the journey. Sikkim Manipal Institute of Technology (SMIT) deserves a special mention, for holding the first edition of ETAEERE 2016 and proving a collaborative opportunity to host ETAEERE 2020 at KIIT University.

Bhubaneswar, India — Dr. Pradeep Kumar Mallick
Rangpo, India — Dr. Akash Kumar Bhoi

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About the Editors

Dr. Pradeep Kumar Mallick is currently working as Senior Associate Professor in the School of Computer Engineering, Kalinga Institute of Industrial Technology (KIIT) Deemed to be University, Odisha, India. He has completed his Post-Doctoral Fellow (PDF) from Kongju National University South Korea, PhD from Siksha 'O' Anusandhan University, M. Tech. (CSE) from Biju Patnaik University of Technology (BPUT), India. Besides academics, he is also involved in various administrative activities like Member of Board of Studies, Member of Doctoral Research Evaluation Committee, Admission Committee, etc. His areas of research include algorithm design and analysis, and data mining, image processing, soft computing, and machine learning. Now, he is the editorial member of Korean Convergence Society for SMB. He has published 12 books and more than 75 research papers in national and international journals and conference proceedings in his credit.

Dr. Akash Kumar Bhoi has completed his B.Tech. (Biomedical Engineering) from Trident Academy of Technology, BPUT University, Odisha, and M.Tech. (Biomedical Instrumentation) from Karunya University, Coimbatore, in the year 2009 and 2011, respectively. In 2019, he was awarded Ph.D. from Sikkim Manipal University, India. He is working as Assistant Professor in the Department of Electrical and Electronics Engineering at Sikkim Manipal Institute of Technology (SMIT), India, since 2012. He is member of ISEIS and IAENG, associate member of IEI, UACEE, and editorial board member reviewer of Indian and international journals. His areas of research are biomedical signal processing, medical image processing, sensors and transducers, and medical instrumentation. He has published several papers in national and international journals and conferences. He has also served on numerous organizing panels of international conferences and workshops.

Dr. Gyoo-Soo Chea has received Ph.D (Electrical Engineering) from Virginia Polytechnic Institute and State University (Virginia Tech), Blacksburg, VA. After receiving Ph.D, he worked at Amphenol Mobile, Korea, as a RF manager from June 2001 to February 2003. He has been with Baekseok University in Korea as a

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Dr. Kanak Kalita received his B. Tech in mechanical engineering from RGTU, Bhopal, India, and M.E and Ph.D. in aerospace engineering and applied mechanics from the Indian Institute of Engineering, Science and Technology, Shibpur, India. He has over 5 years of teaching, research, and industrial experience. Currently, he is with VJ Coresoft Pvt. Ltd. as Senior Software Engineer, where he works on developing and testing novel optimization algorithms. He is on the editorial board of 2 international journals and has reviewed over 170 manuscripts for more than 30 journals and conferences. He has published 17 SCI and 39 Scopus indexed research articles. His areas of interests include meta-modeling, optimization, finite element method, and composites.

Realization of Security System Using Facial Recognition and Arduino Keypad Door Lock System

Rasmita Lenka, Nishant Shubham, Nishant Sinha, and Rohit Gupta

Abstract In today's world which is full of technological and unseen errors security is one of the major issues that should not be over seen. The technological and modern perspective has to be used to resolve the modern day problems. This project here in is based on Open CV face detection module to feature a face recognition system to identify and recognize the face of a person using certain facial feature which is again integrated with the traditional keypad pin input for ensuring the overall security throughout. It can be used as an access control system that is by registering the staffs, students, employee or officials of an organization with their faces, and later which can be used to recognize the people by capturing the images of the faces, the system show cases the accurate recognition which happens to become more accurate as time passes due to machine learning algorithm which enables constant learning of the system. The system is implemented on desktop using web camera or mounted camera; it first captures the image using the web camera or mounted camera and then applies machine learning algorithm to chalk out the features that could be used for the prediction at the time of implementation.

Keywords Local binary pattern histograms (LBPH) · Histogram of oriented gradients (HOG) · Light emitting diode (LED) · Local binary pattern (LBP) · Support vector machine (SVM)

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1 Introduction

In prospective of "security," there are many options that can be taken into consideration. Few of the various preferred approaches could be biometric password, retina scan, voice enabled and so on in reference with the developing technology. One of the authentication systems is facial recognition system used in most of the modern day industries as well as in developing smart phones and high security regions in industries and cooperate sectors.

Face recognition system is used to recognize certain features of the faces, and by matching the image of the face with the stored model of each individual face stored in the database. Face recognition plays an important role in an security and authentication in day-to-day lives for recognizing the intruders. Along with considering the following trend, we need to chalk out and remove the drawbacks of the existing security system. Face recognition system is more complex due to its unstable characteristics, for example, beards, glasses will show some impact on face detection which can be countered by considering the different angles and multiple images of face of the same person [1].

To make the system more authenticated, the system was integrated with the traditional method of keypad input password which would work hand in hand with the face recognition system to provide two-way authentication that could be more relied upon. The keypad input takes the input from the subject which uses Arduino board to verify the input password with the correct password.

The Arduino board serves as the two-way authenticator. If the subject face is a recognized face stored in a database and the password input by the subject both matches simultaneously, then only the door of this system is unlocked which is indicated by the glowing of green LED, which will indicate that the persons face is stored in the database and password input by them is correct, and hence, two-way authentication is achieved. If any of the condition is not matched, the door will remain unlocked.

The aim for this project is on developing an "real-time face detection module that uses the web camera to view and recognize the individual face using open CV an open-source library for computer vision and machine learning along with the password input authentication from user using keypad and integrate both output to ensure two-way security" [2].

This article is explained through several sections. Section 3 describes about the system analysis of the model. The working model block diagram has been explained in this section. There are various methodologies used in facial recognition. In this, we are using Haar Cascade, LBPH [3] and scale selection. Haar Cascade feature is an machine learning algorithm approach in where a cascading function is trained by a lot of a people and image negatives. It is then used to detect other images. Local binary pattern (LBP) is simple yet very efficient texture operator which labels the pixels of an image by threshing upon the neighborhood of each of the pixel so as to consider the result as a binary number. Now, we have learned about the overview and the methodology in building the module, so we have to now build such model.

This model is made using modules like Arduino, keypad, LED and breadboard. These modules have been explained in detail in Sect. 5. Section 5.5 describes about training the model where we have to first create a raw image directory. When the person's face comes in front of camera, it will detect the person if his/her image is present in the raw image directory else the face will not be recognized. If the face is recognized, then the person has to enter the password using Arduino keypad lock system. If the person enters the correct password, then the door will open else it remains closed. The above algorithm is explained in Arduino keypad lock system in Sect. 6.

2 Overview

This part is concentrated on the problems related to the face recognition. There are several aspects used by the face detection algorithm such as pattern recognition, neural network, deep learning [4]. The face recognition has its application mainly toward the fields of biometric, surveillance system, access control.

The face recognition system problem can be considered as a classification problem as it deals with identifying one or more person in the scene, detecting and mapping the face from data base stored faces. Training the model accordingly with the training sets (faces) of known individual and classify the newly confronted test image to the one of the classes and making the prediction is the main aspects of the face recognition system.

Some of the features that might be seen that cause difficulty to face recognition system which are easily recognizable by humans are the existence of limited memory and some of the other like:

- Facial expression may change
- Scaling factor
- Pose change
- Occlusion due to obstacles in front, mask, or scarf
- Illustration change
- Presence or absence of spectacles, beard, mustache, makeup, etc. [5].

Face recognition algorithm could be categorized in following classes, geometry feature base and image template based. Template method computes the correlations between one or more model template and the faces for estimating the identity of the face. Local facial features and geometric and appearance property are extracted by the feature-based method as the features to identify face.

As a human, we can recognize thousand of faces that comes across us having significance of certain extent. This feature could be used as one of the key feature in the facial detection. Computer used for recognizing face could be confronted to a wide variety of problem that including criminal identification, security systems, image and film processing, but unfortunately building a facial detection system of such context are complex. Eigen face is a face recognition technique which could be used to detect/track the face of the subject and then confirming the person through

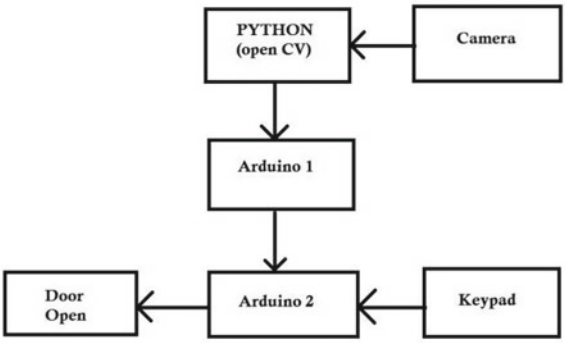

Fig. 1 Block diagram

comparison of characteristics of face of subject to that of faces in database. Euclidean distance is taken into consideration for calculating the distance between nose and eye or distance between forehead and chin. These parameters are matched with the stored database to get accurate result [6].

3 System Analysis

In this, we are using open CV platform to capture the image and matching the image with the images stored in the database. If any image features matches any face in the database, the Arduino1 synchronized with the open CV platform gets high signal and led in the Arduino board is lit indicating the same. Arduino1 now signals the Arduino2 that has been programmed for keypad door lock security to enter the password. If password as entered by person is found to be correct, then the door gets unlocked which is indicated by the conversion of red light to green light, else the door remains locked (Fig. 1).

4 Methodology

In this, we are using Haar Cascade, LBPH and scale selection. Haar Cascade feature is based on cascade classifiers; it can be considered effective for the object detection methods. It is the machine learning algorithm-based approach where a cascade function is trained from a lot of a people and negative images. It is then used to detect other images. LBP (Local binary pattern) is a very simple yet very effective texture operator which labels the pixels of the image by threshing the neighborhood of each pixel to consider the result as a binary number. LBP is then combined to histogram of oriented gradients (HOG) descriptor that helps in improving the detection performance considerably on some of the data sets [7].

Fig. 2 Data set of training images

LBPH uses four parameters such as: radius, neighbors, grid X, grid Y. The LBPH algorithm will take number of images in different angles and then will use them in the time of recognition. In this, we are using web camera to capture the image and store image in databases. The different individual faces were saved in different folder with their respective names which were then used to train the system and store it into the database. At first, algorithm converts the color image into gray scale image, then it is converted into pixel for detecting images, this will divide images into various pieces, and then it is arranged in a matrix format in order to recognize the new image captured through web camera to that of image stored in database, depending upon different angle and portion of the face (Fig. 2).

5 Modules

5.1 Arduino Board

The Arduino UNO is an open-source microcontroller based on the Microchip ATmega328P microcontroller and developed by Aruino.cc. It consists of six analog pins (I/O), 14 digital pins that can be used to interface to other boards. The Arduino is programmed with the help of Arduino IDE via a USB cable. Two Arduinos are used in this project, one is programmed for keypad door lock security system and the other one is used for synchronizing with the open CV platform [8].

5.2 Keypad

A keypad is a set of buttons arranged in a "pad" or a block bearing digits, alphabetical letters, symbols. In this project, a (4×4) matrix Keypad is used. Keypad is used for the security system of door lock for the purpose of entering password.

5.3 Light Emitting Diode

A light emitting diode (LED) is a semiconductor device that emits light when current flows through it. In this project, two LEDs, green and red, are used to display the output. If the face is recognized by the open CV platform, then the Arduino1 signals the Arduino2 for entering the password. If the password is found to be correct, then the green LEDs glow indicating that the door is unlocked, else red LED continues to glow indicating that the door is locked.

5.4 Breadboard

A breadboard is a solderless device used for testing circuit designs. The components on the breadboard are inserted by their leads or terminals in the holes in the breadboard and then connection is made through wires where appropriate.

5.5 Training the Model

Open CVs open face is core for the face detection module that provides us with features extraction method so as to obtain a low dimensional representations of any faces. Demos/classifier.py is a library represented to show a demo on how this representation can be used, to create a face classifier. Model is used for representation of feature and to train the model for classifying people with the said model. There are distinct featureS that can be used to differentiate people using feature of DNN model.

There are some major ways to train a classifier

- Using HOG algorithm to create simplified version of the image.
- Finding the landmarks of face and wrap the image.
- Use of neural network that is capable of measuring and extracting the features of the image by passing the centered face image.
- After the generation of features, the use of SVM classifier for recognizing new face (Fig. 3).

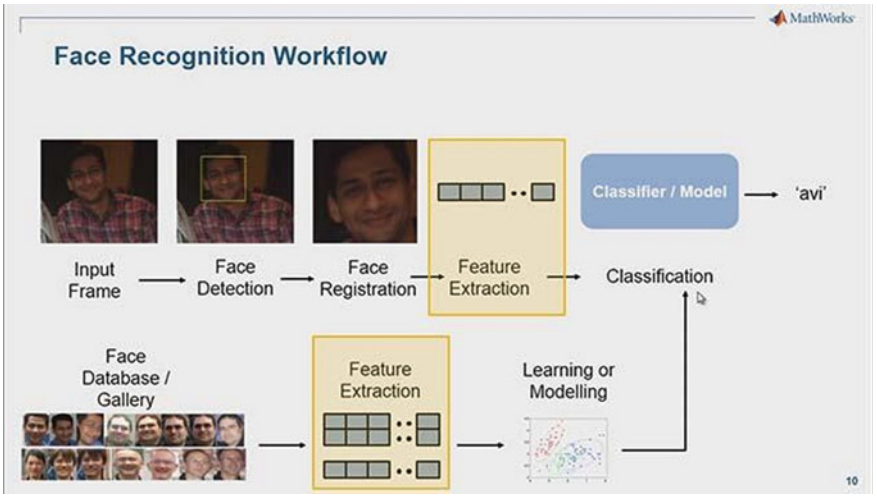

Fig. 3 Classification and similarity detection (*Source* Face recognition with MATLAB—Video—MATLAB and Simulink)

5.6 Create a Classification Model

5.6.1 Creating a Raw Image Directory

Creating a directory for the raw images so that the images of different people can be placed in different subdirectory with their names as the name of subdirectory. Each subdirectory containing certain amount of images of that person.

5.6.2 Prepossessing of Images

The algorithm described above will detect the face from the part of image and will extract the features of given images and align the particular image.

5.6.3 Classification and Generate Model

After extracting the features of each and every input image, model will create representation and label of each image. After generating the representation, it will generate a classification of number of people present in the database. Let us, suppose there are five different people subdirectory in data set, then it will recognize five classifiers present in the classification model.

The test images are put to compare with the images in database after the generation of classifier .pkl file. If the provided image was found in the training set, then the

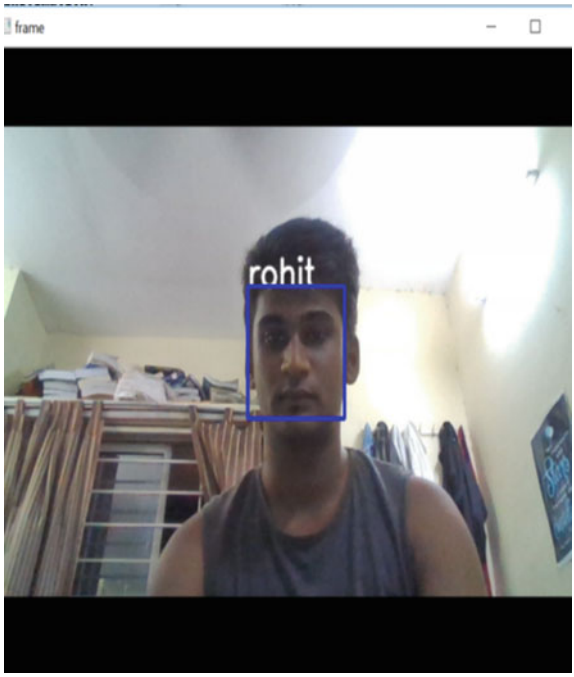

Fig. 4 Face detected after matching with stored database

system would recognize the image with confidence. Otherwise it would recognize the image with certain level of confidence (percentage) (Figs. 4 and 5).

6 Arduino Keypad Door Lock System

After the face of the person is recognized, the LED pin of the Arduino1 which is synchronized with the open CV platform gets into high state.

6.1 Configuration of Arduino1

The LED of Arduino1 will be high for 25 s.

1. During this short span of 25 s, the Arduino1 will send a signal to Arduino2 to enter the password.
2. If the password is entered during this time interval and if it matches with the password which was preset, then the door will unlock, else the door remain locked.

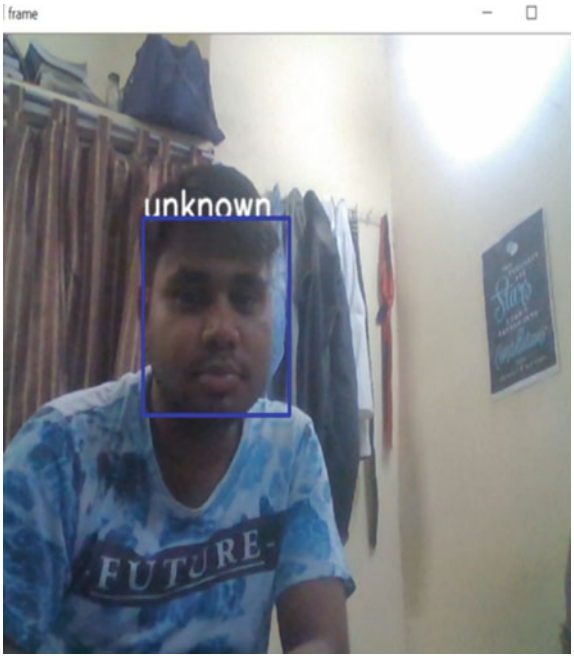

Fig. 5 Unknown person infront of camera

3. If the password is entered after this interval, then the door will remain unlocked.

The person has to once again go through the process of facial recognition and keypad door lock system.

To enable the Arduino1 to enter the password by the user by giving signal through digital pin no 12 of Arduino1 to analog pin A0 of Arduino2.

6.2 Connection and Reading a Key

The circuit connection for the keypad door lock system is performed on Arduino2 which is clearly depicted in Fig. 6. The connection is done as:

1. The eight pins of the keypad (4 × 4) are connected with the pins ranging from 2–9 on the Arduino.
2. The red and green LEDs are connected on the breadboard.
   (i) The positive terminals of the green LED are connected with the pin number 13 on the Arduino.
   (ii) The positive terminal of the red LED is connected with the pin number 11 on the Arduino.

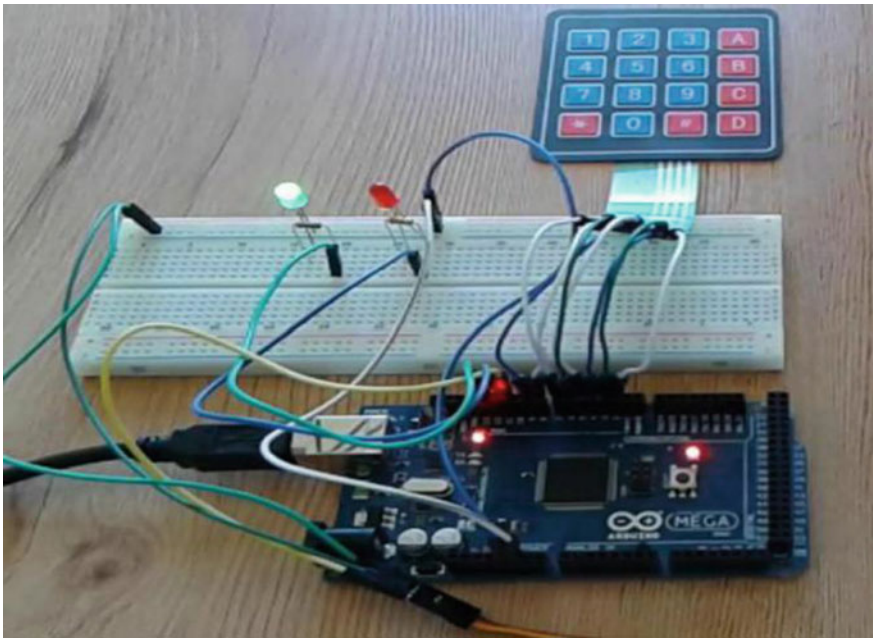

Fig. 6 Arduino keypad door lock system

(iii) The negative terminal of the green and red LED is connected in series with the 220 Ω resistor which is connected to ground (GND) of the Arduino [9, 10].

6.3 Cases Possible After Entering Password

CASE 1: If the person whose face matches the images stored into the database enters a wrong password by mistake, then red LED continues to glow indicating that the password entered is incorrect and door remains unlocked. The user has to once again go with the process of facial detection and then entering the correct password to unlock after a 10 s lapse. Figure 7 clearly depicts this case.

CASE 2: If the person whose face matches the images stored into the database, then the green LED glows indicating that door is unlocked now. Figure 8 clearly depicts this case.

Fig. 7 Wrong password is entered

7 Conclusion

In this project, we have used facial recognition system using an open CV platform with the Python as the language. In the facial recognition system, we have stored data set of different persons at different angles, expressions, etc. When a person comes in front of the camera, the camera is used to capture the image, and if the images matches with the stored data base, then the LED pin of Arduino1 gets high and Arduino1 now signals the Arduino2 to allow the user to enter the password. If the password entered is found to be correct, then the door gets unlocked which is indicated by the glowing of green light, else red LED continues to glow indicating that the door is locked. The system is highly reliable as it provides the enough needed flexibility that suits the requirement and its face detection system makes it is more secure. Thus, we have successfully built and implemented a facial recognition-based security system.

Fig. 8 Password entered is correct

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Analysis of *t*-distribution in Variable Step Size Firefly Algorithm in the Applications of Machine Learning

Shubhendu Kumar Sarangi and Archana Sarangi

Abstract The firefly algorithm in the field of swarm intelligence is recognized as one of the widely demanded algorithm for machine learning applications. This algorithm is inspired by natural leaving pattern of firefly. This algorithm is modified by several researchers for getting better exploration of solution space for various applications. In all these modifications the variable step size firefly algorithm is gathering popularity in the field of machine learning because of its simplicity in modification. In this paper, this modified version is further enhanced by the addition of *t*-distribution function. This newly proposed version helps in the improvement of exploration along with the exploitation of the searched space to generate better solutions. Simulation of the novel projected version is done with standard benchmarking functions to prove the enhancement in the solution. The analysis of results proves the betterment of the solution in a variety of cases. This approach of modification can be utilized for applications in machine learning.

Keywords Firefly algorithm · Variable step size firefly algorithm · Variable step size firefly algorithm with *t*-distribution function · Benchmark testing functions · *t*-distribution

1 Introduction

In this world of machine learning, the demand for efficient training algorithm is increasing day by day. In this area, several researchers projected various algorithms in relation to the nature-inspired computing. Since all the algorithms are not found suitable for all types of applications, different modified versions of several algorithms

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are also proposed. The firefly algorithm [1] in recent years is in demand for multidimensional and multimodal type of applications. Several types of modified versions [2] are also proposed in last years to make this algorithm suitable for applications in the machine learning. Out of all these modifications, the variable step size firefly algorithm is gaining a little importance due to its simplicity in nature for implementation and lesser computation time. But, this algorithm has some limitations in better convergence as the exploitation is limited due to only variation in step size. So, in this paper, a versatile but less implemented *t*-distribution function is added to increase the exploitation feature in order to provide better convergence in comparison to the earlier version. The following section of this paper consists of a brief overview of the firefly algorithm along with the variable step size firefly algorithm. This section also describes a detailed analysis of the newly modified version, i.e., variable step size firefly algorithm with *t*-distribution function. After that the performance valuation of this new algorithm is presented along with the detailed analysis of the result followed by the conclusion.

2 Optimization Techniques

2.1 Firefly Algorithm (FFA)

The firefly algorithm [3] is a demanding algorithm in the area of nature-inspired computing. This algorithm is inspired by the calculated flashing movement pattern of the fireflies. This type of movement of fireflies is mathematically modeled to use as an algorithm in the world of computing. In this flashing pattern of fireflies, the fireflies' changes position with the movement of lighter one to the brighter one. Generally, this algorithm is operated by two distinguished feature, i.e., the difference in the intensity of light as well as the initial attractiveness. The factor attractiveness is basically associated with the cost function used for the solution in the problem. The brightness of fireflies is symbolized as Glow(x) which is defined at a particular x with the intensity of light at the reference as Glow_0

$$\text{Glow} = \text{Glow}_0 e^{-\gamma r^2} \tag{1}$$

The relationships for the attractiveness of firefly having the neighboring fireflies with β_0 as attractive parameter at $r = 0$ can be referred as

$$\beta = \beta_0 e^{-\gamma r^2} \tag{2}$$

In between every two fireflies, the expression of relative distance is given by

$$r_{ij} = \left\| x_i - x_j \right\| = \sqrt{\sum_{k=1}^{D} \left(x_{i,k} - x_{j,k} \right)^2} \tag{3}$$

The above equation refers to the distance between two relative positions of the fireflies. Depending on this, the movement of one firefly to another is given by

$$\text{Pos}_i = \text{Pos}_i + \beta_0 e^{-\gamma r_{ij}^2} \left(\text{Pos}_j - \text{Pos}_i \right) + \alpha \left(\text{rand} - \frac{1}{2} \right) \tag{4}$$

where the value of β is positive for proper movement of fireflies. The parameter α is adoptable in nature whose values are taken arbitrarily in the process of program execution within the range 0 to 1 for a variety of applications. The value of β_0 is also 1 for the majority of the applications.

2.2 *Variable Step Size Firefly Algorithm (VFFA)*

In the standard firefly algorithm, step size is normally invariable which is recognized as one of the biggest limitations in the searching pattern of fireflies. This algorithm removes this limitation by the introduction of the feature of variable step size [4] to replace the constant step size. This feature adaptively changes the step size depending on the area of searching process. So, in larger area of searching, the step size is more where as in smaller area, the step size is less. The step size goes on reducing when the experiment approaches the final solution. Therefore, the dynamical variation of the step size can be expressed as

$$\begin{aligned} \alpha(\text{existing\_iteration}) = 0.4/(1 + \exp(0.015 * (\text{existing\_iteration} \\ - \max \text{generation})/3)) \end{aligned} \tag{5}$$

2.3 *Variable Step Size Firefly Algorithm with* t*-distribution (TVFFA)*

The *t*-distribution function [5] is one of the statistical analysis functions which was used by several researchers for statistical analysis. It is a probability distribution function with continuous probability distribution which can be used when the population standard deviation is unknown with smaller sample size. This function is symmetrical in nature like normal distribution but has heavier trails. The trail heaviness is related to number of degrees of freedom taken in the problem. This also approaches to the normal distribution for higher degrees of freedom. The degrees of freedom in

statistical analysis can be described as the total number of values which are free to vary in the data sample. The mathematical expression for the t-distribution function is given by

$$h(t) = \frac{\Gamma[(\upsilon+1)/2]}{\Gamma(\upsilon+2)\sqrt{\pi\upsilon}}\left(1+\frac{t^2}{\upsilon}\right)^{-(\upsilon+1)/2} \tag{6}$$

where ν is recognized as degrees of freedom and $\Gamma(.)$ is the gamma function.

Steps of execution

1. Initialize the group of fireflies with arbitrary parameter values and assign all related simulation parameter.
2. Computation of the fitness value utilizing the standard benchmarking functions.
3. Estimating the most excellent value for the position.
4. Apply t-distribution to the algorithm and calculate the value which will be assigned as the global best value.
5. Again using the objective function, compute the overall finest value.
6. Repeat the procedure till the termination criteria is satisfied.

3 Result Analysis

This paper makes the utilization of standard functions for benchmarking the performance of the projected customized version of the algorithm in comparison to the previous improved version of the firefly algorithm. The new version proposed here is variable step size algorithm with t-distribution where as the reference version used is variable step size algorithm. The normal firefly algorithm is not involved in the simulation as its higher version that is variable step size firefly algorithm is acting as reference and its further modification is used in this paper. The standard parameters utilized in the simulation procedure are listed as population size $= 30$, $\alpha = 0.2$, $\beta = 1$, $\Upsilon = 1$, and dimension $= 16$. The iterations utilized for the simulation experiment is 150. The simulating experiment intends to provide minimum value of the involved benchmark functions [6] as much as possible. To have the convenience, the identical searching ranges are assumed for all test functions as $[-100, 100]^{\mathrm{D}}$. The simulation is done 40 times and the best as well as worst values are noted down along with the computation of mean values. Table 1 list the benchmarking functions utilized in this paper. Table 2 lists the mean values along with the best as well as worst values. The sample plot for cost versus iteration is shown in Figs. 1 and 2, respectively.

Table 1 Benchmark function

Function name	Function expression
Discuss function	$F_1(xx) = 10^6 xx_1^2 + \sum_{i=2}^{D} xx_i^2$
Sphere function	$F_2(xx) = \sum_{i=1}^{D} xx_i^2$

Table 2 Performance analysis for function

Function	Algorithm	Best	Worst	Mean
Function 1	VFFA	0.7563	0.7948	0.7572
	TVFFA	0.7221	0.7452	0.7224
Function 2	VFFA	1.6628	1.9895	1.6762
	TVFFA	0.7698	0.7764	0.7705

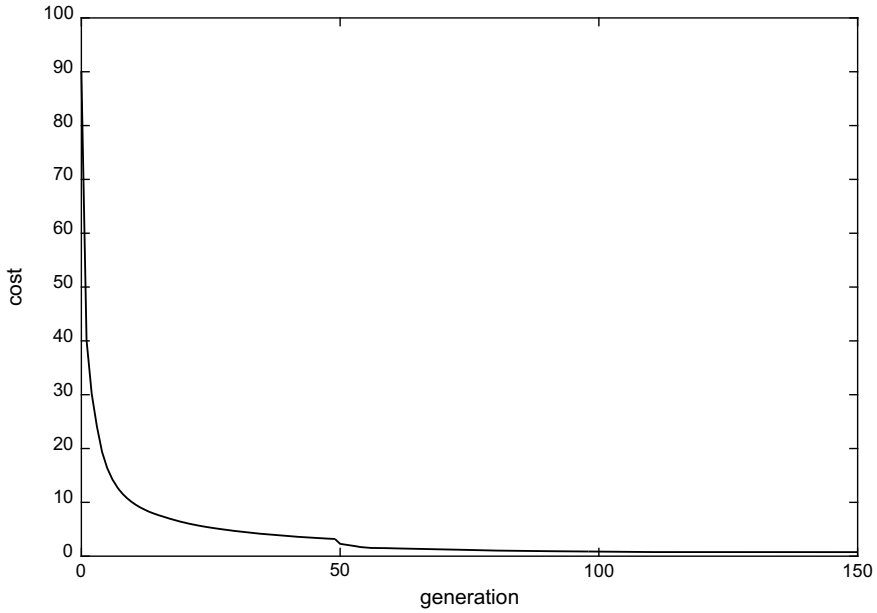

Fig. 1 Cost versus generation profile for function 1 utilizing VFFA

The simulation results are listed in Table 2 which indicate the result for the function 1 and 2, respectively. It can be easily verified from the table about the performance of the variable step size firefly algorithm with *t*-distribution in reference to variable step size firefly algorithm. The table results summarize the improvement exhibited by the newly proposed modified algorithm. The mean value produced by the TVFFA algorithm is 0.7224 whereas the mean value measured by the VFFA is 0.7572 for function 1, respectively. This improvement in mean value of TVFFA exhibited the dominance of this algorithm. Similarly, the best values produced by TVFFA and VFFA are 0.7221 and 0.7563, respectively, whereas the worst values produced are 0.7452 and 0.7948 consecutively. The difference between the best as well as worst values in case of TVFFA is smaller as compared to the VFFA which provides an indication about the higher value of precision of the newly modified algorithm. Similarly, for the second function, the mean values are 0.7705 and 1.6762 for TVFFA as well as for VFFA, respectively. The best values are 1.6628 and 0.7698 as well as the

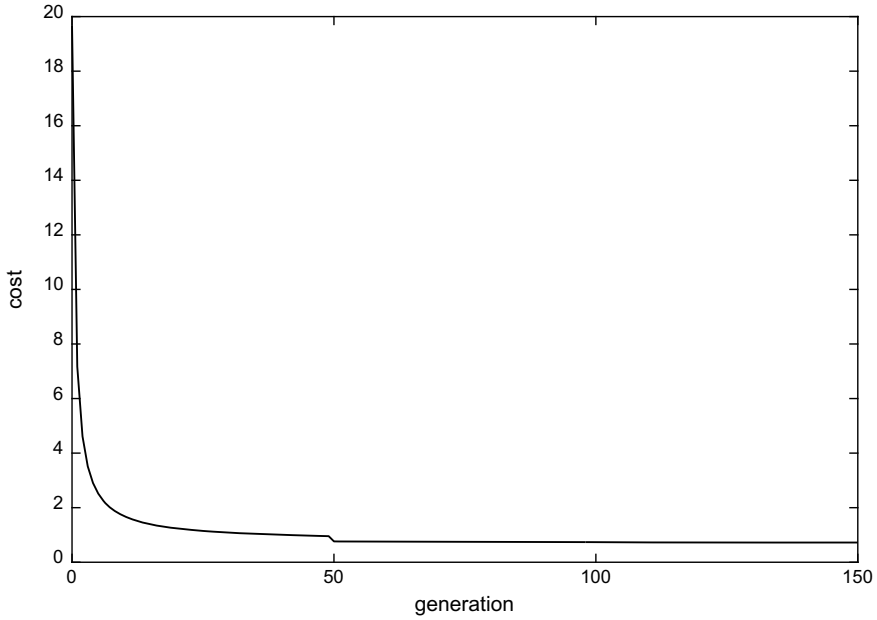

Fig. 2 Cost versus generation profile for function 1 utilizing TVFFA

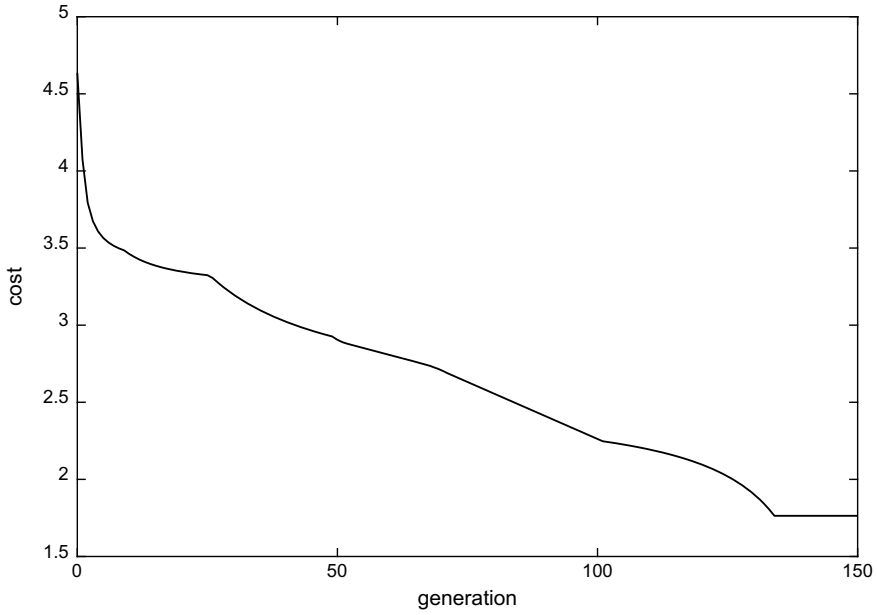

Fig. 3 Cost versus generation profile for function 2 utilizing VFFA

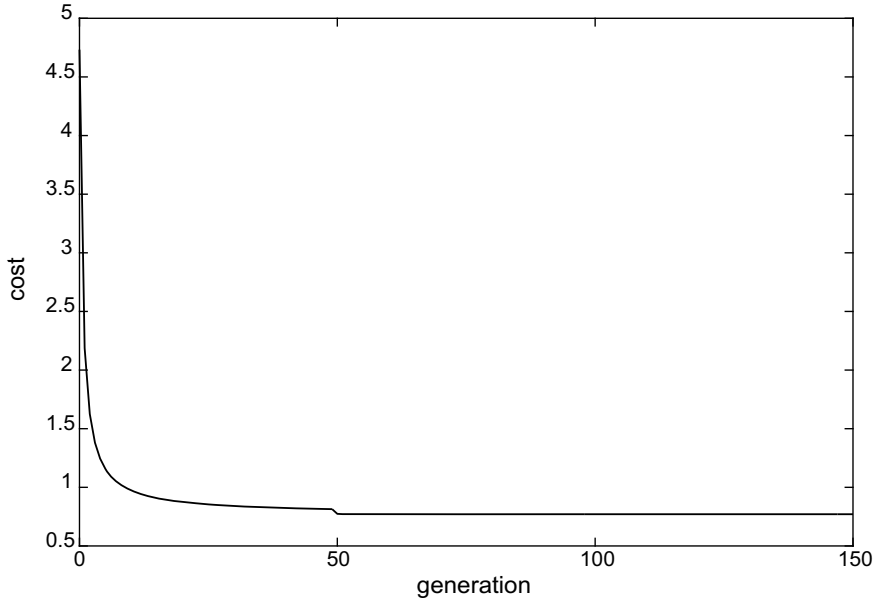

Fig. 4 Cost versus generation profile for function 2 utilizing TVFFA

worst values 1.9895 and 0.7764 for VFFA along with for TVFFA algorithm. These values also proved the dominance of new TVFFA algorithm for the second function. Figures 1 and 2 demonstrate the plot of cost versus iteration of VFFA and TVFFA algorithm for the function 1, respectively. On comparing these two plots, it can be effortlessly concluded that the newly modified algorithm suggested in this paper provides a better convergence profile in comparison to the reference VFFA algorithm. Similarly, Fig. 3 as well as Fig. 4 describe the convergence profile for function 2 using the VFFA and TVFFA algorithm. Figure 3 as well as 4 also provide the identical conclusions about the superiority of the newly modified algorithm projected in this paper.

4 Conclusion

In this paper, one improvement for the variable step size firefly algorithm is suggested for further enhancement of the searching ability of the well-known existed improvement of this algorithm. The proposed projected version which is known as variable step size firefly algorithm with *t*-distribution exploits the searching space more for a better advancement to the final solutions. It combines the step size adaption feature of the existing version of firefly with the exploitation feature of *t*-distribution function. The suggested improvement is also found fruitful when the simulation experiment

is done utilizing the standardized benchmark expressions. This suggested modification is also simple in nature to implement without increasing the complexity of the computation. The addition of the distribution concept to the existing algorithm provides an organized investigation of the search space. In the process of experimentation, this algorithm is also found fruitful when a comparison is done with the previous versions of firefly algorithm. The involved statistical parameters give a clear view of the improvement provided by the newly modified version of this algorithm. The projected version depicted in this paper provides better output for lower number of population. The need of taking higher amount of population to get a better result can be easily avoided in this case. So the reduction in population size with a better improvement of result can easily compensate the extra computation time. Therefore, this modified version can be used in a variety of machine learning applications.

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Detecting Vulnerabilities of Web Application Using Penetration Testing and Prevent Using Threat Modeling

Sandip Sarkar

Abstract The number of Web attacks is increasing gradually, mainly the popularity of Web application in organization, school, and colleges. For this reason, the security of their sensitive information against attacker becomes very important for all organization and companies. In this paper, we describe different type of Web application attack like SQL injection, XSS attack, CSRF attack, and Buffer overflow. Besides, we discuss about different types of penetration tools for Web applications. Penetration testing try to find the vulnerabilities of Web application so that we can build a defense mechanism to deal with Web attack. Finally, we build attack trees and defense trees to represent the attacks and to prevent those attack.

Keywords Web application · SQL injection · XSS attack · CSRF attack · Attack tree · Defense tree

1 Introduction

In the beginning of Web application, there were only static Web pages which contained static information. Now, the popularity of Web application gradually increases, and in the same time, the architecture of Web application become more complex. Web applications are used in organizations, bank, so companies concentrate to secure their sensitive data like username, password, bank card numbers, etc. An attacker can get sensitive information using malicious code. SQL injection and cross-site scripting (XSS) are the two most famous vulnerabilities in Web application. Detection or prevention of Web attack is a challenging issue. To detect the vulnerabilities of Web application, we have used different types of automatic vulnerabilities tools but none of them can guarantee to find the vulnerabilities of Web application. In our paper, Sect. 2 describes different types of Web attack. Section 3 gives some brief description of different types of Web application-based penetration tools. We build different types of Web attack trees and those are described in Sect. 4. Section 5

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gives the information that how to prevent those attack using defense trees. Finally, Sect. 6 conclude the paper.

2 Different Types of Web Attack

In this paper, we discuss different types of vulnerabilities of Web applications. Besides, counter mechanism for those Web vulnerabilities is given.

2.1 SQL Injection

SQL injection is one type of code injections in which malicious code injected into the SQL query so that attacker can direct access to the database and leak confidential, or even sensitive, information without proper authorization [1, 2]. The main reason of SQL injection is mainly because of insufficient validation of user input. Table 1 describes the statics of SQL injection from year 2012 to 2019.

(a) **Tautology**

In SQL tautology, attacker user injects malicious code into one or more conditional statements to bypass user authentication [3]. If a malicious user enters '*OR*' 1 = 1- - instead of a legitimate username into username fields, then the SQL query looks as follows:

*select * from user where name = 'Alice 'OR' 1=1- - 'and password ="*

This statement is only checking the username field and successfully bypassing the authentication mechanism. Similarly, attacker injects *Alice/** into the username field and */ into the password field to bypass user authentication. This malicious code.

*select * from user where name = 'Alice'/* 'and password ='*/*
*select * from user where name = Sandip/# and password =#/*

Table 1 Statistics of SQL injection

Year	Matches	Total	Percentage (%)
2012	366	5288	6.92
2013	269	5187	5.19
2014	478	7937	6.02
2015	389	6487	6.00
2016	253	6447	3.92
2017	692	14,645	4.73
2018	732	16,512	4.43
2019	820	17,311	4.74

(b) **Union Query**

A common example of SQL injection to add the statement 'union select', along with an additional target dataset so that queries return the union of the intended database with the target database.

*Select * from users where username = 'union select * from student -' and pwd = 'xyz';*

The first SELECT query gives no result but the second query returns all information about student.

(c) **Piggy-Backed Query**

In this technique, malicious user supply relies on server configurations that allow several different queries within a single string of code. For example, an attacker can add a query delimiter such as ';', use it in such as a way that can delete using drop table command.

select name from student where password='Kharagpur';drop table user;
update employee set position.id = '2456' where id = '255'; delete from orders WHERE id = 'C0201';

2.2 Cross-Site Scripting

A cross-site scripting attack (also known as XSS or CSS) occurs, due to poor security awareness of developers [4]. In this attack, the attacker executes malicious code on the victim's machine for lack of input validation [5–7]. There are two type of XSS attack: (i) Reflected XSS attack and (ii) Stored XSS attacks. Figure 1 describes about

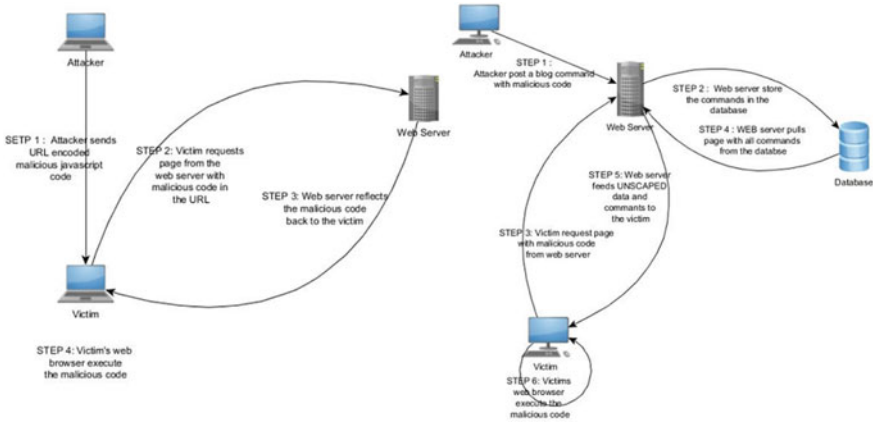

Fig. 1 Reflected and stored XSS attack

Table 2 Statistics of cross-site scripting

Year	Matches	Total	Percentage (%)
2012	771	5288	14.58
2013	639	5187	12.32
2014	1092	7937	13.76
2015	780	6487	12.02
2016	409	6447	6.34
2017	943	14,645	6.44
2018	920	16,512	5.57
2019	856	17,311	4.94

reflected and stored XSS attack. Besides Table 2 shows the statistics of XSS attack form year 2012 to 2019.

(a) **Reflected XSS Attack**

In a reflected XSS attack, the actual malicious code is not stored on server but the malicious code are delivered to the victims via e-mail messages [8]. This type of attack mainly occurs when data submitted by the client is immediately processed by the server and send back the result to the client.

(b) **Stored XSS Attack**

In a stored XSS attack, the malicious code is permanently stored on the target server. The actual attack is occurred at later, when the client requests a dynamic page that is managed by this server. The user's Web browser executes the malicious code.

2.3 Cross-Site Request Forgery

Cross-Site Request Forgery is one type of Web attack where attack performs unauthorized activities using victims' authority and credentials [9, 10]. In this attack occurs while victim is currently logged into their account [11]. In the same time, victim's browser automatically sends request to the server without user's knowledge. In this attack, the server cannot understand which request is from the legitimate user. For example, a user sends a request to the server with its session ID while sending money to an account. An attacker can steal that user's session ID and send request to the server after modification of that request. An attacker can steal the session ID and send the request to the bank server and he can also put his account number. For this reason, the bank server deducts the money from the user and credit to the attacker account. Figure 2 describes the mechanism of this attack. The statistics of CSRF attack is given in Table 3.

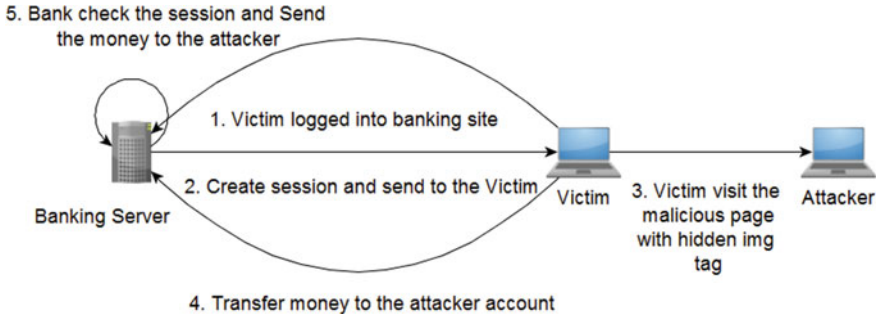

Fig. 2 CSRF attack

Table 3 Statistics of cross-site request forgery

Year	Matches	Total	Percentage (%)
2012	165	5288	3.12
2013	120	5187	2.31
2014	247	7937	3.11
2015	246	6487	3.79
2016	73	6447	1.13
2017	190	14,645	1.30
2018	154	16,512	0.93
2019	226	17,311	1.31

2.4 Broken Authentication and Session Management

Broken authentication and session management attack is one of the most common application layer attack mechanism used by attacker [12, 13]. Developer uses different type of cryptographic algorithms and session management tokens, but it is still a major problem how to secure the authentication. Wireshark is well-known packet collector tool to perform this attack. The network packet may contain password, session ID, cookies. If the logging session of a user was not managed properly then after the user's logout, session may still reside in the Web application. Another reason of this attack is to use GET method. User's private credential may be visible if the developer of the Web application use GET method.

2.5 Security Misconfiguration

The most common Web vulnerability is security mis-configuration which can occur in any layer of Web application [14]. Most of the time, Apache HTTP server and MySQL database server are used in Web application. Normally users use those

Web application environment with default settings. The configuration of MySQL is controlled by my.conf file or using MySQL-specific directives in php.ini. For empty root password of MySQL causes command injection attacks or denial of service attacks. PHPSecInfo and PHP security edit are automatic tool to check security mis-configuration. But both automatic tools are only limited to PHP.

3 Web Application Penetration Tools

A Web Application Penetration Test tries to provide a clear idea of the system and also provide how to secure an organizations information from real world attacks. In this section, I discuss about well-known penetration tools which help to detect the vulnerabilities of Web applications.

3.1 AMNESIA

AMNESIA is a well-known penetration tool to detect SQL injection. This tool consists of two parts: one is static analysis and another one is runtime monitoring. This technique finds malicious code before being executed on the database. It uses model-based approach. In static part, it analyzes the Web application code to build a model of the legitimate queries. In dynamic part, it checks the dynamically generated queries with the statically built model using run time monitoring. This model finds the malicious queries and prevents it to access the database.

3.2 Xsser

Xsser is an automatic and open-source framework to find the vulnerabilities of Web application. This framework contains several mechanisms to break different filters and various special techniques of code injection.

3.3 Acunetix

Acunetix Web vulnerability scanner is an automated tool to find the vulnerabilities of the Web application. Security analyst uses Acunetix to find the vulnerabilities such that SQL injection, cross-site scripting, and weak passwords.

3.4 Sqlmap and Havij

Sqlmap Havij are both automated SQL injection tool that help the developers to check SQL injection vulnerabilities of Web application. Attacker can retrieve username and password from login database using those automated tools. Sqlmap is developed using Python language and for this, it is independent of operating system.

3.5 Netsparker

Netsparker is a very powerful Web application security scanner and it can find most of the vulnerabilities of the Web application. This penetration tool is platform independent. It is very useful for security analyst to build a secure Web application.

4 Threat Modeling Using Attack Tree

In the previous section, we discuss different types of threats of Web application. These threats can come inside the application or outside the application. For this reason, threat modeling is very essential to prevent sensitive information which are stored in the database. Threat modeling is mainly built to find problems before designing of a system. Threat modeling can be achieved by different mechanism. Nowadays, attack tree is very popular for the designing of threat modeling.

Attack trees describe a graphical representation of attacks which are performed by the attacker. The root of this tree is the main goal of attacker. Each node of the attack tree contains an action. There are two types of relationship (i.e., OR and AND relationship) which connect the child node. For OR relation between child node, if any of the child node is executed by the attacker, then attacker can access parent node. Likewise, for AND relation between child node, if all child nodes are executed

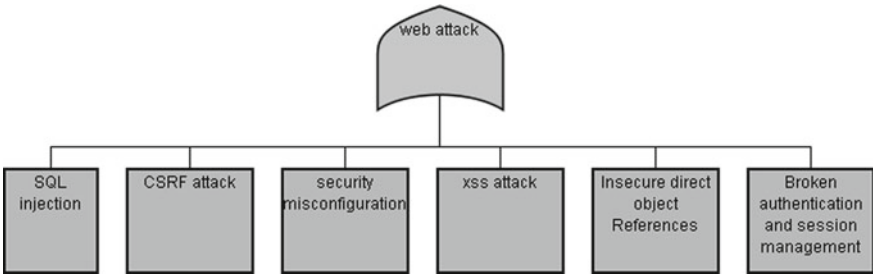

Fig. 3 Attack tree of web attack

by the attacker then attacker can access parent node. Figure 3 shows the attack tree of web attack.

We are trying to build an attack tree of Web attach which is shown in Fig. 4. It describes the general view of Web attacks is divided into six main categories.

Those are XSS attack, Insecure data object, Broken authentication and session management, CSRF attack, SQL injection, and security miss-configuration. Figure 5 describes the attack tree of SQL injection. SQL injection can be performed using steal system information or using attack against database. If any of the them is successful, then the parent node means SQL injection is successful. Similarly, other nodes of

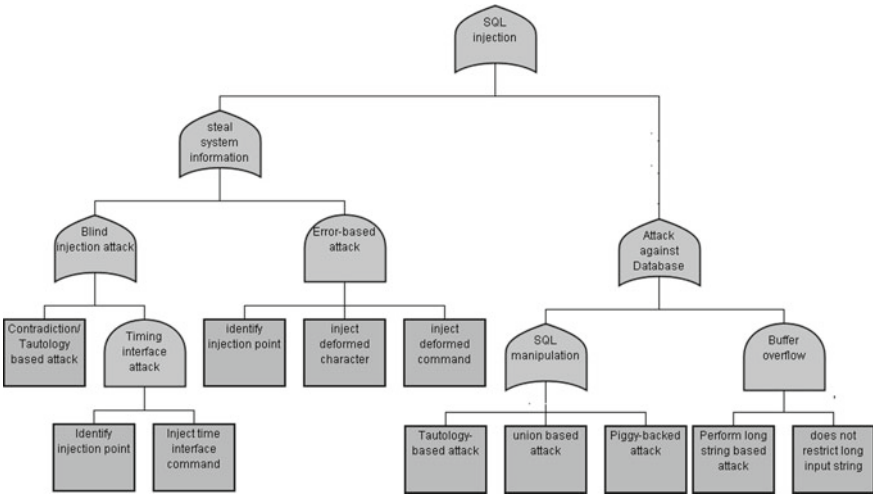

Fig. 4 Attack tree of SQL injection

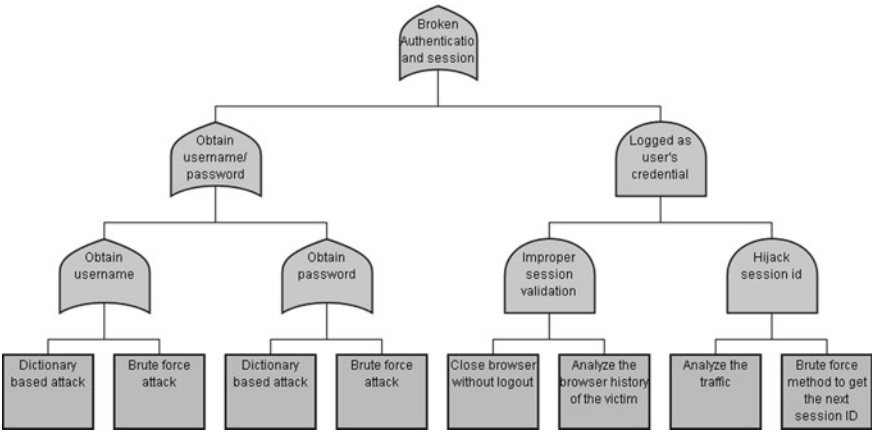

Fig. 5 Attack tree of broken authentication and session management

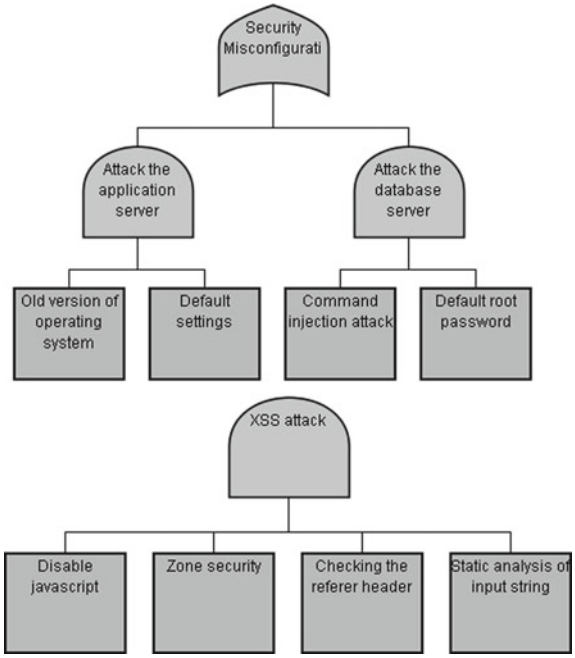

Fig. 6 Attack tree of security mis-configuration and XSS attack

attack tree of SQL injection are executed using same scenario. Figure 5 shows that architecture of broken authentication and session attack. Attacker can obtain user name and password using brute-force attack and dictionary-based attack or user can enter into the system using user's session-id. Figure 6 described that xss attack is divided into three subdivisions. To perform persistence XSS attack, attacker first finds the injection point and then injects his code into the database. Here, the relation is AND operation, if the two-child node are successful then the Persistence XSS attack is successful. It is same for the reflected- and DOM-based XSS attack.

5 Defense Tree

Attack tree represents the attacking scenario based on attacker's point of view. We cannot secure our Web application using attack tree. For this reason, we need another type of mechanism (i.e., Defense tree). Defense tree represent the counter mechanism for different types of attack (i.e., described in attack tree). Figure 7 describes the defense tree of SQL injection. Database can be protected using encryption, minimum user privilege, and using prepare statement. In our previous section, we described about SQL injection. Similarly, Figs. 7, 8, and 9 describe the defense tree of broken authentication and session management, XSS attack, and security mis-configuration.

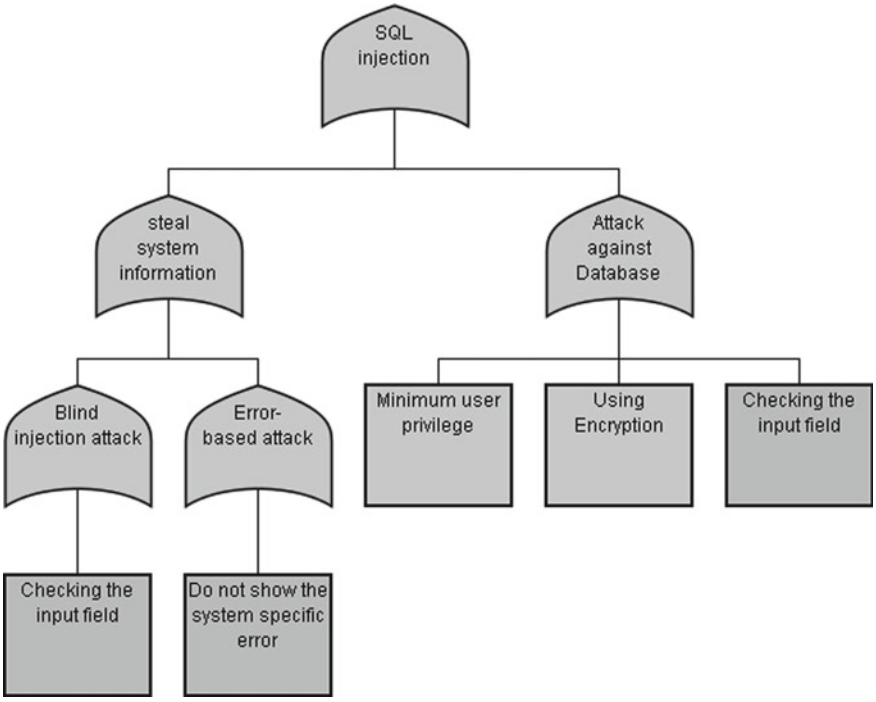

Fig. 7 Defense tree of SQL injection

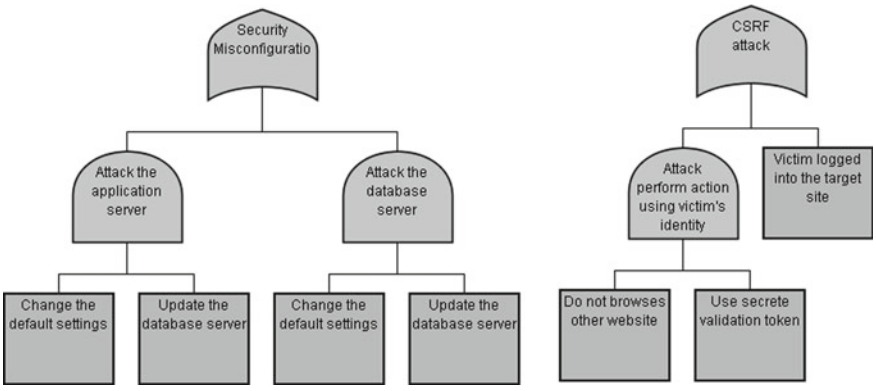

Fig. 8 Defense tree of security mis-configuration and CSRF attack

6 Conclusion and Future Work

In this literature survey, different type of security flaws of Web applications is described. Web application vulnerabilities are mainly because of improper input

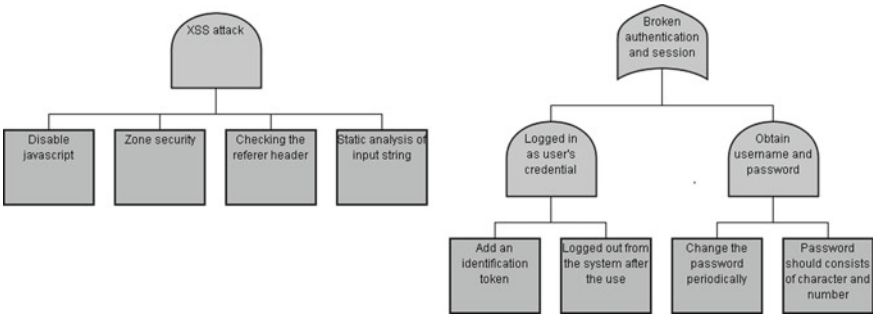

Fig. 9 Defense tree of XSS and broken authentication and session management

validation and unawareness of security mechanism. In the same time, we also represent different Web attacks using attack tree. To prevent those Web attacks, we used different types of mechanism which are presented by defense tree. In the future, we plan to investigate new types of Web attacks which are top rank in upcoming years and want to investigate better counter mechanism to prevent those attack.

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Analysis and Comparison of Credit Card Fraud Detection Using Machine Learning

Saloni and Minakhi Rout

Abstract Credit card sharp practice detection is one of the most important issues which must be motivated to save the financial institution from huge losses. Several machine larning models such as random forest, logistic regression, Naive Bayes, and XGBoost have been used to verify whether the transaction is fraudulent or genuine one. The data sets which is used in the research has been taken out from European Cardholder consisting of 284,807 transactions. As the data sets are highly imbalanced, so, SMOTE oversampling technique has been used. This experiment is carried out in three phases. First with individual standard model next with soft voting and finally with AdaBoost to know which model gives better results. F1 and MCC have been used for evaluation of the model as accuracy might leads to misclassification problem.

Keywords Class imbalance · SMOTE · Machine learning classifiers · AdaBoost · Soft voting

1 Introduction

Nowadays, one of the most prominent fraudulent activities that has taken attention of the world is credit card fraud. Fraud is an unlawful act to gain money and properties by cheating people. Credit card fraud is nothing but the illegitimate use of credit card, debit card, or other sensitive information, so that the fraudster can obtain money or goods. So, there is a requirement of some technique that helps an individual to protect oneself from such a fraudulent act.

As we know, India is digitalizing. Most of the populations are now preferring online transactions rather than going for traditional method of payments. Credit

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card fraud can be considered as one of the harsh realities of digital era because fraudster can easily access the credit card for illegal purchasing. Once he or she gets sensitive information like CVV code, card number, etc., then they can easily carry out fraudulent activity. As per the Reserve Bank of India, during the year 2015–2016, 2017–2018, and 2018–2019, a total number of fraud cases that has been registered are 1192, 1372, 2059, and 921, respectively. Therefore, credit card fraud detection helps an individual to protect himself/herself from such illegal act.

Moreover, credit card fraud detection comes up with several challenges. One of the toughest challenge is non-availability of real data sets. As we know, due to confidentiality constraints, financial institution never wants to reveal the confidential information about their customers. Next big challenge with credit card fraud detection is data imbalance. It can be resolved by using various oversampling and under sampling techniques. Another major challenge is the feature selection. As it plays a vital role in overcoming the problem of over fitting, reduce training time, and improve the accuracy of the model. Besides that, determining the appropriate evaluation metrics is also one of the main challenges. Because the data sets are highly imbalance choosing accuracy as our evaluation metrics may lead to misclassification problem. Apart from that, the dynamic behavior of the fraudsters can be consider as another big challenge as well.

The remaining parts of the paper are sorted as follows: Sect. 2 presents researches that consists of similar kind of problem statements in this area. Section 3 presents the proposed method for the implementation of research work, whereas Sect. 4 consists of results and finally, the conclusion and future scope is presented in Sect. 5.

2 Related Work

Randhawa et al. [1], the author have used several machine learning algorithms to find out the fraudulent transaction. In their experiment, first they have used standard model to evaluate the transaction and then they have used the hybrid model by using two different methods, first with AdaBoost and then with the majority voting. After the experiment, the result shows that the majority voting methods provides highest accuracy. Moreover, they have used MCC as an evaluation metrics and the best MCC score is also got by using majority voting.

Varmedja et al. [2–10] uses several classification algorithms to classify the transaction as fraudulent or genuine one. The several classifiers used by the authors were LR, RF, NB, KNN, SVM, MLP, etc. In [2], the author has suggested SMOTE technique to deal with imbalanced data. In [3], the author used KNN and Outlier techniques. The author suggested that KNN method is suitable for detecting fraud when there is bound or limitation of memory and power whereas Outlier detection works fast on large data sets. Similarly, Kumar et al. [4, 5] have proposed model which has usedrandom forest classifier. In [4], the evaluation of the proposed system's accuracy is based on confusion matrix while in [5] two kinds of random forests are used to identify the fraud different in their base classifiers. Awoyemi et al. [6, 8], have

proposed the method to deal with imbalance data sets. In [6], they have carried out a hybrid technique of under-sampling and oversampling whereas in [8], they have used SMOTE technique. However, in [7] Dighe et al. have compare the used pattern and current transaction, for classifying the fraudulent transaction. For evaluation purpose accuracy, precision, and recall have been used in these papers. Dhankhad et al. [9, 10] have used various supervised learning algorithms and ensemble techniques for detecting fraudulent transaction. In addition, Mishra and Ghorpade [10] have also proposed several under sampling and oversampling technique to analyze credit card fraud.

Further, Sisodia et al. [11] proposed different sampling methods to handle imbalance data sets apart from SMOTE. At the end of the experiment, they have observed that SMOTE ENN detects fraud in better way. Also, in [12] Xie et al. have discussed about different methods for feature extraction.

3 Proposed Method

In this research, the experiment is accomplished in three stages. In the very first stage, individual standard model has been used then in the next stage, the hybrid model with ensemble technique such as AdaBoost and soft voting has been used. Given in Fig. 1, the flowchart of the experiment.

For this research, the credit card data sets have been downloaded from Kaggle. The data sets consists of transactions, by European cardholders September 2013. In entire data sets, 492 out of 284,807 transactions are fraudulent and the rest are

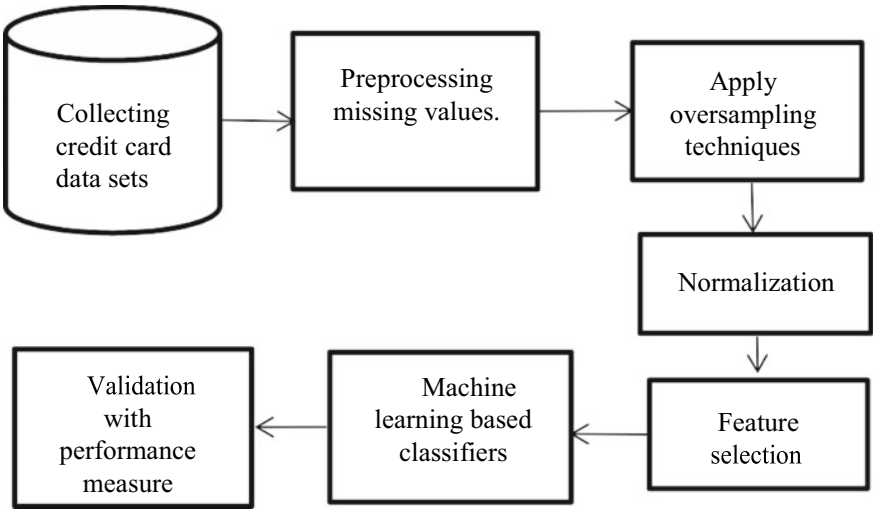

Fig. 1 Flowchart of credit card fraud detection model

non-fraudulent. So by focusing on these statistics, only 0.173% of the transactions are fraud and, therefore, it can be said that these data sets are highly imbalance.

As we know, data preprocessing plays a crucial role in any data mining process. It is one of the techniques which is used to transform the raw data into the useful form. The data preprocessing mainly involves three steps. The first step is data cleaning, then next is data transformation and finally, the data reduction. The first step, i.e., data cleaning is useful for checking whether the data sets consist of any missing values or not and in this experiment, the presence of any missing values is null.

Data transformation is nothing but transforming data from one form to another form. It basically involves feature selection and normalization. Feature selection is important for selecting the most important features either manually or by automatically in a given data set. Carefully, selecting the most relevant features and ignoring the least one can lead to several advantages such as improving accuracy, it will help in cut down training time, and lessen the problem of overfitting. By using univariate feature selection, we have selected the most important features and removed the rest. Here, only 75% features were got selected and the rest were removed.

Further, data normalization is a process of converting the data consists of different numerical values into the range of 0 and 1. Here, in this experiment, standard scalar normalization technique has been used to normalize the data sets.

Moreover, the data sets which have been used for the detection of credit card frauds are observed as extremely imbalanced as the class labels are not equally distributed. To overcome this problem, it requires some balancing technique so that the models get trained efficiently. One of the highly recommended oversampling method that can be helpful in dealing with imbalanced data sets is Synthetic Minority Oversampling Technique (SMOTE).

In this experiment, we have considered different machine learning-based classifiers such as random forest, Naive Bayes, XGBoost, logistic regression. For validation purpose, we have used different metrics such as accuracy, precision, recall, F1, and MCC of each models but our main focus is on F1 and MCC score.

4 Result

All the experiments are done in Python programming language. The software operating environment is Jupyter notebook which is a part of Anaconda platform.

Some of the libraries which have been used include numpy, matplotlib, pandas, sklearn, imblearn. The data sets are splits into training and test data in a ratio of 70:30.

This experiment is accomplished in three stages. Firstly, the standard model with SMOTE technique to deal with the imbalanced data set has been used. From Table 1, we can observe the results of various individual machine learning-based classification models.

The outcome of various individual models is depicted in Table 1 indicates that the accuracy of all the models is around 99%. However, the F1 with 0.89 and the MCC

Table 1 Results of various individual models.

Machine learning-based classifiers	Accuracy	Precision	Recall	F1	MCC
Random forest	0.9996	0.95	0.83	0.89	0.8900
Logistic regression	0.9993	0.91	0.68	0.78	0.7876
Naive Bayes	0.9992	0.86	0.66	0.74	0.7497
XGBoost	0.9995	0.92	0.82	0.87	0.8726

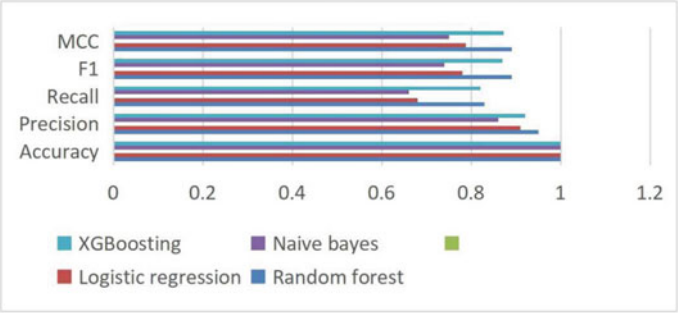

Fig. 2 Performance score of all the individual classifier

score with 0.8900 of RF are slightly high among all the models. Figure 2 shows the score of different evaluation metrics used for the evaluation of several individual classifiers. It can be seen that the score of all the evaluation metrics for random forest is high in comparison with other classifiers.

Inspite of the standard model, Soft Voting and AdaBoost along with SMOTE technique have been implemented with these standard models. The results of Soft Voting are depicted in Table 2.

From the observation noted in Table 2, it can be seen that the RF + DT model performs better than other model. As it can be observed that there is increase of Recall score of LR + DT model and Recall and F1 score of NB + DT model. Moreover,there is drastic decrease in MCC and precision score which can be seen in all the models except the NB + DT when it compares with the standard model. Also, Fig. 3, represents the statistics of different parameters used for the evaluation of classifiers using Soft Voting. The performance score of RF model with Soft Voting

Table 2 Results of soft voting

Machine learning-based classifiers	Accuracy	Precision	Recall	F1	MCC
Random forest + decision tree	0.9994	0.88	0.80	0.84	0.8416
Logistic regression + decision tree	0.9991	0.74	0.80	0.77	0.7729
Naive Bayes + decision tree	0.9992	0.76	0.80	0.78	0.7802
XGBoost + decision tree	0.9991	0.72	0.80	0.76	0.7592

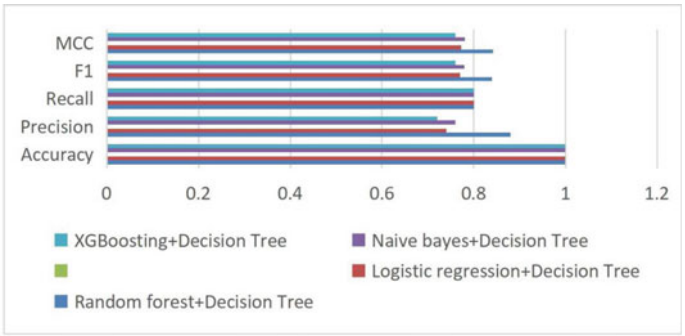

Fig. 3 Performance score of all classifiers using soft voting

Table 3 Results of AdaBoost

Machine learning-based classifiers	Accuracy	Precision	Recall	F1	MCC
Random forest	0.9996	0.95	0.84	0.90	0.8975
Logistic regression	0.9993	0.90	0.69	0.78	0.7884
Naive Bayes	0.9992	0.86	0.66	0.74	0.7497
XGBoost	0.9995	0.92	0.83	0.88	0.8764

is far better than the other model with Soft Voting but it can be seen that there is decrease in the rate when it compared with the standard method. Therefore, the AdaBoost method is applied.

So, in addition to the Standard model and the Soft Voting, the results of AdaBoost can be seen in Table 3.

From Table 3, it can be observed that here also the RF model gives the best results in comparison with other model. No change is observed in Naive Bayes model. However, there is slight increment of Recall, F1, and MCC score of RF and XGBoost model. Further,there is no change observed in the F1 score of LR and NB model when it compares with the individual standard model. From, Fig. 4, it can be seen that using standard model with AdaBoost increases the performance when it compares with the other two. As there is a slight increase in the score of evaluation metrics.

5 Conclusion and Future Scope

In the present paper, comparison on numerous machine learning model such as RF, LR, NB, XGBoost to detect fraudulent transaction has been made. This experiment is carried out in three stages. First with individual standard model, then with Soft Voting , and finally with AdaBoost. The data sets which have been used were highly

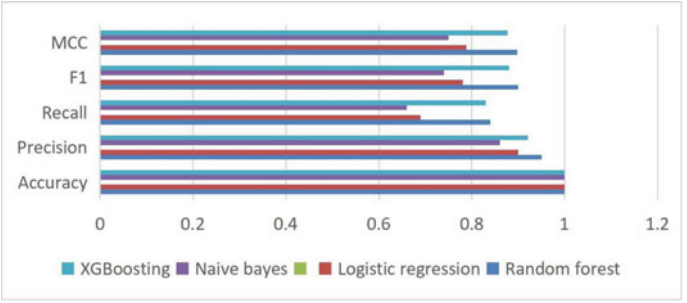

Fig. 4 Performance score of all classifiers using AdaBoost

imbalanced so accuracy cannot be considered as right metrics for model evaluation. Therefore, in this paper, F1 and MCC score have been taken as evaluation metrics. As from the results, it is observed that random forest applied with Adaboost along with SMOTE technique gives the best result. The highest F1 score is 0.90 and MCC score is 0.8975 achieved by using AdaBoost. In the future, the various machine learning models used in this research can be extended to deep learning model. Alongside, other methods for feature selection and to deal with the problem of data sets imbalance can be used for better results.

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Data Hiding Technique Using Differential Evolution

Sharbari Basu, Arunothpol Debnath, Abhishek Basu, Tirtha Sankar Das, Avik Chattopadhyay, and Anirban Saha

Abstract The method of data hiding has become one of the most trustworthy techniques to combat the malicious attacks on communication networks. Among various data hiding methods, watermark has turned one of its foremost technique, in which an image is veiled in a cover image. The paper proposes a Differential Evolution based watermark technique that eases to locate the covert region for data hiding where the unwanted attacks can almost be nullified. Least Significant Bits are used for veiling the watermark. The proposed scheme is carried out in the spatial domain. The experimental results show the competent quality of images are restored even after various attacks, as well as the watermark itself, is still in a recognizable state.

Keywords Differential evolution · LSB · Optimization · Watermarking

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1 Introduction

Data sharing as multimedia content has become relevant and well-liked with the rapid growth of the world wide web, which, at the same time, has become an unguarded medium to the malicious users who not only steal data but also do unwanted modifications [1]. At this junction, digital image watermark technique [2–4] plays a key role and imparts copyright protection [5] to the image and preserves its originality. Principally, digital image watermarking can be classified into spatial domain and transform domain [6, 7]. In line with the need for host data during the watermark detection process, digital watermarking technique can be classified into private and public algorithms. The primary goal in embedding and extraction of the watermark is to acquire an appropriate measure of optimization, viz, imperceptibility and robustness [2, 8]. So, the embedded watermark in the cognitive significant regions, though robust to attacks but hiding capacity is very poor. On the contrary, the insignificant regions, though seem to have high hiding capacity but are prone to attacks [9, 10]. Thus the trade-off between the two becomes an important perspective of investigation. At this point, many watermarking schemes have taken advantage of intelligent optimization techniques [11–13]. A watermarking technique has designed its watermark from miscellaneous robust attributes of approx. host's forged images. Though it may be robust, but the level of imperceptibility is very poor. The balance between the two can be viewed in the frequency domain but the hiding capacity still remains low [14]. A work on DWT-SVD based image watermarking [14], though effective but complex. Here, differential evolution (DE) is used to optimize the scaling factors(SF), but the experimental results show serious distortion of image quality as well as watermark [3]. Thus, the scheme, though used the optimization method, failed to deliver the trade-off. Embedding strength has also been optimized through genetic algorithm (GA), but fails to reduce time complexity, so, exploring the positions to hide the watermark nonetheless left a question [15]. Our proposed methodology deals with pixel values and their positions thereby reducing the number of steps. The said technique focuses on the cognitive regions responsible for keeping secrecy of the watermark. The use of DE in the algorithm also helps to obtain a higher quality of imperceptibility. Moreover, watermark extraction results in subjective recognition of watermark pattern with an acceptable level.

2 Proposed Methodology with DE

The paper proposes a method that uses Differential Evolution as an optimization algorithm to probe the cognitively insignificant regions in order to embed watermark in the given host image.

An image I can be denoted as an array A, having N columns and M rows. $A[x, y]$ represents the element in column x as well as in row y with

$$x \epsilon \{0, N-1\},\ y \epsilon \{0, M-1\} \tag{1}$$

Every pixel has a value. For Grayscale images, the values are scalar that indicates intensity of each pixel p. Each pixel $p \approx 1\,byte$ and has a gray label L, that is, number of possible intensity values. Each pixel p has a value i, where $i = \{0, \ldots, \ldots, L-1\}$

A one-dimensional array Q stores for each gray label, the number of pixels having the value:

$$n[k] = n_k, k = 0, \ldots, \ldots, L-1 \tag{2}$$

where n_k is the number of pixels in an image with gray label k, that is n_k is the cardinality of the set of pixels whose intensity is k.

$$n_k = |\{p : I(p) = k\}| \tag{3}$$

Every pixel p_i has neighbours. A pixel q can be granted as a neighbour of pixel p, if q placed in the neighborhood of p: $q \epsilon N(p)$, where N is the neighborhood function. The most common neighborhoods in image processing are 4 neighborhood, denotes as N_4 having set of pixels at left, right, above and below the pixel, and 8 neighborhood, denoted by N_8, which is $N_4 \cup N_8$, where N_D are the four pixels diagonal from pixels.

The next important step considered in the proposed method is finding out a region of connected pixels in the given grayscale host image. Pixels considered to be connected or contiguous if a path exists between them. Path T bears pixel sequence $p_0, p_1, \ldots, \ldots, p_{n-1}$, such that p_{i-1} and p_i are adjacent for all $i = 1, \ldots, n-1$.Two pixels in a grayscale image are said to be adjacent if they have the same gray label and are neighbours of each other. There are two types of adjacencies, namely 4 adjacency and 8 adjacency. Here we have used 4 adjacency. 2 pixels p and q in a gray scale image I are said to be 4 adjacent if

$$I(p) = I(q) \quad \text{and} \quad q \leftarrow N_4(p) \tag{4}$$

Neighborhood relation are considered as symmetric for all adjacencies, so that $q \epsilon N(p)$, iff $p \epsilon N(q)$ for any neighborhood N. Connected path consideration and finding adjacency as well as probing out those regions play an important role in the proposed method. This is because they help the host image to split.

Differential Evolution, being an optimization method, is applied on the proposed scheme, to find out the regions of connected path along their adjacencies. The main advantage of DE over other evolutionary algorithm is its high stability [16] and result accuracy is much higher which is necessary for data embedding.

In the proposed methodology, the pixel values are considered as population of size S. We have to minimize $f(X)$ where $X = \{x1, x2, x3, \ldots, xD\}$, where D is the number of variables. Figure 1 shows the converged value of a single pixel among the connected pixels. The population matrix can be represented as $x^g_{n,i} = \{x^g_{n,1}, x^g_{n,2}, x^g_{n,3}, \cdots \cdots \cdots x^g_{n,D}\}$, where g refers the Generation and $n = 1, 2, 3, \ldots, N$.

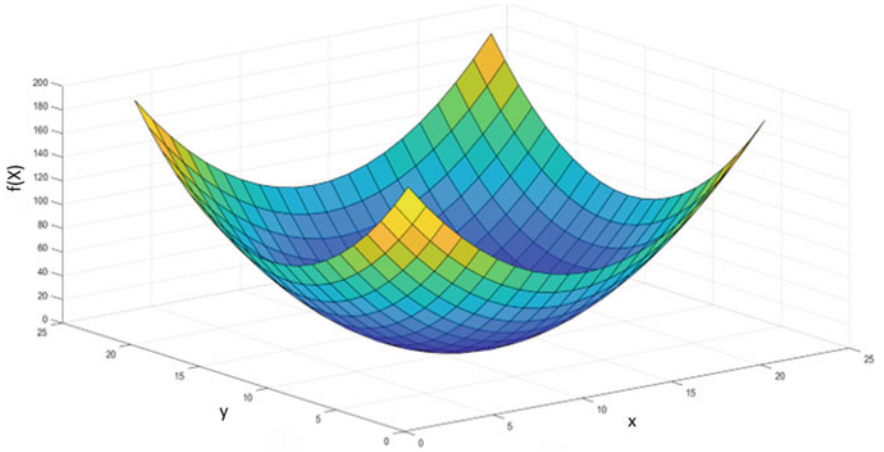


Fig. 1 Converged result of a single pixel through sphere test function

The initialization is done by random selection of pixel values. In the next step, three random pixel values are taken and the weighted difference is added to the third, i.e. $v_n^{g+1} = x_{r1n}^g + F(x_{r2n}^g - x_{r3n}^g)$, $n = 1, 2, 3, \ldots N$. v_n^{g+1} is refered as the donor vector. F usually ranges between 0 and 1. At the recombination step, a trial vector $u_{n,i}^{g+1}$ hais evolved from target vector $x_{r,i}^g$ and the donor vector $v_{n,i}^{g+1}$. Selection is done by comparing the values of target vector and donor vector, and the lowest function value is selected.

The steps continue until the stopping criterion is reached.

The result after application of DE on finding regions is a 2-dimensional array, having the same size of image I. Here every element is assigned with an integer indicating the region with a common feature to which it belongs. This creates various regions among which the cognitively insignificant regions are being considered for embedding. The advantage of such probe is that the data hidden in a region of the same label, the image modification is rarely distinguishable, thus it can be well hidden. The results show the scheme has well worked in case of both imperceptibility and robustness.

3 Watermark Embedding and Extraction

As mentioned in the previous section, the watermark embedding and extractions are done by considering the pixels of both cover image CI and watermark image W. CI being the gray scale image and W is the binary image. LSB is used to replace the pixels of CI with W for embedding as well as extraction procedure.

3.1 Watermark Embedding

1. Select Cover Image CI and Watermark W.
2. Compute pixel values of CI. If size of the cover image is aXb, then $CI = aXb$.
3. Compute the pixel values of W, i.e. if size of W is mXn, then $W = mXn$.
4. Apply DE on aXb to find optimized positions P_i, where $i = (a_i, b_i)$.
5. Generate the coordinates with optimized positions P_i.
6. Embed W in CI on the positions P_i using LSB.

3.2 Watermark Extraction

The steps for watermark extraction have been offered as follows:

1. Obtain the pixel values of the cover image and apply DE on it, thus getting the same number of optimized pixels.
2. Acquire the pixel value of the watermarked image.
3. Compare the pixels of both the image and extract the unmatched pixels sequentially according to the sequence of optimized pixels the receiver has obtained after applying DE on the cover image. Else, the receiver will only get the distracted pixel values but will not able to cognize the exact watermark.

4 Results and Discussion

The present section defines the experimental setup and metrics that are used to develop the proposed scheme. The entire execution is acted on 20 gray scale images of 128 × 128 pixel taken from the SIPI Image Database [17].

Pepper, Moon surface and Sailboat of size 64 × 64 pixels, from the SIPI database are chosen as watermark images. The watermark images are considered as binary images. Figure 2 depicts how DE locates the cognitively insignificant regions from the cover image's pixels (here Baboon, Fig. 3a) and how the watermark(here Pepper, Fig. 4a) is hidden in those specific locations thus getting the watermarked image(here Fig. 5a). Figure 3 shows the cover images and Fig. 4 shows the watermark images used and Fig. 5 shows the watermarked images with their corresponding PSNR values. The results of the graph shown in Fig. 6 represents a comparative result indicating the proposed method is more competent than normal LSB.

The algorithm has been simulated in Matlab (2016a) environment and DE optimization algorithm with 1000 iteration having population size 20. Crossover rate being 0.2, number of decision variables is 20, lower bound of decision variable is -5, upper bound is 5. The proposed scheme is evaluated mostly in terms of imperceptibility, though robustness is also put as a key point, its detailed development is kept for future work. Presently, average filtering, gamma correction and cropping are the

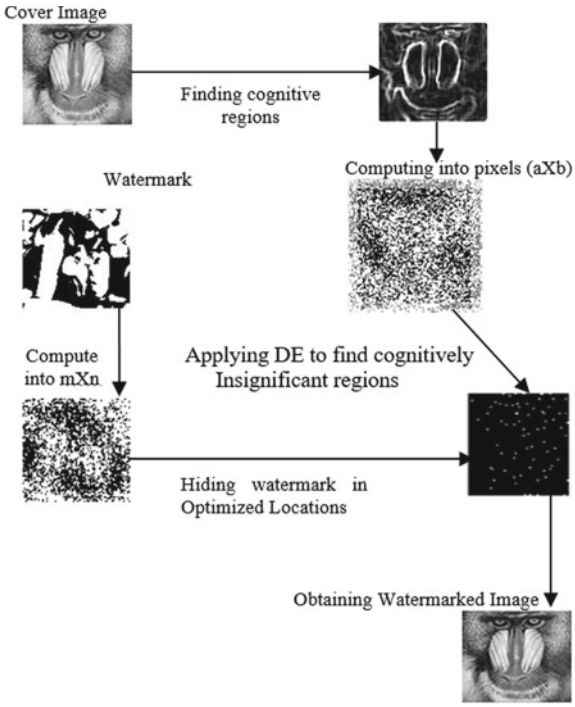
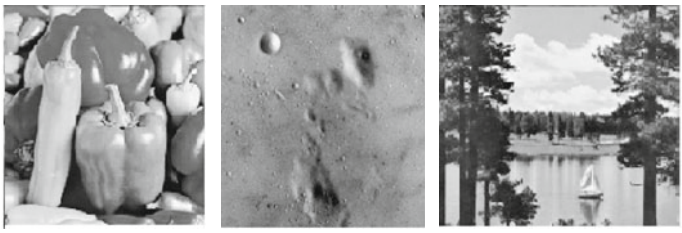


Fig. 2 Step by step procedure of watermark embedding

(a) Baboon (b) Airplane

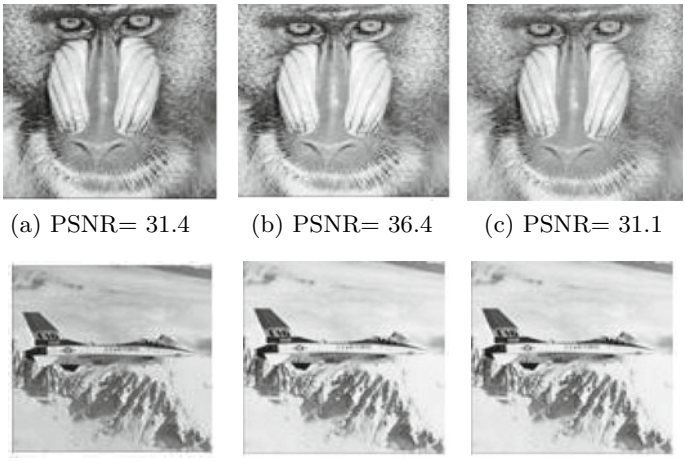
Fig. 3 Cover images

attacks chosen. Figure 7 shows the watermarked images with attacks, corresponding retrieved watermark with PSNR values of the cover image. Comparisons are done based on imperceptibility bearing in mind PSNR as quality metrics. PSNR is given by: $\text{PSNR} = 10 \times \log_{10}[\frac{\max^2(x(i,j))}{\text{MSE}}]$ where x denotes the cover image and $x(i, j)$ is the pixel value of the image, $\max(x(i, j))$ refers to the maximum possible value of the pixels in the cover image. Comparisons with two similar methods, namely, DE in DWT-SVD Domain [15] and Digital image Watermarking and its optimization



(a) Pepper (W1) (b) Moon Surface (W2) (c) Sailboat (W3)

Fig. 4 Watermark images



(a) PSNR= 31.4 (b) PSNR= 36.4 (c) PSNR= 31.1

(d) PSNR= 39.5 (e) PSNR= 36.3 (f) PSNR= 41.5

Fig. 5 Watermarked Images: **a** Baboon (W1 insertion), **b** Baboon (W2 insertion), **c** Baboon (W3 insertion), **d** Airplane(W1 insertion), **e** Airplane (W2 insertion), **f** Airplane (W3 insertion)

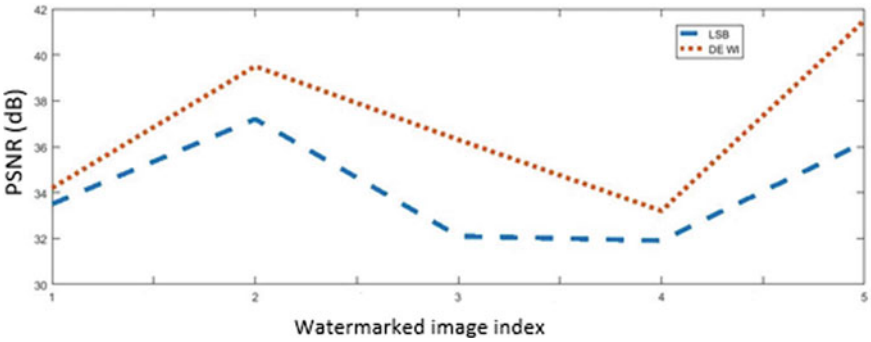
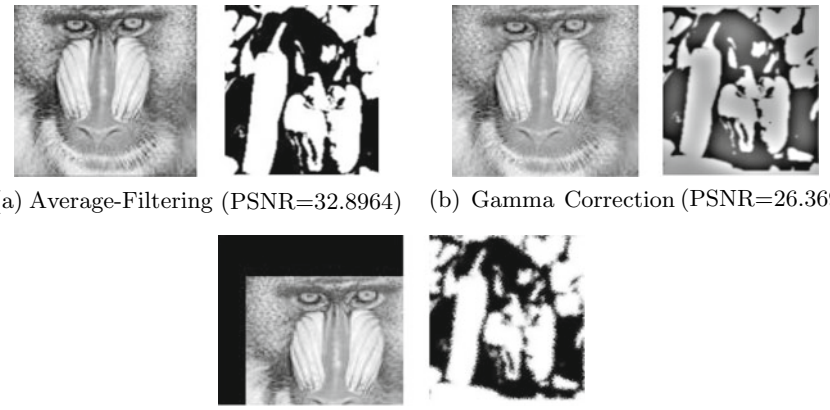


Fig. 6 Comparison of PSNR values of proposed method and LSB on airplane Image



(a) Average-Filtering (PSNR=32.8964) (b) Gamma Correction (PSNR=26.3691)

(c) Cropping (PSNR=21.7852)

Fig. 7 Various attacks on watermarked Baboon image, corresponding extracted watermarks and PSNR values

Table 1 Comparison table on imperceptibility

Cover image from SIPI database	Method	PSNR (dB)
Male/Pirate	***Proposed method***	***53.7***
	DE in DWT-SVD Domain	28.763
	Digital image watermarking and its optimization using genetic algorithm	52.3612

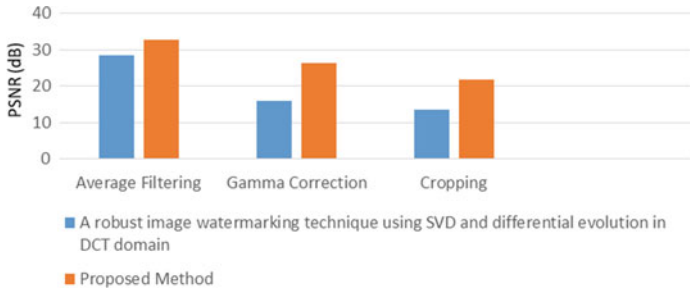


Fig. 8 Comparison of robustness of proposed method and robust image watermarking technique using SVD and differential evolution in DCT domain

using Genetic Algorithm [11] are carried out. The results are shown in Table 1. The results are clearly showing the proposed method is more competent than the other two.

Similar comparisons are done in case of robustness with an existing method "A robust image watermarking technique using SVD and differential evolution in DCT

domain" [15]. The comparative graph is shown in Fig. 8. The results show clearly, the proposed method is also robust to malicious attacks, as the retrieved watermark is recognizable with competent PSNR values better than the existing scheme with whom the comparisons are done.

5 Conclusion and Future Work

The paper presents a new watermarking scheme using DE optimization algorithm. Here the hiding places of the watermark are sought through DE. Moreover, the balance between imperceptibility and robustness is also kept in mind and the results show the proposed method has almost succeeded in meeting the very criterion as this becomes a serious point of concern when data is hidden in the spatial domain. Though further progress on robustness is yet to be accomplished in future work, the concerned trade-off has already been fulfilled.

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Intelligent Baby Monitoring System Using Blynk

Soham Talukdar and Shinjini Saha

Abstract With the significance of embedded system in conjunction with the Internet, this paper aims at designing a baby monitoring system that maintains the baby in the absence of any manual surveillance. The prototype includes an external heat supply for the baby in correspondence to the increase or decrease in temperature along with a constant notification to the admin—a fan, which starts instantly over a heat-set as the threshold. For a safety measure, firstly, a baby's cry is detected, which is indicated by a buzzer. Secondly, if the baby's surrounding is encapsulated with smoke, then a led glows. The entire data is transferred to the cloud server (here, Blynk Platform) via ESP8266 with an Internet connection. This overall system will work for monitoring a baby without any manual hindrance.

Keywords Monitoring · Intelligent · Internet · Baby · System

1 Introduction

Internet of things is a well-discussed technology or a system which mostly consists of a coordinated network of devices or things implanted with sensor modules, software, and network connectivity. IoT can be defined as a result of humanity's convenient lifestyle, which aims at reducing labour and human error. IoT is mainly used to remotely analyse the data received by the sensor modules and take appropriate action. From here, comes the idea of the Intelligent Baby Monitoring System using Blynk.

Baby monitoring has been there in history. Previously, monitoring a baby's health required a one-hundred per cent manual presence. However, over time life has become

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much more advanced. With the increasing birth rate, even nursing homes and hospitals have become much more congested and busy. With the advancement in technology and its application has made the life of people much more comfortable. The same has taken place in case of monitoring baby where now people do not have to be physically present as the pressure has been taken over by technology. Presently, in third world countries, the baby monitor system is not thought of mainly because of the lack of technological knowledge. People are monitoring 24×7 live for their baby. Single baby monitoring is possible, but multiple baby monitoring is not a convenience. Manual control is not practical to be implemented in hospitals and nursing homes. An automated system will make things easier and simplified; it can improve the efficiency of the administration to monitor multiple newborn. An extra level of security would be provided for transparent smoke that might not be visible to the human eye. With ever-increasing demands for automation and lack of manual intervention, advanced baby monitors could replace all the headaches and keep the baby safe and secure with remote monitoring with real-time observation and notification system.

Previously, a lot of work and models were created with advanced safety features and usability where a cradle is designed [1] such that the entire system is closed and does not require more modification. The researcher tried to integrate different modules and make it better and more efficient, however, it has become stagnant with the ideation of how to make it better.

In this paper, the aim is making the baby monitor more advance and secure in many ways and is made with the mind that it can be implemented in a hospital and nursing home. Suppose there are many babies kept in incubation. External heat is supplied to keep the baby warm. If the temperature increases over a specific limit, then a fan would turn on automatically. If the baby cries or even the surrounding of the baby is encapsulated in smoke, it would be notified. The cloud used is Blynk (in this case). It would send repeated notification via an app or even via email to inform the administration. The integration of these different modules makes it more safe and compact without increasing the cost of the model.

The detailed description of the proposed protocol is described in Sect. 3. The results have been given in Sect. 4, and the paper concludes with the future work in Sect. 5.

2 Related Work

A lot of research and articulation have taken place while designing and improving the baby monitoring system over the years. A different approach and modification lead to different results. Here, we will be looking into some of the previous research and have mentioned it below.

In one, researchers designed a baby monitoring in the following manner.

Using the Raspberry Pi B+ module which controlled working of the integrated hardware, a condenser MIC was applied which detected the baby's cry; a PIR motion

sensor was used which caught the baby's manoeuvre, and a pi camera was used to record the baby's movements, and a screen was required to receive the current condition of the infant sleeping. The entire system automatically detected the crying condition and motion of the baby [2].

Another researcher proposed a similar device of monitoring a baby in a crib. The AdaFruit MQTT server was used to gather and upload the data that was received by using NodeMCU using Wi-Fi. Ambient temperature, moisture, and crying are the essential variables of the baby that the model was used to detect. A prototype of the proposed baby cradle was designed. According to the system architecture, the cradle automatically swings when the baby cries. An external Web camera for monitoring the infant, the MQTT server would let the parents turn on a piece of music for the baby while tracking [3].

In another research, a baby monitoring system designed was based on a contactless approach. Using the Raspberry Pi B+ module, live monitoring of the baby was detected. The pi camera was used to take videos, for crying detection MIC was used, and image processing was used for detection of real-time movement of infants and the extreme limit of the bed. In case of any abnormal change, a notification about the present condition of the baby is sent to the particular user via email. Firstly, the system required the installation of OS Raspbian and other packages like OpenCV, Numpy, and Virtual environment. For positive face and negative non-face images, face detection algorithms were trained using the Haar classifier [4].

3 Proposed Protocol

The model that has been proposed in this paper is used to concentrate on increasing the safety measures as well as improving the usability of the user. This required the utilization of different components and their integration. The connectivity with the cloud system will track real-time data from the sensor and give instant notification to the user who would be remotely monitoring the baby. The details of the component used and its integration, along with the total workflow of the system have been described in the upcoming sections.

3.1 Components

3.1.1 Arduino UNO

The focus while designing the system was to minimize the cost and space. Raspberry Pi, as used in this paper [2], costs too much [5, 6]. To reduce the price, we opted for Arduino boards. There are many boards in the Arduino family [7]. We focussed on Arduino UNO as it served our motive the best. The best alternative that can be considered was Arduino NANO. While designing the model, we came to the point of

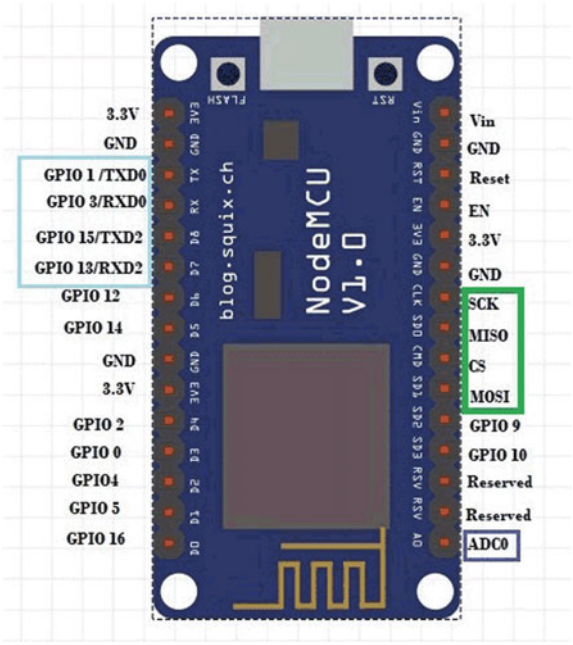


Fig. 1 ESP8266. Source: https://circuitdigest.com/microcontroller-projects/getting-started-with-nodemcu-esp12

convenience where we felt that the use of NANO while connecting the device might not be as practical as it should be as the requirement for USB mini is not readily available like the regular one. Considering the usability Arduino UNO would serve the purpose.

In the figure below, a rough schematic diagram would help to understand the layout of the module in Fig. 1.

3.1.2 NodeMCU ESP 8266

ESP 8266 is used here for connecting to the Wi-Fi. This low-cost module is used could have been replaced by raspberry Pi or even Arduino MKR1000, which would make the system more compact. However, the price would get doubled up. The second problem that we faced was the integration of the wifi, along with the different modules. While going for a trial phase with the other boards, we faced that it was becoming quite tedious with managing different components without losing the Wi-fi connectivity. Raspberry Pi was smooth enough with the working but was taken out of consideration for its pricing.

Documentations [8–10] can give an insight into the module and its use. A rough schematic diagram would help to understand the layout of the module in Fig. 2 (Figs. 3 and 4).

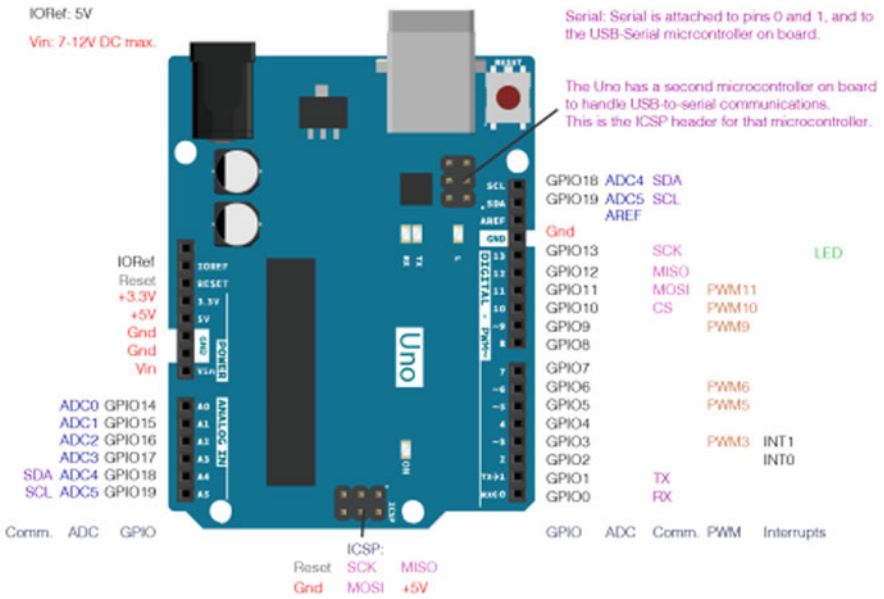


Fig. 2 Arduino UNO. Source: https://stackoverflow.com/questions/42022000/which-pins-should-i-take-for-i2c-on-arduino-uno/42022566

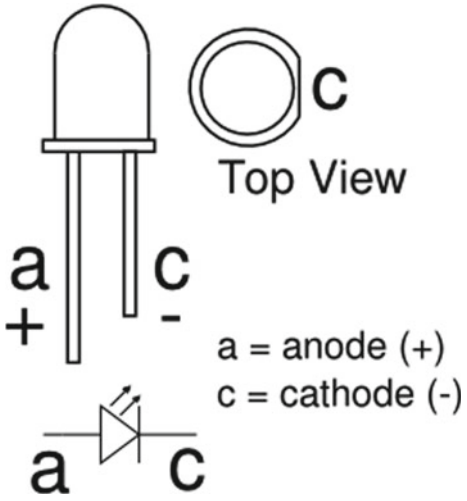


Fig. 3 LED. Source: https://startingelectronics.org/beginners/components/LED/

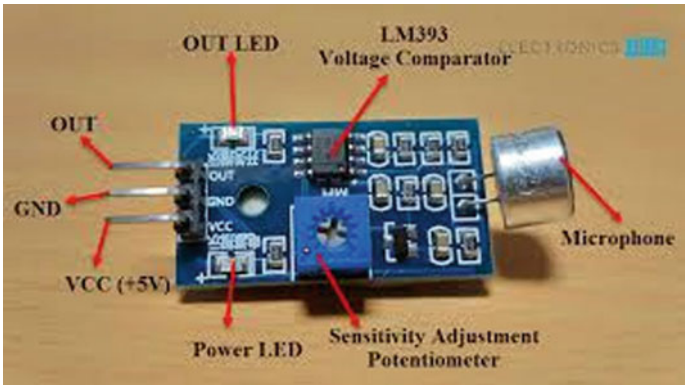
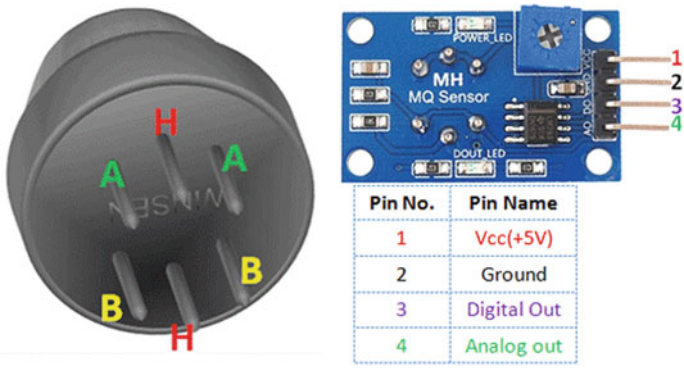


Fig. 4 RKI-3103. Source: https://www.electronicshub.org/interfacing-sound-sensor-with-arduino/

3.1.3 Gas Sensor (MQ-6)

The gas sensor has been used as a protective measure for the baby, which is unique as there was no previous use of any gas sensor that got integrated into a baby monitoring system. The primary purpose of a gas sensor is to predict any harmful gas that might lead to the discomfort of the baby. There are different gas sensors available. The most common discomforting condition will arise with an increase in CO_2. There are occasions where too much emission of CO_2 occurs without our knowledge. In these scenarios, the gas sensor might help to identify the surrounding. The MQ-6 is particularly useful in sensing one single gas. However, it will also help in determining other gases caused due to leakage, which are highly combustible. A rough schematic diagram would help to understand the layout of the module in Fig. 5.



Pin No.	Pin Name
1	Vcc(+5V)
2	Ground
3	Digital Out
4	Analog out

Fig. 5 MQ-6. Source: https://components101.com/sensors/mq-6-gas-sensor-pinout-equivalent-datasheet

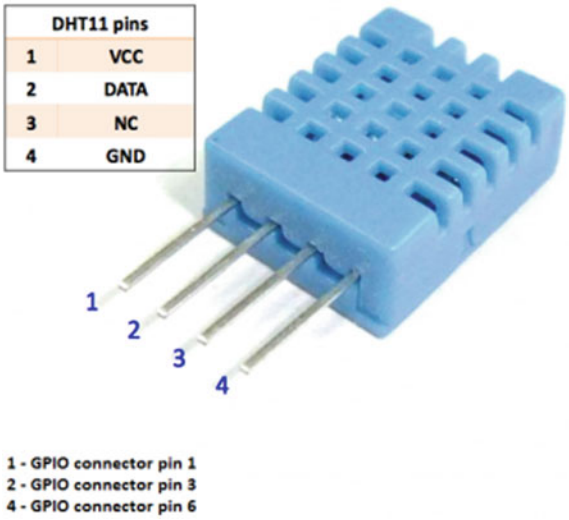


Fig. 6 DHT11. Source: https://www.programming-electronics-diy.xyz/2017/02/dht11-library-temperature-and-humidity.html

3.1.4 Temperature Sensor (DHT11)

Temperature and humidity can be a crucial factor when it comes to a baby's comfort. Maintaining a suitable temperature and humidity level is difficult. But before taking any precautions, we first need to identify the current temperature and humidity levels. To that, we have used DHT11, a prevalent temperature and humidity measuring sensor. This sensor is quite irreplaceable when it comes to both value and price. In this paper, [3] DHT22 a higher version of the one we are using is used. A minor difference is seen with such change, and due to price constraints, we used DHT11. It is widely used, and it is quite useful for our purpose. A rough schematic diagram would help to understand the layout of the module in Fig. 6.

3.1.5 Sound Sensor (RKI-3103)

A baby's discomfort can be most easily identified with a cry. A newborn baby when just born or kept in incubation has a deficient volume high-pitched sound. For this to identify, we need a sound sensor. Previously, audio sensors have been used for the same purpose. A rough schematic diagram would help to understand the layout of the module in Fig. 4.

3.1.6 Notifiers

After gathering data and processing in real time, there need to be specific ways by which it gives a signal or alarm to the surrounding or gives immediate back-up. For

these, we have used a few components which will be very useful in combating the stressful times by giving out appropriate notification.

Fan
Fan acts as a back-up when the temperature increases and there is no immediate external support. In this case, Fan would help in bringing down the temperature and give relief to the baby's discomfort.

Led
Led is an excellent indicator from a distance which gives the surrounding a notification that something might be wrong. A rough schematic diagram would help to understand the layout of the module in Fig. 3.

Buzzer
Buzzer gives an immediate alarm in case the monitor or the person who is in-charge accidentally dozed off.

3.2 Architecture

3.2.1 Circuit Design

The entire set-up could be embedded by only using the ESP8266. Still, due to the presence of only one analog pin, Arduino UNO has been used in a master-slave configuration with ESP8266 where the former is the slave while the latter is the master. Communication between Arduino UNO and ESP8266 is initiated with Tx of former to Rx of latter and similarly with Rx of former to Tx of latter. The Arduino UNO is responsible for the processing of all the data and its transmission to the ESP8266 while the ESP8266 is only responsible for the network connectivity. A PCB board is used to short the GND and Vcc pins of the sensor modules with the same pins in Arduino UNO and ESP8266. DHT-11 is connected to the analog pins of the Arduino Uno, GND, and Vcc as mentioned above. MQ-6 which is connected to one of the digital pins and has the same GND and Vcc connection as DHT-11. Now RK-3103 also has the same link as that of the MQ-6. This entire set-up is connected to the PC, and the code is dumped to the Arduino UNO. A schematic diagram has been shown in Fig. 7. And a working model is represented in Fig. 8.

3.2.2 Connection Between Circuit and Blynk Server

Once the code has been dumped into the Arduino UNO, the working of the entire system starts with the temperature sensor DHT-11, which detects the temperature of the area concerned. If the sensed temperature goes beyond the desired temperature, the cooling fan automatically starts along with notification alert and email. The same

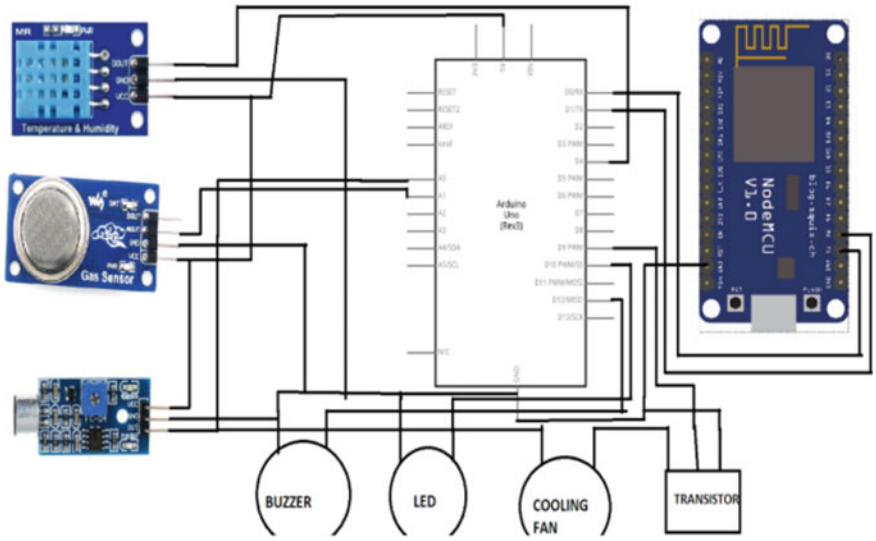


Fig. 7 Schematic

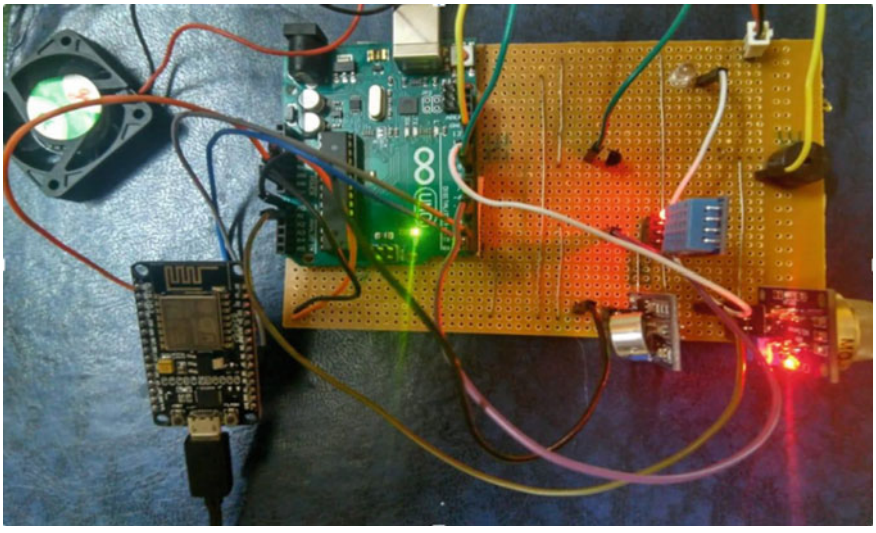


Fig. 8 Working model

stops when the required temperature has been reached. MQ-6 detects the presence of smoke or colourless gases such as LPG. An absolute threshold has been set using an incense stick. If the identified gas content goes beyond the limit, the buzzer or LED used goes off and does not switch off till the issue is resolved. Last but not

least comes the sound sensor RK-3103, which helps to detect the baby's cry and the buzzer goes off is this case [1, 11].

3.3 Working

3.3.1 Communication Between ESP8266 and Arduino UNO

- Both the micro-controllers are connected in a master and slave configuration where ESP8266 is the master, while Arduino UNO is the slave [12, 13].
- Both the micro-controllers are connected via their Tx and Rx pins, where the Tx of one is connected to the Rx of the other and vice-versa [14].

3.3.2 Temperature Detection

- The temperature is detected by the temperature sensor module DHT11. The sensed data is sent to the micro-controller via the data pin in the DHT 11 module.
- On receiving the data, the condition for the temperature being at optimum temperature is checked.
- If the temperature is above the optimum temperature, the cooling fan goes off, bringing down the temperature to the required optimal one. Also, a mail is sent to the administrator e-mail id regarding the high temperature and is sent continuously till the heat goes to the optimal temperature.

3.3.3 Smoke Detection

- The smoke or colourless gases, if any is detected by the gas sensor module MQ-6. The sensed data is sent to the micro-controller via the analog out pin in the MQ-6 module.
- On receiving the data, the condition for the presence of smoke or gases being within the permissible range is checked.
- If the value or values are above the optimal, the buzzer goes off alarming the administration regarding the high level of unwanted smoke or gases.

3.3.4 Sound Detection

In events of a baby crying, the decibel of the sound detected is sent to the micro-controller via the analog pin. A notification is sent to the administrator until the baby is not attended.

4 Result and Validation

The system is designed for these main purposes:

1. Providing utmost care to the infants
2. Reduction of workforce.

The above purposes are implemented by the automatic action taken by the sensors.

Whenever the temperature goes beyond the optimal range, the cooling fan automatically turns on and again automatically turns off when the optimal temperature is received. Also, an email and notification are sent continuously. If the email and notification continues for a long time, then the equipment requires servicing.

Whenever the concentration of gas goes beyond the safe value, the buzzer turns on, and it turns off only when the level of gas decreases.

A detailed explanation for all the components has been shown and how it provides output is explained below in Tables 1, 2, and 3.

- *For DHT-11*

  A representation of how it looks in Blynk while working is shown in Fig. 9.

- *For MQ-6*

- *For RKI-3103*

When an infant cries, another buzzer goes on till it is attended. In the case of temperature issues, the care is taken by the temperature sensor.

Comparative Analysis

The result of this model is different as it has taken into account various modules. This baby monitoring system would be very much beneficial in hospitals where the care of multiple babies has to be made. Security camera would of not much use and hence has been replaced by buzzer such that it gives immediate sense from where it is used. The facility of emailing, it can find a pattern as to which time for which reasons a baby's discomfort is being aggravated according to which the supervisors can take precautions beforehand.

The notification is shown in Fig. 10.

This model has used many different modules for ensuring security and efficiency. The best part of it is quite portable and can be fixed anytime anywhere, and due to its low price, it is quite affordable. Previously, the work that has been mentioned here

Table 1 Output of DHT-11

Temperature value	Action taken
Greater than 28 °C	Fan turns on, E-mail and notification alert
Less than or equal to 28 °C	Fan turns off

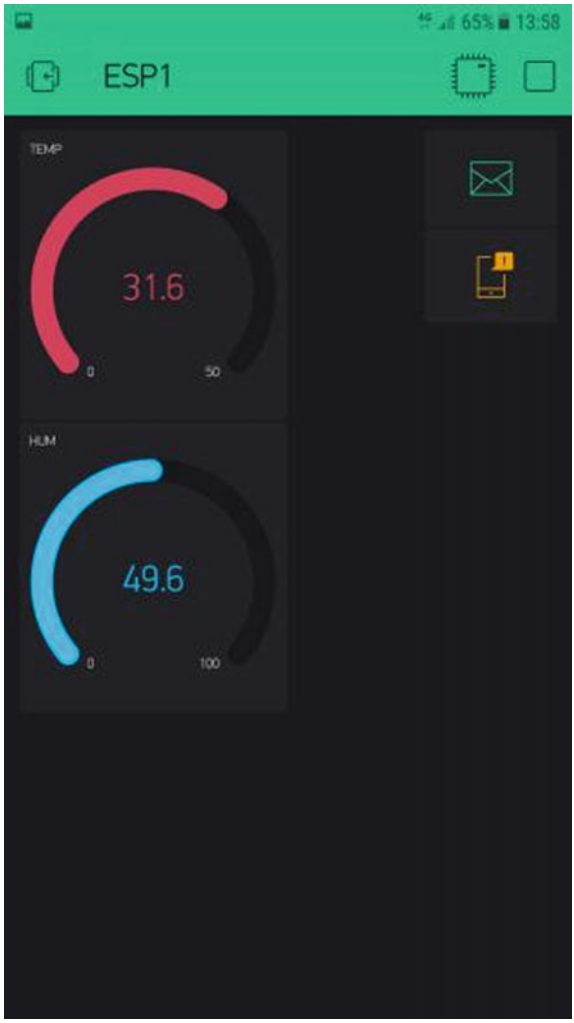


Fig. 9 Blynk interface

Table 2 Output of MQ-6

Concentration of gas	Action taken
Greater than or equal to 250	Buzzer/LED goes on
Less than 250	Buzzer/LED goes off

Table 3 Output of RKI-3103

Decibel value of sound	Action taken
Greater than or equal to 950	Buzzer/LED goes on
Less than 950	Buzzer/LED goes off

Fig. 10 Output

is quite good, but it either lacked the portability or was too pricey. With this model, we hope to overcome the problems and make the model better for real-time use.

5 Conclusion

Helping to keep an eye on any discomfort faced by the newborn infants, this system helps to maintain the required temperature and humidity; also the addition of a camera module would help the parents to see their baby without being physically present to avoid the presence of any germs and would allow the staff in-charge to monitor them and take necessary action as and when required.

On the one hand, monitoring the baby with the help of video streaming, the temperature, and humidity sensors informing about the conditions around the baby, the PIR sensor to detect the movement and graphical representation of the data helps the parents to analyse them carefully. Notifications, on the other hand, notifications received alert the parents and caretakers regarding the infants' discomfort, vaccination schedule, and also their feeding time helping to maintain a proper plan.

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Implementation of Dual Image Watermarking for Copyright Protection

Soumodeep Das, Subhrajit Sinha Roy, Abhishek Basu, and Avik Chattopadhyay

Abstract In this paper, a copyright protection scheme for images has been developed through dual watermarking method. Here, the watermark, i.e., the copyright information has been embedded visibly and invisibly into the cover image. The visible watermark enhances robustness against signal processing attacks, whereas the invisible watermark is used to prevent different types of malpractices. The proposed scheme has completely been developed in spatial domain, and thus, the system complexity is very low. The system proficiency has been evaluated in terms of the three major qualities: imperceptibility, robustness, and data hiding capacity. The output results, being compared with some other existing methods, confirm the efficacy of the proposed scheme.

Keywords Dual watermarking · Image · Payload · Robust · Visible

1 Introduction

In this modern era, multimedia security is extremely important for data communication and data storing; because, the multimedia objects, being available in digital form, can be augmented or manipulated easily. Data hiding is an art of secured transmission, which is being carried on from centuries [1]. Watermarking is a conventional data hiding concept, which has been used in currency, stamps, and many other

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government documents from years. With the advancement of data processing, paper watermarking has turned into digital watermarking. Basically, watermark is some asserting information on any multimedia object that can be concealed into that particular object through a definite process, such that the information can also be retrieve to verify the originality. This art of copyright protection is termed as digital watermarking. Data embedding can be performed either in spatial or in frequency domain [2]. Digital images are generally chosen as test object because, images can be represented easily both in spatial and frequency domain. Robustness, imperceptibility, and data hiding capacity are three main characteristics of any digital watermarking method [3]. Robustness means the amount of designated class of transformation that can be handled by the information signal without corrupting the original information. Imperceptibility is the measurement of perceptual resemblance between the original cover and the watermarked object. Data hiding capacity or payload is the maximum amount of information that can be hidden into the informational signal without causing any significant distortion in it. These three characteristics are contradictorily related to each other, and thus, these properties cannot be independently improved [2]. It is a challenging issue for researchers to overcome the trade-offs among these qualities. In this occasion, this paper has proposed a dual watermarking scheme where the watermark is embedded visibly and invisibly at the same time. The visible watermark can be perceived easily, and make an assertion on the cover object. Moreover, it is also robust against most of the signal processing attacks. But, being visible, it can be intentionally removed or manipulated. Thus, this watermark is also embedded invisibly into the cover. Least significant bit (LSB) replacement technique has been used, and for visible watermarking, pixel replacement technique has been involved.

The watermark embedding and extracting for proposed dual image watermarking scheme have been expressed in Sect. 2. The experimental results have been shown in Sect. 3, and these results are compared to the same of some state-of-the-art existing image watermarking techniques. Section 4 consists of the concluding remarks on this proposed work.

2 Proposed Methodology

2.1 Dual Watermark Embedding System

This dual watermarking scheme has been developed to embed copyright information into a gray cover image both in an invisible and a visible way.

Let, H is the gray cover image of size $M \times N$. Therefore, H can be defined as,

$$\boldsymbol{H} = \{h(m,n) | 1 \leq m \leq M, 1 \leq n \leq M \wedge h(m,n) \in [0, 1, 2, \ldots, 255]\} \quad (1)$$

The copyright information has been made binary for invisible watermarking whether it is gray for visible watermarking. For a gray scale watermark G of size $X \times Y$, a binary watermark B has been formed by taking the MSBs of the pixels of G. Let,

$$\boldsymbol{G} = \{g(x, y)|1 \leq x \leq X, 1 \leq y \leq Y \wedge g(x, y) \in [0, 1, 2, \ldots, 255]\} \quad (2)$$

Now, for any gray scale watermark pixel $g(x, y) \in G$, its corresponding binary image pixel $b(x, y) \in B$ can be formed through a function f: $G \rightarrow B$ is defined as,

$$b(x, y) = \text{mod}\left(\left\lfloor \frac{g(x, y)}{2^7} \right\rfloor\right)$$

Thus, B can be considered as,

$$\boldsymbol{B} = \{b(x, y)|1 \leq x \leq X, 1 \leq y \leq Y \wedge b(x, y) = [0, 1]\} \quad (3)$$

The invisible or imperceptible watermarking has been performed by embedding the bits of B into H for multiple times through LSB substitution technique, and the watermarked image W is generated. For any cover pixel $h(m, n) \in H$, its analogous watermarked image pixel $w(m, n) \in W$ is generated through a function f_e: $H \times B \rightarrow W$ is defined as,

$$\begin{aligned} w(m, n) &= \sum_{j=3}^{7} w_i(m, n)2^j + \sum_{j=0}^{2} b(x, y)2^j \quad \text{for } (m + n) \bmod 2 = 0 \\ &= \sum_{j=2}^{7} w_i(m, n)2^j \qquad\qquad \text{otherwise} \end{aligned} \quad (4)$$

The binary watermark B is embedded for $t_1 \times t_2$ times to generate the watermarked image W, and a distinct portion in cover H is left to embed the gray scale watermark G, which is kept visible. After embedding G into W, finally, the dual watermarked image D has been produced. Any pixel in W is modified with G to produce the corresponding pixel $d(m, n) \in D$ through another function f_v: $W \times G \rightarrow D$, such that,

$$\begin{aligned} d(m, n) &= g(x, y) \qquad \text{for } m > t_1.M \wedge n > t_2.N \\ &= w(m, n) \qquad \text{otherwise} \end{aligned} \quad (5)$$

Thus, the watermarked image is generated through the proposed dual watermarking method, which has been simplified in Fig. 1.

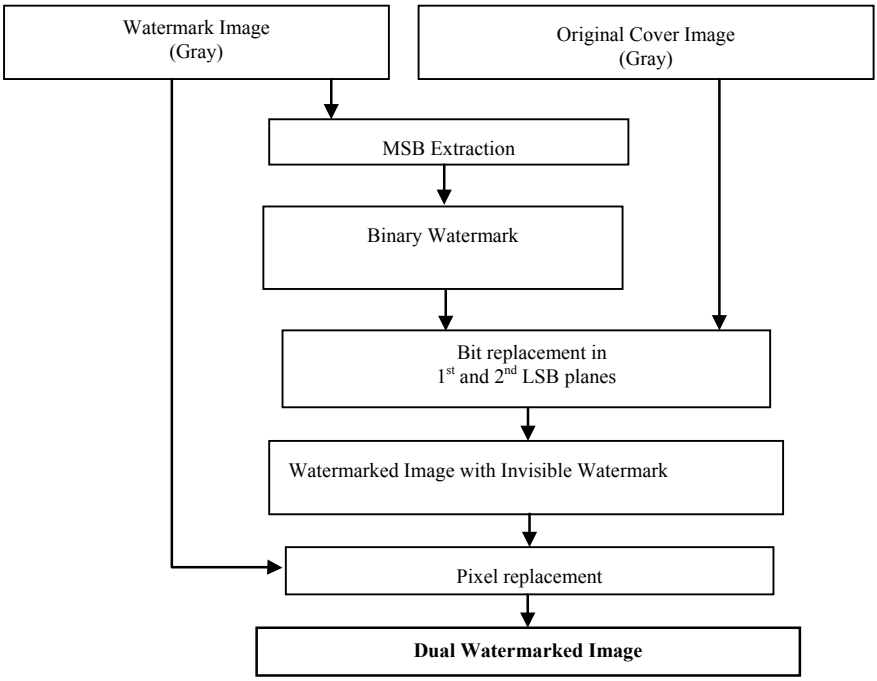

Fig. 1 Block diagram for dual watermark embedding system

2.2 Invisible Watermark Extracting System

The cover can be copyright protected through the visible watermark only. But, as the visible information is not kept in any significant region of the cover, it can be removed without hampering the fundamentals of the cover. Thus, it is very essential to verify the authenticity of the received watermarked image through the invisible watermark; and in this occasion, watermark extracting system has been developed for the invisible information. It is a simple process, illustrated in Fig. 2. Bit retrieval

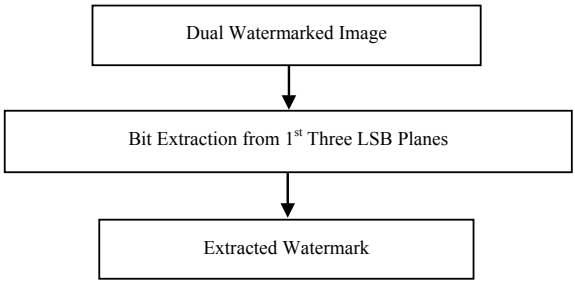

Fig. 2 Block diagram for extracting the invisible watermark

from third LSB planes generates a set of extracted watermarks, which are verified to the original one. Third bit-plane is assumed to be more robust against most of the attacks. The bit extraction process is executed through a function f_z: $D \rightarrow Z$ such that,

$$z(x, y) = \text{mod}\left(\left\lfloor \frac{d(m,n)}{2^2} \right\rfloor\right) \text{when } (m+n) \text{ mod } 2 = 0 \tag{6}$$

where, $z(x, y) \in Z$ and $d(m, n) \in D$.

3 Results and Discussion

The proposed dual image watermarking has been carried out for a few 512 × 512 Gyscale cover images [4]. A binary watermark has been formed from the MSB-plane of a gray scale image of size 130 × 210. This binary watermark has been used as invisible watermark, and for visible watermark, the size of the gray watermark is scaled down to 13 × 21. The invisible and visible watermarks are shown in Fig. 3a, b, respectively. The cover images are shown in Fig. 4a. Figure 4b–e consist of the watermarked images, along with the first three bit-planes of those, after invisible watermarking. The final watermarked images after dual watermarking have been shown in Fig. 4f.

The hiding capacity or payload has been computed as 1.88 bits/pixel for this proposed watermarking scheme. A set of image quality metrics [5, 6] has been involved to compute the imperceptibility and robustness quantitatively. Metric-values given in Table 1, computed from the deviations between the original and watermarked cover images, are related to the imperceptibility of the proposed scheme. Average PSNR value is obtained more than 38 dB, which is good enough for a watermark method, generating a visible watermark in the cover along with information, invisibly embedded in it. Moreover, the values of other metrics are very close to unity, where the values should be equal to unity for two identical signals. Therefore, it is clear that as a dual watermarking method, this proposed scheme can offer a high imperceptibility.

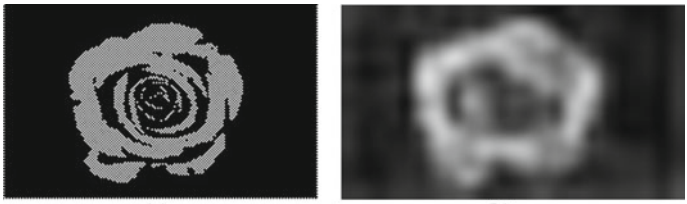

Fig. 3 **a** Binary watermark for invisible watermarking; **b** gray watermark for visible watermarking

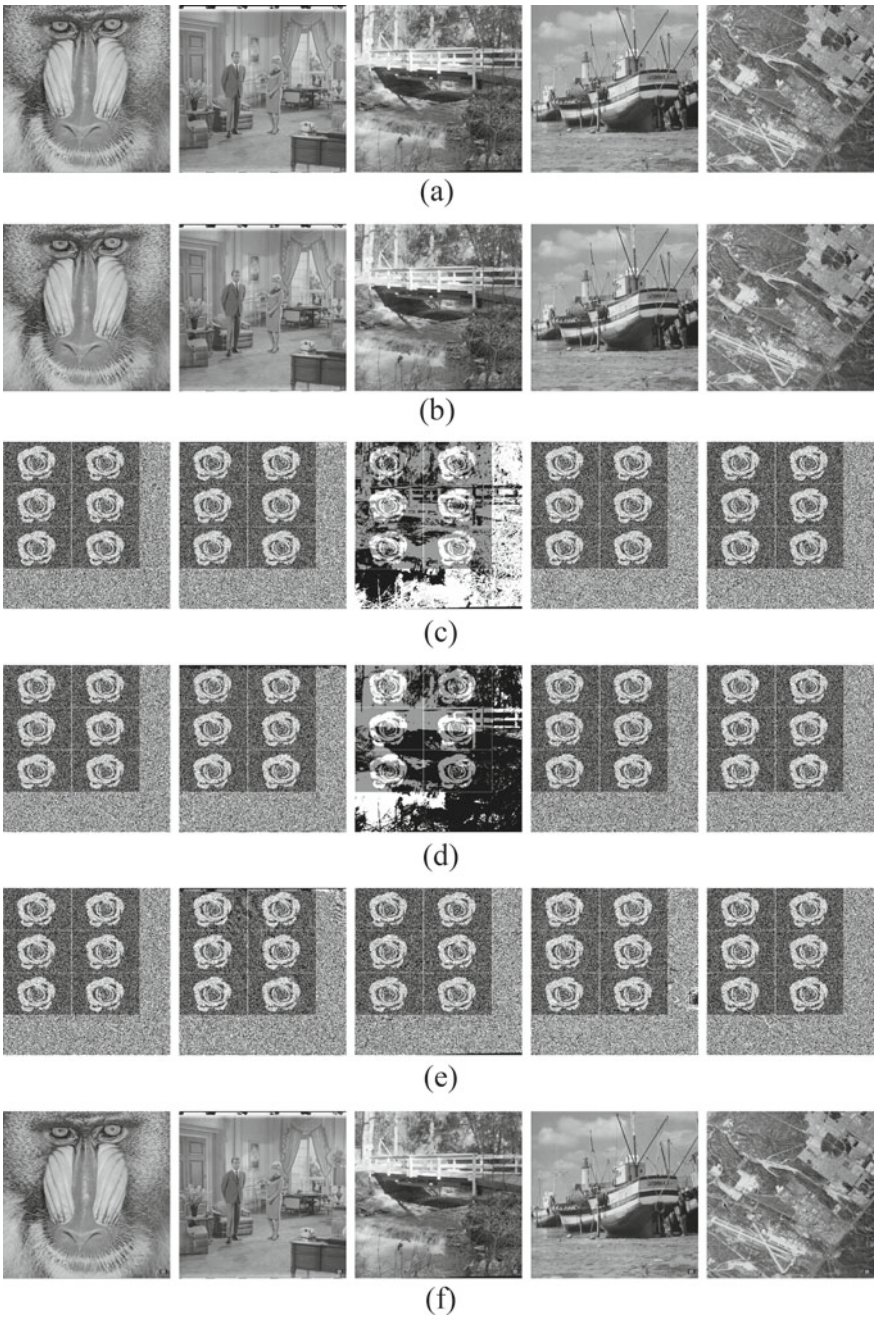

Fig. 4 **a** cover images; **b** invisible watermarked image; **c–e** 1st, 2nd, and 3rd LSB planes of watermarked images, respectively; **f** dual watermarked images

Table 1 Imperceptibility measurement table

Parameters	Lena	Brick house	Boat	Baboon	Peppers
PSNR	38.53585	38.54505	38.51235	38.43301	38.27861
UIQI	0.9997	0.9997	0.9997	0.9996	0.9997
SSIM	0.996174	0.994198	0.996948	0.992932	0.996572
NAD	0.851059	0.861069	0.866226	0.83617	0.850399
NCC	0.996123	0.995665	0.995121	0.995976	0.995868
SC	0.991239	0.991289	0.99075	0.990912	0.990866

Robustness is another important feature to assess the quality of a watermarking scheme. During transmission, the watermarked image may come under various attacks, which may cause distortion in the embedded information. Robustness is the comparison of the watermark, retrieved from the received image, with the original watermark. In this event, a few attacks have been involved here. Results, shown in Table 2, address to the robustness of the proposed scheme. The analogous images of the recovered watermark after different attacks are shown in Fig. 5.

The experimental outputs for this proposed work have been compared with some relevant state-of-the-art existing works, and the comparison results have been provided in Table 3. From this table, it is revealed that this dual watermarking is good enough to overcome the trade-offs between hiding capacity and imperceptibility.

Table 2 Robustness measurement table

Attacks	NC for visible watermark	NC for invisible watermark	SSIM for visible watermark	SSIM for invisible watermark	PSNR for visible watermark	BER for invisible watermark
No attack	1	1	1	1	∞	0%
90° rotation	1	1	1	1	∞	0%
45° rotation	0.8423	0.8883	0.388261	0.998729	14.23 dB	7.77%
Resize (0.75%)	0.9928	0.2530	0.919807	0.974762	26.03 dB	37.70
Median filtering	0.9935	0.7974	0.809286	0.988876	22.02 dB	13.25%
Salt and pepper	0.9615	0.9896	0.971167	0.998225	23.72 dB	1.02%
Gaussian filtering	0.9924	0.2578	0.982794	0.974907	29.98 dB	37.19%
LSB inversion (1st LSB $\leftrightarrow$ 2nd LSB)	1	1	1	1	∞	0%
Negative	1	1	1	1	∞	0%

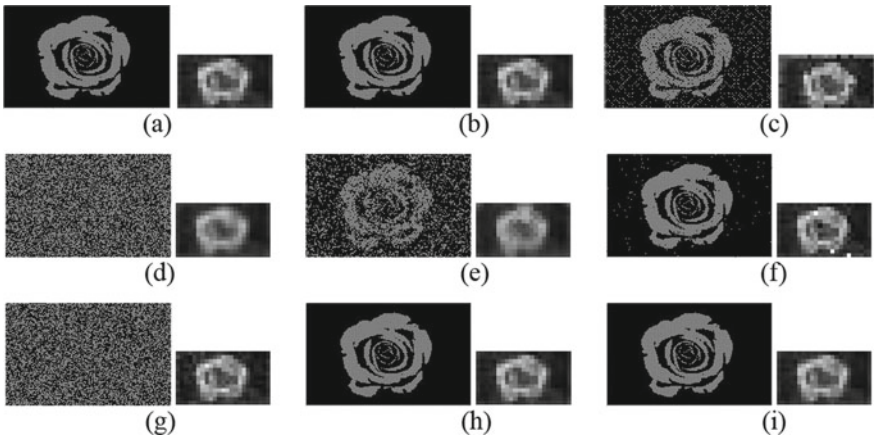

Fig. 5 Invisible and visible recovered watermark after **a** no attack; **b** 90° rotation; **c** 45° rotation; **d** resize; **e** median filtering; **f** salt and pepper attack; **g** Gaussian filtering; **h** LSB inversion; **i** negative attack

Table 3 Comparison table

Methods	PSNR (dB)	Payload (bpp)
Proposed scheme	38.5	1.88
Kumar et al.'s scheme [7]	35	0.5
Su et al.'s scheme [8]	50	0.001
Wong et al.'s scheme [9]	45.83	0.58
Gui et al.'s scheme [10]	34.26	1

4 Conclusion

A dual watermarking scheme has been executed in this proposed work as a contribution to the area of digital multimedia copyright protection. As the watermark is simultaneously appeared in the cover both in visible and invisible way, the data security is confirmed with high robustness. Moreover, the imperceptibility is also optimized with increased payload. Being a spatial domain-based technique, its hardware will be easy to implement, and thus, it can be executed in the near future with low computational cost.

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Edge of Things-Based Smart Speed Monitoring System: A Smart City Initiative

Biswaranjan Acharya, Roshan Gupta, Pradyumna Kumar Sahoo, Jitendra Kumar Rout, and Niranjan Ray

Abstract The paper describes an Edge of Things-based vehicle speed monitoring system that could be helpful in realizing the smart city. The IoT is a conceptual framework that includes several systems that collect information from the various environments of the traffic system. These collected data further send to the central control room by means of various access points. This whole process is controlled through a microcontroller unit (MCU). The proposed model also incorporated with a radar system that gauges vehicle speed through the installed surveillance system. Upon exceeding the speed, the vehicles can be traced with its properties like vehicle types, registration number of vehicles, and speed of the vehicle through the video or imagery data which is captured through installed cameras. These captured data further forwarded to the edge nodes for further processing and decision making. The computation or analysis work is done through the edge computing (EC). Then it stores in the cloud environment and necessary action can take by the authority. The model consists of different sensors and controllers to capture the required information.

Keywords Internet of Things · Edge of things · Sensor network · Smart city · Automation · Web/CCTV

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1 Introduction

Internet of Things (IoT) is a collection of similar or different objects which are capable of generating and receiving signals. These IoT enabled devices or sensors-based devices sense the surrounding and collect data. Then, these collected data get forwarded to the remote end for processing over the internet. These objects possess IP address which collects data and sends them to the server through a network. The Internet of Things is about installing sensors (RFID, IR, GPS, laser scanners, etc.) for everything, and connecting them to the internet through specific protocols for information exchange and communications, in order to achieve intelligent recognition, location, tracking, monitoring, and management. Inbuilt technology in things helps them to communicate with the external environment. Consequently, edge gadgets can perform lightweight registering in the developing circumstance and transmit the information streams to the cloud for bunch computation. IoT is a set of different types of devices; hence, it is expected that the architecture of IoT should behave straightforward with countless consistency. To achieve this, a miscellaneous architecture, need to be developed which should choose metadata for the advanced computation and administration [1]. Engineering IoT is thus a very tough task, basically while implementing it with a high range of substantial assortment of devices, interface layer innovations, and its assembly that might be included in such architecture [2]. The wide acceptance of IoT both in a world-inclusive community and world-wide business demands a unique architecture for the all above-mentioned circumstances [3]. A smart city can be defined in many ways, for example, it is a city which works intelligently, reduces human interference and gathers data from several parameters that include people, devices, water distribution model, architectures, transportation, management information system, etc. The collected data from the various environments further analyzed and processed for the betterment of society. The smart city concept realized in the combination of instrumented, interconnected, and intelligent by the use of IoT integrated with data analysis. The basic property of the smart city includes the integration of highly available information with connected devices that control and monitor the activity without any human intervention or less human effort for easy and faster. It includes smart technology, smart industry, smart services, smart management, and smart life which provide waste management, structural design of buildings for automation, noise monitoring, city energy consumption, traffic congestion, air quality, smart parking, smart lighting, smart home, smart healthcare, etc.

2 Related Work

A smart city is a city where the traditional network is more effective, efficient, and sustainable with technological transportation with the facility of a remotely controlled environment for improvement of city operation. This can be achieved through IoT and

big data analytics (BDA) detailed described in the literature [4]. The paper represents many aspects of a smart city such as smart home, smart agriculture, smart energy consumption, smart education, governance and, etc. There are many components are required for a city became a smart city like infrastructure, building, transportation, energy, healthcare, education, governance, technology, etc. Infrastructure is the most important physical component that is required for facilitated smart service. So Jin et al. [5] proposed the basic infrastructure of an IoT-based smart city in their article. Patti et al. [6] have given a model for power optimization among heterogeneous IoT and to handle big data. On the other hand, the main motivation of the work is to prevent road accidents. It observed that the main reason behind the accident is the high speed of vehicles in rush roads.

A smart city is an all-around development process. It not only focuses on overall infrastructure but also targets the other aspects of a city like governances, education, environment, sustainability, and services. Zygiaris [7] had the target to explain the characteristics of advanced inventive infrastructures. The author explained the assemblage of ever smart city thoughts into green, open incorporated, correlated, and digitally instrumented with smart and intelligent layers to make a planned system known as the smart city reference model. The smart city has many challenges such as environmental monitoring, augmented reality, crowd sourcing, and user engagement. Theodoridis et al. [8] explored various research issues in the context of the smart cities such as inventions, technical problem statements, and many opportunities in the field of the smart city. Many concepts conceptualized on the idea of developing a city-wide test bed for IoT and the upcoming testing on the internet, allowing provisions for an assembled model for deploying different smart city applications. They have highlighted the various research challenges in association with ICT and explored ICT opportunities in the smart city domain.

IoT-based vehicle nothing but connected vehicle or we can say that internet vehicle for both safe and smart driving the authors Singh and Singh [9] proposed an architecture that could be implemented for safe and automated driving in personal/public vehicles. The purpose here is to use the internet of vehicle's dashboard camera for improving the control and accident monitoring applications. This dashboard camera has the ability to capture the footage of the real-time traffic/accident and share it in the form of text, audio, and video to the concerned authorities, hospitals, family members, and wherever it is being needed instantly along with the location. As various business administrations have transformed from the cloud to the edge inferable from its front line processing administrations, the economy of scale has fundamentally enhanced, giving tremendous advantages to the business benefits that give the foundation and in addition, the endeavors utilizing it. Following are a portion of the note-worthy business habit benefits of the edge [10]:

- Data analytics is quicker which enhances the general execution of continuous applications.
- The server farm execution cost is notably diminished by choosing hub stations as edge servers.

- It destroys single purpose of disappointment and takes up local server computation by adopting distributed computing.
- It expands virtualization and adaptability in the system.
- It enhances the QoS by limiting the information exchange separate.
- It accomplishes dependability by introducing applications in nearness to the end gadget.
- It is inbuilt with less intricate and simple to oversee equipment gadgets.

Along these lines, paying little respect to whether it is an individual gadget, or at the armada or plant level, EC has become a standard technology that builds the effectiveness and efficiency of the business and modern divisions. The specific internet of vehicle-based on the ad-hoc network that uses different routing protocol, basically traditional zonal routing protocol improved version with vehicle searching algorithm and topology maintenance algorithm proposed by Yan et al. [11] in their article. It gives the proposed implementation of a more efficient ZRP routing protocol algorithm capable of increasing the rate of transmission and efficiency of information, thereby reducing the network energy consumption which results in the good performance that could meet the information transmission need for the internet of vehicles. Through connected vehicles are able to detect the possibility of congestion using big data technologies and accordingly its controls. The interested readers can go the article by author Cárdenas-Benítez et al. [12]. Security, privacy, and verifications are another and most important part of any system otherwise the whole system will be worthless. Sun et al. [13] studied the basic requirements in the field of security and privacy, different types of attacks and the possible solutions; they also discussed the several challenges and future trends in the field of internet of vehicle (IoV).

3 Proposed Model

The primary goal of a smart city is to reduce the human effort and to enhance the comfortability of the lifestyle. It makes life more comfortable and additionally, it gathers information for different purposes. The smart city model cab is representing as the integration of various sub-models like fire detection and alarming model, air condition checking model, weather forecasting model, temperature and humidity sensing model, smart dust bin with GIS model, web monitoring model. Likewise, many other models are possible for the smart city which makes the common people's life smooth and comfortable. These models help to reduce resource consumption and human efforts. The very lively example of a power model is a solar panel that saves electricity and supplies power from external resources. In a few cases, it also provides backup mechanisms [14].

Smart Speed Monitoring System (SSMS): The SSMS models primarily focus on monitoring of speed of vehicles. The monitoring process helps to reduce accidents and life-loss through accidents. To capture and study the vehicular speed, the total city is occupied with a radar system and infrared signals. These radar systems are

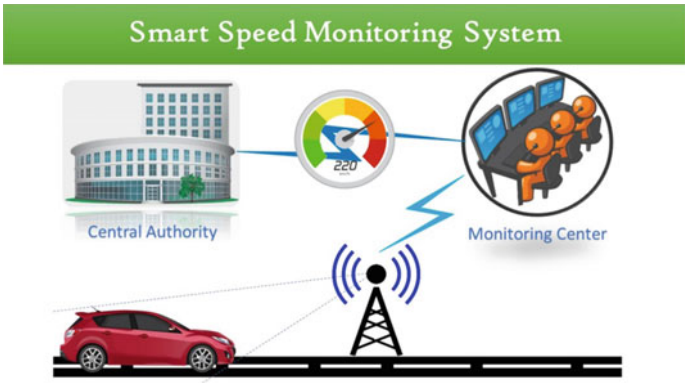

Fig. 1 A typical scenario of SSMS

responsible for monitoring the vehicles and their speed. In any case, if any vehicle exceeds the regulated speed that particular bike details get captured through the CCTV cameras. The CCTV camera is another integral part of SSMS module. This captures the images of the vehicle number plate, vehicle color, etc. These collected or captured data further forwarded to the central control room for processing. The central control room communicates with each cop through a mobile application [5, 15]. Fig. 1 illustrates the working process of SSMS module.

3.1 Functional Structure of SSMS

All above-discussed components are processed in a framework as follows to achieve our proposed system. The whole processing architecture depicted in Fig. 2.

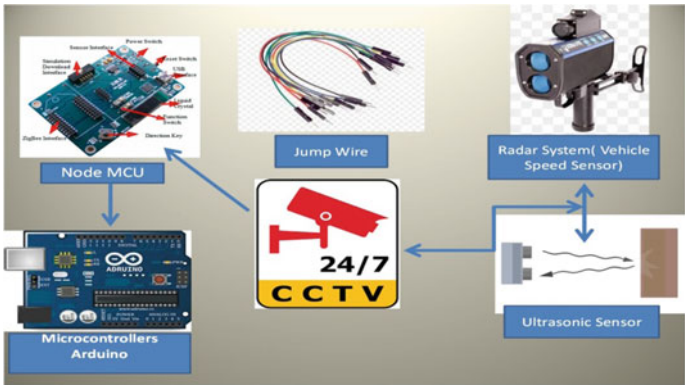

Fig. 2 Internal structure of lower layer

The radar system which is worked as vehicle speed sensor which measure speed of vehicle on the road and ultrasonic sensor measure distance between the vehicles, if speed exceeds a specified limit, then CCTV automatic on and starts capturing video. On the other side, ultrasonic sensor calculates the distance between two or more vehicles. If the chances occurrences to collide then alarms to the driver. The CCTV connects with node MCU which is a microcontroller specified for IoT. This MCU transforms the signal to microcontroller Arduino which is used processing the big data. These are the below different components are requiring for the SSMS model.

- **Vehicle Speed Sensors (Radar System)**: This use of radar sensor most for monitoring the speed of vehicles. The vehicle's speed gets monitored by emitting a signal towards the vehicles. When the emitted signal hits the vehicle surface, it returns to the radar system with certain frequencies. By judging the frequency strength, the radar sensor able to detect the presence of bikes. These return signal helps to monitor the presence of bikes, people, and speed. The speed parameter primarily based on the length of the waveforms transmitted by the radar system.
- **Web/CCTV Camera**: The CCTV camera is another integral part of the SSMS module. Which captures the images of the vehicle number plate, vehicle color, etc. The collected data need to be forwarded to the control room for further action making.
- **Ultrasonic Sensor**: This sensor most used on the echo signals. When two bikes become close to each other or there are chances of accidents then the ultrasonic sensor generates an alarm for the driver to maintain a safe distance.
- **Microcontrollers Arduino**: It comprises of a community of open-source computer hardware and software, project, and individuals that designs and develops single-board and microcontroller kits for developing digital system and user-friendly objects that are capable of sensing and controlling objects in the physical and digital world.
- **Jump Wire**: The jump wire is occupied with two pins at both ends. These wires mostly used for the connection of components with a breadboard. Sometimes, it also used for connecting tools with different test circuits. In this, no soldering work is required to connect the devices.
- **Node MCU**: It includes a firmware running on the ESP8266 WiFi SoC chip that is based on the ESP-12 module. It is an open-source IoT platform. The term "Node MCU" is mostly known as firmware rather than dev kits.

3.2 Working Model of SSMS

Edge computing (EC) is the most emerging and efficient technology for a large of mission-critical applications. EC has cut a specialty in the innovative world because of its enormous performing capacities of giving ongoing information investigation, low operational cost, high adaptability, lessened inactivity, and enhanced nature of administration. Today, the IoT is all over the place and is being consolidated in a wide range of ways. It is anticipated to be a significant driving component for the next

generation. In forthcoming years, multitudinous sensors, processing frameworks, and internet-prepared brilliant applications will before long overwhelm the whole tech world. With the end goal to adapt to these huge requests, a well-grounded EC plan ought to be executed that can handily deal with both preparing and communication, making it an upgraded framework.

Lately, IoT devices are being conveyed to detect as well as work as the wellspring of information and transmit this information to the cloud for handling and capacity. Because of the popularity of constant information investigation, edge computing comes into the scenario. In the recent research, era and flow inquire about edge devices are conveyed in the base station of the system, so information streams transmit to cloud through the edge node. Henceforth, edge computing can perform lightweight processing in the rising circumstance and transmit the information streams to the cloud for cluster handling. The proposed model works in three layered premises. The primary layer is known as the lower layer which is straightforwardly connected with street and associated vehicle through the various sensors which clarified subtleties in before area. This situation also monitored by a surveillance system for the exact identification of all movements. The complete architecture of the proposed working model is shown in Fig. 3.

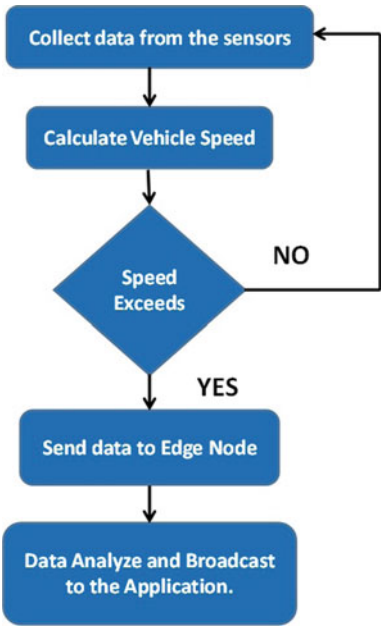

Fig. 3 Flow diagram for proposed working model

3.3 Algorithm for Smart Speed Monitoring System

The algorithm for Smart Speed Monitoring System works as follows: First, we set the vehicle speed but it must be dynamic because in practice, there may be free in certain possibility rush roads too. So, the system updates the speed of vehicles and road information dynamically at all times. When the system itself, since there is the rush and any vehicle crosses the threshold speed, the surveillance system starts to capture whole scenario and check the particular vehicle. Further, if that vehicle not alerted or create disturbance in the system that may be punished by the administration. This system can be integrated into the traffic routing system, where the vehicle comes to know there is a rush in traffic or road he may opt for an alternative road if there are any alternative roads available with short distance [16].

Algorithm 1 Smart Speed Monitoring System (SSMS)

Step 1: System initialization
Step 2: Initialize the speed limit (SL) of vehicles (20 <= SL <= 60)
Step 3: Update data via. radar sensor (RS) for current vehicle speeds(s) and road info (RI)
Step 4: ***if*** s $\geq$ SL ***then***
Step 5: Capture vehicle information
Step 6: Send control message
Step 7: ***end if***
Step 8: Repeat step 4, 5, and 6

4 Conclusion and Future Score

In this paper, we highlighted the design and development of a speed monitoring system that could be contributed to a smart city framework. Through this model, the stake holders of various level can use the existing devices with smartness attribute. This added smartness will bring innovation and transformation in the existing system. With the introduction of IoT, we are able to find out the role and involvement of IoT in the various smart city applications. This proposed model tries to reach the required communication, computing requirements, and computation. This model provides parking space availability information to the citizens through a visual platform like a smart phone. This becomes possible as the sensor is gathering information from ground level and communicates that with a smart phone. The proposed model functions through a three-tier layout model. The lowest layout occupied with motes; the middle layout includes contain forwarder. This forwarder is stick to the light poles. The upper layout consists of a BS with internet-enabled gadgets. The data about the parking vacancy, the area is communicated in a portable application. It will give the data like parking availability close by that we can say that automated parking the executive's framework, further reached out to automated parking framework.

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Bengali Spoken Numerals Recognition by MFCC and GMM Technique

Bachchu Paul, Somnath Bera, Rakesh Paul, and Santanu Phadikar

Abstract Speech is the standard vocalized communication media. Speech is one of the comfortable way for humans to communicate with each other. Similarly, speech recognition system is eagerly necessary to communicate with computer through voice. Speech recognition in English language already helps us to operate English voice command-based applications. But in rural and semi-urban areas, due to lack of knowledge in English in India, it is necessary to implement automatic speech recognition in regional languages. Here, we have built a Gaussian Mixture Model (GMM)-based Bengali (also called Bangla) isolated spoken numerals recognition system where mel frequency cepstral coefficients denoted as MFCC is taken for feature extraction. The proposed system achieved 91.7% correct prediction for the Bangla numeral data set of 1000 audio samples for 10 classes which is satisfactory for previous Bangla spoken digit recognition.

Keywords ASR · Zero crossing · FFT · MFCC · HMM · DTW · GMM

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1 Introduction

Speech is the primary communication media in our every moment of life to communicate with each other. Anyone who is not computer professionals can communicate with computer through speech because speech is normally easy and more comfortable for communication with human. As all over the India, people are not totally literate and the major percentage of people is illiterate and semi-illiterate, so speech recognizable application will be more benefitable and suitable for them [1]. Communicating with computer through speech can be possible through speech recognition. For this application of speech, it is seen that already speech recognition becomes a demanding and interesting subject for research purpose. Generally, speech recognition system recognizes the speech and converts it into text format and finally made it into a format that a machine can read it easily [2]. Each country has multiple regional languages. Bangla is a regional language which has been considered in this paper. More than 215 million people all over the world speak in Bangla as their native language [3]. But very few research works have been done on regional language. So, there is a good opportunity to us to do more research work in ASR of Bangla language to improve more. The proposed work based on spoken Bangla numeral recognition. This research work can help to those people who are interested to do their research in Bangla language.

There are many applications of spoken numerals recognition. It is used in ATM machines, biometric system, cellular phone, computer, smart wheel chair, etc. In railway system, announcement of train number of arriving, or departure trains, this system can be used. In our paper, we try to build a Bengali spoken numerals recognition system using GMM where MFCC can be used as feature extraction technique.

2 Literature Review

Karpagavalli and Chandra [1] developed phoneme which is speaker independent and also developed word-based speech recognition system in Tamil language using hidden markov tool kit. They took MFCC to extract features and also used HMM for developing the acoustic model. For estimating the state emission probabilities, they have used multi-variant Gaussian Mixture Model to build acoustic model. They choose 10 speaker who used Tamil language and made 50 words vocabulary for building and testing the model. After analyzing, they discussed about the accuracy of identification and word error rate (WRR) of this model. Taking the small data set, it is seen that the accuracy of recognition is high where the word error rate is too minimum which will finally treated as negligible.

Gamit and Dhameliya [4] carried out their research on isolated word recognition using artificial neural network. In this paper, combination of MFCC and LPC both are used for feature extraction. They used a classifier, i.e., back propagation

neural network to separate unvoiced speech samples from the voiced speech samples. Speech database contains the speech uttered by 28 speakers in which 14 speakers are males, and 14 speakers are females. After evaluation, they got 51.25% accuracy by using only MFCC whereas by using both MFCC and LPC, they got 85% accuracy.

Patil et al. [5] proposed an isolated word recognition system in Hindi language. They took MFCC for feature extraction and used vector quantization with GMM for isolated Hindi word recognition. The Hindi words were taken from some male and female speaker and used KNN for matching the pattern. They used KNN classifier for classification of sample feature of training and testing. Finally, in result, they shown some performance parameter and presented graphical representation of classification. Their implementation will be helpful to disabled, illiterate people in communication, education sector, etc.

Hammami et al. [6] proposed automatic spoken Arabic digit recognition based on GMM. They used $\Delta\Delta$MFCC for feature extraction. It has seen that accuracy level of GMM is average 99.31%, whereas accuracy level of CHMM is 98.41%. This paper shows the result and says GMM is most appropriate and attractive for this system. From the recognition result, it is seen that comparable rate of automatic speech recognition system is too high and also it is too much better than other reported results.

Chauhan et al. [7] carried out their research on speech-to-text conversion using GMM. They used MFCC for extracting the feature of speech signals and also used GMM to train the audio files for speech recognition. They experimented on multiple isolated words and got near about 71% accuracy to recognize those words. The only drawback of this system is that it is not suitable for high ambient noisy environment.

Ali et al. [8] proposed a technique to recognize Bengali words. They proposed four different models for words recognition system. In model 1, to extract features, they have used MFCC as a feature extraction technique and they used dynamic time warping for the purpose of matching. In model 2, they used LPC. Linear predictive coefficients are also calculated to extract the features and dynamic time warping for matching. In model 3, as previous MFCC was used to extract features and GMM was used to get the probability function for the purpose of matching. In model 4, LPC compressed MFCC for extracting the features and dynamic time warping for matching purpose. Finally, in this paper, they got 84% accuracy to recognize the speech whereas they took 100 Bangla words and they took general room environment to complete the Bengali word recognition purpose.

After careful studying, some of the existing system we focused a simple Bengali spoken digit recognition system by GMM. In Fig. 1, the proposed method is given properly.

This paper is expressed as: Sect. 3 discusses the dataset that are used and the pre-processing phase, Sect. 4 discusses feature extraction phase, Sect. 5 describes how GMM classify a speech and also shows the outcome of the proposed method and at last in Sect. 6 conclusion of the above work is discussed here.

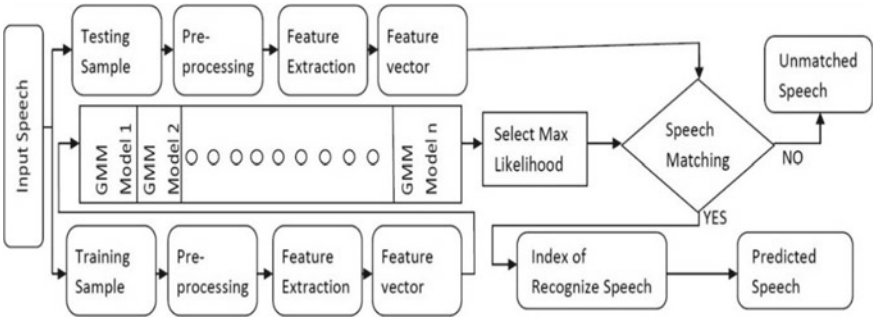

Fig. 1 Block diagram of the proposed model

3 Dataset and Preprocessing

3.1 Dataset Used

For the proposed work of isolated Bangla spoken digit recognition, we have taken a small data set of 10 Bangla digits zero to nine (pronounced as 'sunno' to 'noi'), uttered by 10 speakers, among them five male and five female with the age group from twenty to forty. Each word is uttered by ten times for each speaker with normal room environment. We used the audacity software with sampling frequency of 16 kHz and 32 bit mono channel. The data set contains 1000 audio samples of 10 classes. The whole data set has been used as training data set of GMM. Then each audio sample has been tested for most accurate match.

3.2 Preprocessing

In this stage, the voiced activity zone is detected from each of the uttered word. This is done by framing the signal of 25 ms with 50% overlapping. Then for each of the frame, the average energy and average zero crossing have been computed by the formula given in Eqs. 1 and 2, respectively. The energy of a frame calculates how much information it holds and zero crossing takes decision for a noise or noiseless frame with some threshold [9, 10].

$$E_n = \sum_{m=-\infty}^{\infty} [X(m) - W(n-m)]^2 \tag{1}$$

where $X(.)$ is the frame and $W(.)$ is the windowing function.

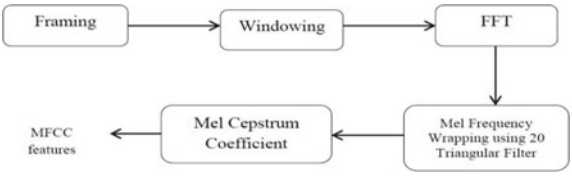

Fig. 2 Steps taken to calculate MFCC

$$\mathrm{ZCR} = \frac{1}{2N} \sum_{j=i-N+1}^{i} |\mathrm{sgn}(x(j)) - \mathrm{sgn}(x(j-1))| w(i-j) \tag{2}$$

where,

$$\mathrm{sgn}(x(j)) = \begin{cases} 1, \text{ if } x(j) \geq 0. \\ 0, \text{ if } x(j) < 0. \end{cases}$$

4 Feature Extraction

For each of the voiced frame, we have computed the first 13 coefficients which are taken as the MFCC coefficients and taken as our feature vector. Here, the feature extraction technique MFCC is computed in the following steps given in Fig. 2.

In Fig. 2, we discussed the steps of MFCC which we used for finding MFCC from speech signal.

4.1 Framing

The voiced section for each audio sample detected in Sect. 3.2 is segmented into 25 ms frame with 50% overlap. A single frame contains 400 samples, i.e., 80 frames per second.

4.2 Windowing

Since speech is an aperiodic signal, so the [6, 8] same size hamming window multiplied with signal because of maintaining the continuity at two extreme ends of a frame, Here, the hamming window equation is expressed by Eq. 3.

$$w(n) = 0.54 - 0.46 \cos\left(\frac{2\pi n}{N-1}\right) \tag{3}$$

4.3 Fast Fourier Transform (FFT)

Here time domain is converted into frequency domain by using FFT [4]. It is generally used to measure the energy distribution over frequencies. The FFT is calculated using the Discrete Fourier Transform (DFT) formula given in Eq. 4.

$$S_i(k) = \sum_{n=1}^{N} s_i(n) e^{\frac{-j2\pi kn}{N}} \quad 1 \leq k \leq K \tag{4}$$

K is the DFT length.

4.4 Mel-Frequency Wrapping

Here, power spectrum is mapped onto mel-scale using 20 triangular band pass filter. There exist a relationship between frequency (f) and mel (m) is given in Eq. 5.

$$m = 2595 \log_{10}\left(1 + \frac{f}{700}\right) \tag{5}$$

4.5 Mel Cepstrum Coefficient

The frequency domain into time domain of the signal is converted by discrete cosine transform (DCT) using Eq. 6.

$$C_m = \sum_{k=1}^{M} \cos\left[m\left(k - \frac{1}{2}\right)\frac{\pi}{M}\right] E_k \tag{6}$$

Here, M is the length of filter bank which is 20 in our case; $1 \leq m \leq L$ is the number of MFCC coefficients.

Thus, for a single frame, the 13 numbers of features as our feature vector.

5 Construction of GMM

An acoustic model for each utterance of individual word can identify the word. Since, we know the sounds are produced by different shape of vocal track and different frequency. But it encounters a problem if we want to match the same word uttered

by another person even the same person in later time. If we see, the power spectral density (PSD) shape of the same word spoken by different speakers, it changes, since the human vocal track change from person to person. This can be solved by the GMM, where one spectral feature commonly very robust is MFCC calculated from each utterance of the same class. Combining all such features, we developed a multidimensional probability density function (PDF) for the particular class of Bangla numeral. For ten Bangla numeral (zero to nine), ten such model is developed.

GMM is a probabilistic model expressed as a weighted sum of Gaussian component densities. It is a probability density function that can be used as a parametric model to measure the features in biometric system [6]. GMM evaluates mean and variance using iterative expectation maximization (EM) algorithm. Mean calculates frequency of power spectrum and variance measure how distance number spread out. These features are here extracted through MFCC [8, 9]. Multiple Gaussian distributions are mixed up and finally create the Gaussian Mixture Model. There are two types of Gaussian distribution. First one is uni-variant Gaussian distribution given as,

$$G(X|\mu, \sigma) = \frac{1}{\sigma\sqrt{2\Pi}} e^{-(x-\mu)^2/2\sigma^2} \tag{7}$$

Here, μ is denoted as mean, and σ is the standard deviation. σ^2 is the variance of distribution. Second one is multi-variant Gaussian distribution given as,

$$G(X|\mu, \Sigma) = \frac{1}{\sqrt{2\Pi|\Sigma|}} \exp^{\left(-\frac{1}{2}(X-\mu)^T \Sigma^{-1}(X-\mu)\right)} \tag{8}$$

Where, Σ is the covariance matrix. So, GMM can calculate the mean and variance using EM algorithm [5]. If x is a d-dimensional feature vector, then for a K-cluster problem, the probability distribution of the MFCC and obtained from cluster i, $i = 1, 2, \ldots, K$ is modeled as a mixture of N component probability densities as follows:

$$p(x|\lambda_i) = \sum_{j=1}^{N} p_{ij} f_i\left(x|\theta_{ij}\right), \sum_{j=1}^{N} p_{ij} = 1 \tag{9}$$

where for the ith speaker, P_{ij} is the prior probability for the jth component of the mixture. $\lambda_i = \{P_{ij}, \theta_{ij}, j = 1, 2, \ldots, N\}$ is the collection of unknown parameters and $f(x|\theta_{ij})$ is the probability density of x

$$p(x|\lambda_i) = p_{ij} \frac{1}{(2\Pi)^{\frac{d}{2}}|\Sigma_{ij}} e^{-\frac{1}{2}(x-\mu_{ij})^T \sum_{ij}^{-1}(x-\mu_{ij})} \tag{10}$$

where

$$\left\{\theta_{ij} = \mu_{ij,} \sum_{ij}\right\} \quad i = 1, 2, \ldots, K, j = 1, 2, \ldots, N$$

During testing phase, the MFCC feature is calculated for the test audio sample. Then, the maximum likelihood is calculated with the posterior probability of all GMM. The index of the maximum log-likelihood value is the recognized digit.

5.1 Result and Analysis

The PSD of the Bangla numeral one and four (Bengali pronunciations 'ek' and 'char,' respectively) for three different speakers is shown in Figs. 3 and 4, respectively, using the all-pole filter of Yule-Walker parametric spectral estimation technique.

It is clear that, the number of peaks for each of the digit is same, but different from others. The voiced portion boundary of the utterance of numeral 'ek' (English equivalent one) is given in Fig. 5. The accuracy on different class is given in the confusion matrix of Table 1. To justify the performance of the given proposed technique depends on the True Positive says as TP, True Negative says as TN, False Positive says as FP, and False Negative denoted as FN. So,

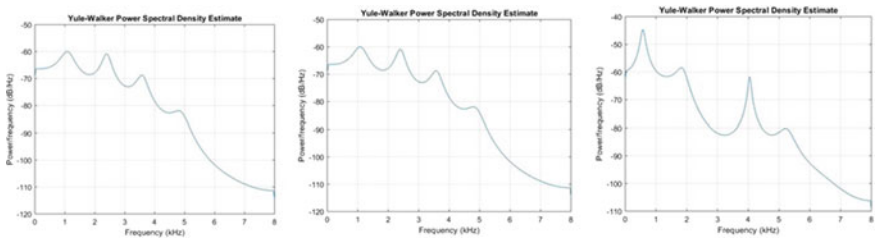

Fig. 3 Three different PSD of the numeral 'Ek'

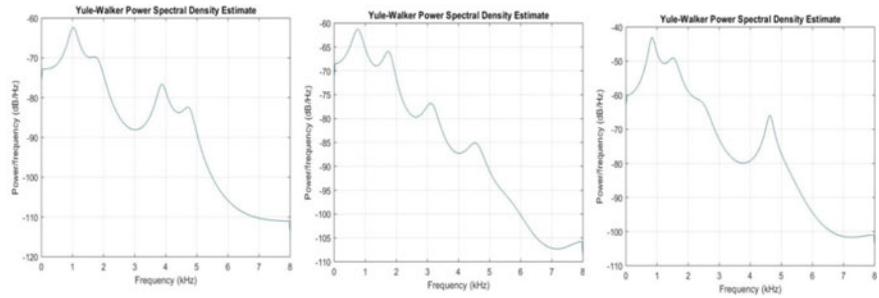

Fig. 4 Three different PSD of the numeral 'Char'

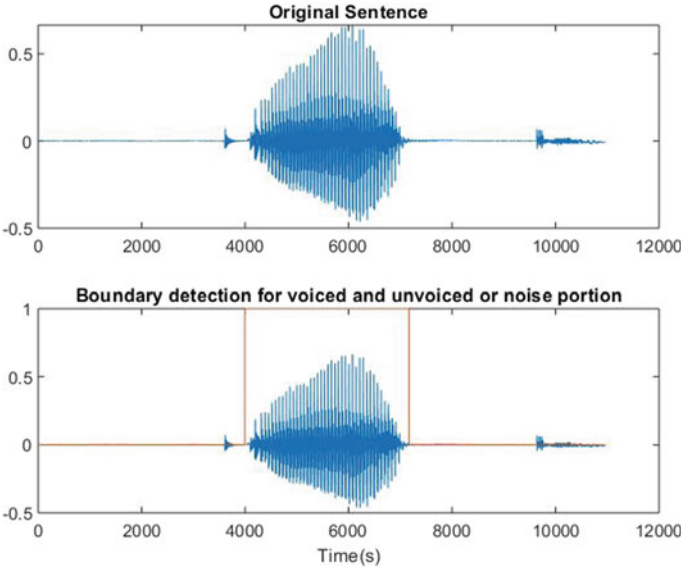

Fig. 5 Boundary detection in voice section

Table 1 Confusion matrix

	Predicted class										
True Class		0	1	2	3	4	5	6	7	8	9
	0	**99**	0	0	0	0	0	0	0	0	1
	1	4	**88**	0	0	0	0	0	1	6	1
	2	0	0	**98**	1	0	0	0	0	1	0
	3	6	0	3	**90**	0	0	0	0	0	1
	4	3	0	0	0	**84**	0	0	7	6	0
	5	0	0	0	2	0	**91**	0	0	5	2
	6	2	0	3	0	0	0	**88**	0	0	7
	7	2	2	0	0	0	0	0	**84**	8	4
	8	0	0	0	0	0	0	0	2	**98**	0
	9	0	0	1	0	0	0	2	0	0	**97**

i. Recall expressed as RE = TP/(TP + FN)
ii. Precision expressed as PR = TP/(TP + FP)
iii. Specificity expressed as SP = TN/(TN + FP)
iv. False Positive rate expressed as FPR = FP/(FP + TN)
v. False Negative rate expressed as FNR = FN/(TP + FN)
vi. Percentage of wrong classifications says as PWC = 100 * (FN + FP)/(TP + FN + FP + TN)

Table 2 Evaluation metrics

Evaluation metrics	Class										Mean
	0	1	2	3	4	5	6	7	8	9	
RE	0.99	0.88	0.98	0.9	0.84	0.91	0.88	0.84	0.98	0.97	0.917
PR	0.8534	0.97778	0.9333	0.96774	1	1	0.978	0.894	0.79	0.858	0.92524
SP	0.9811	0.99778	0.9922	0.99667	1	1	0.998	0.989	0.971	0.982	0.99078
FPR	0.0189	0.00222	0.0078	0.00333	0	0	0.002	0.011	0.029	0.018	0.00922
FNR	0.01	0.12	0.02	0.1	0.16	0.09	0.12	0.16	0.02	0.03	0.083
PWC	1.8	1.4	0.9	1.3	1.6	0.9	1.4	2.6	2.8	1.9	1.66
F-score	0.9167	0.92632	0.9561	0.93264	0.913	0.953	0.926	0.866	0.875	0.911	0.91757

vii. F-Score: (2 * Precision * Recall)/(Precision + Recall)

where, True Positive is highly predictable and False Negative is regrettable. The values of the all these traditional efficiency parameters compared with the ground truth and the outcome is given in Table 2.

6 Conclusion

Speech recognition is basically the highly preferable research work to researchers. A very progressive result on English, French, and Chinese like languages, but not satisfactory result in local or regional language. Our proposed work of isolated word recognition focused on Bangla language using GMM and can recognize a spoken Bangla numeral satisfactorily. Here, it has been observed from the confusion matrix that a misclassification between 'choy' and 'noy' similarly between 'sat' and 'aat' have occurred because their PSD mostly matches. The proposed works fine for a small data set but the performance degrades with large number of class and data set. It is also highly biased for a speaker dependent system. In our future work of isolated word recognition for Bangla language, a hybrid model of both feature extraction process and multiple classifiers such as DTW, SVM together with GMM to improve the accuracy and evaluation metrics.

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Detection and Evaluation of Chronic Kidney Disease Using Different Regression and Classification Algorithms in Machine Learning

Anusmita Sarkar, Avinash Kumar, Sobhangi Sarkar, and Chittaranjan Pradhan

Abstract Nowadays, many people are suffering from chronic kidney disease worldwide. Factors responsible for such conditions are food, living standards, and the environment. Detection and identification of chronic kidney disease are costly, time-consuming, and often risky. Therefore, the early detection of such disease is very important. In this research study, we have tried to reduce the clinical effort by automating the process of detection. We have classified whether the person is suffering from chronic kidney disease or not. We have used different classification algorithms and regression algorithms like KNN, SVM, Naive Bayes, and logistic regression. We have got some good results in all the algorithms but KNN performed very well.

Keywords Kidney disease · KNN · Logistic regression · Naive Bayes · Support vector machine

1 Introduction

Kidneys are essential for the normal functioning of the human body. Some of the crucial functions performed by kidneys include filtration of waste materials, excessive water content from the blood. They also help to maintain acid base balance and regulate electrolyte concentrations in the body. The other tasks of the kidneys are to regulate blood pressure by creating hormones, creation of red blood cells, and

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promote bone health. Millions of people belonging to different age groups suffer from kidney disease all over the world. It happens when they become damaged and cannot filter blood the way they should do. Kidneys may get damaged due to high blood pressure, diabetes, etc. It might also cause other medical problems such as malnutrition and weak bones. Chronic kidney disease is the most frequent form of kidney disease. It is commonly induced by high blood pressure. Kidney stones are another typical kidney problem. Kidney stones can make urination extremely painful. There are also other types of kidney diseases like glomerulonephritis and polycystic kidney disease.

Doctors run some investigations to see if the kidneys are working properly. These investigations include glomerular filtration rate (GFR) to determine the stage of the disease, kidney biopsy to determine what type of kidney disease, and to what extent damage has occurred; urine test, blood creatinine to determine whether the kidney is working properly and ultrasound and CT scan to produce images of kidney and urinary tract. These tests are used by doctors to deliver some judgment about the condition of the kidney or kidney disease. To help improve their judgment, techniques namely machine learning, deep learning and artificial intelligence are used [1].

2 Existing Work

Anusorn Charleonnan et al. used machine learning models like K-nearest neighbors (KNN), logistic regression, support vector machine (SVM), and decision tree classifier to predict chronic kidney disease and compared their accuracy. The performance measures used were accuracy, sensitivity, and specificity. SVM had the highest sensitivity was 0.99, and KNN had the highest specificity. SVM was selected as the appropriate model for predicting chronic kidney disease [2].

Engin Avci et al. used WEKA software with Naive Bayes, J48, and some other algorithms to make predictions about chronic kidney disease. The performance measure used were accuracy, precision, sensitivity, and F-measure parameters found that J48 classifier gave 99% accuracy and J48 model was as the most appropriate model for predicting kidney disease or ckd [3].

W. H. S. D. Gunarathne et al. used different types of algorithms such as multi-class decision jungle and multi-class neural network, etc., for the detection of kidney disease [4]. The research approach that had been used is cross industry standard process for data mining (CRISP-DM) [5]. They have used Microsoft Azure machine learning studio to develop this model. The highest accuracy of 99.1% was achieved by multi-class decision forest [4].

Y. Amirgaliyev et al. used SVM classifier with linear kernel for predicting chronic kidney disease. The performance measures used were sensitivity, specificity, and accuracy metrics. SVM classifier with linear kernel got a sensitivity of 93.1% [6].

Mubarik Ahmad used SVM. SVM has been used for detection of kidney disease. The random forest package had been used to calculate the error rate which came out to be 1.66%, and hence, an accuracy of 98.34% was obtained [7].

3 Methodology

We have downloaded the dataset from online source which was publicly available on UCI repository. The data was taken within a period of 2 months in India with 25 features consisting 400 rows. The features that was used in building our model is shown in Table 1.

The different algorithms used here are discussed below.

Table 1 Dataset attributes

Attribute	Short name used
Age	Age
Blood pressure	Bp
Specific gravity	Sg
Albumin	Al
Sugar	Su
Red blood cells	Rbc
Pus cell	Pc
Pus cell clumps	Pcc
Bacteria	Ba
Blood glucose random	Bgr
Blood urea	Bu
Serum creatinine	Sc
Sodium	Sod
Potassium	Pot
Hemoglobin	Hemo
Packed cell volume	Pcv
White blood cell count	Wc
Red blood cell count	Rc
Hypertension	Htn
Diabetes mellitus	Dm
Coronary artery disease	Cad
Appetite	Appet
Pedal edema	Pe
Anemia	Ane
Classification	Class

3.1 K-Nearest Neighbor (KNN)

It is a ML algorithm which can be utilized to work out classification and regression domains. It works by recording existing occurrence and categorizing new occurrences using method which is known as similarity measure also known as distance function. By obtaining the majority of votes of its neighbors, a case is categorized to the most common class. The case belongs to the class of its nearest neighbor if $K = 1$ [8].

3.2 Naive Bayes

For binary-class and multi-class classification problems, Naive Bayes algorithm is used. It is related to Bayes theorem. This classifier computes the probabilities for every factor. It selects the result with the highest probability. This classifier assumes the features are independent. Thus, Naïve Bayes theorem calculates happening event's probability against one already happened event.

3.3 Support Vector Machine (SVM)

For classification and regression problems, SVM is another common supervised machine learning algorithm. In a *n*-dimensional space, a point is plotted for each data item. Here, "*n*" represents the number of features. Then classification is accomplished by determining the hyperplane which best distinguishes the two classes. The coordinates of each observation are support vectors.

3.4 Logistic Regression

For classification task, logistic regression is another machine learning algorithm. The cost function of logistic regression can be described as the sigmoid (or logistic) function. The hypothesis of logistic regression usually confines the cost function between 0 and 1. When the inputs are passed through a prediction function, this classifier gives a set of classes and finds the probability.

4 Proposed Work

We have used a dataset for the development of the model in our research is available on an open source website. The development of model was initiated with pre-processing

of it. Preprocessing is the most important step in development of any model. It helps the model to be more accurate and precise.

First of all, we started with the data cleaning and pre-processing steps. Our dataset had lot of textual values which we converted into numerical values, i.e., 0 or 1. We have also changed the target parameter values to 1 and 0 to be able to use the classification algorithms.

Moreover, we have also transformed some of the attributes into integer with the help of replace method of pandas dataframe. The value abnormal and normal were changed to 1 and 0, respectively, for attributes such as for rbc, pc. The value present and not present were also changed to 1 and 0, respectively, for attributes such as ba, pcc.

The target column was also transformed. If the value is "chronic kidney disease" (ckd) then it is replaced with 1, if not then its equal to 0. Our dataset have some NaN values. We have imputed all those rows which were Null. After the data pre-processing, we have visualized the correlation of parameters with the help of heatmap as shown in Fig. 1.

We have split our dataset into 70:30 ratio, where 30% is test size and 70% is training size and have applied different machine learning algorithms to analyze the accuracy.

```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,random_state=1,test_size=0.3)
```

The following sections give the description of regression and classification algorithms used.

4.1 K-Nearest Neighbor (KNN)

We have applied KNN classification algorithm by using following code and achieved an accuracy of 97.5%.

```
from sklearn.neighbors import KNeighborsClassifier
knn=KNeighborsClassifier(n_neighbors=3)
knn.fit(x_train,y_train)
knn.predict(x_test)
```

The confusion matrix for the KNN algorithm was visualized on heatmap is shown in Fig. 2.

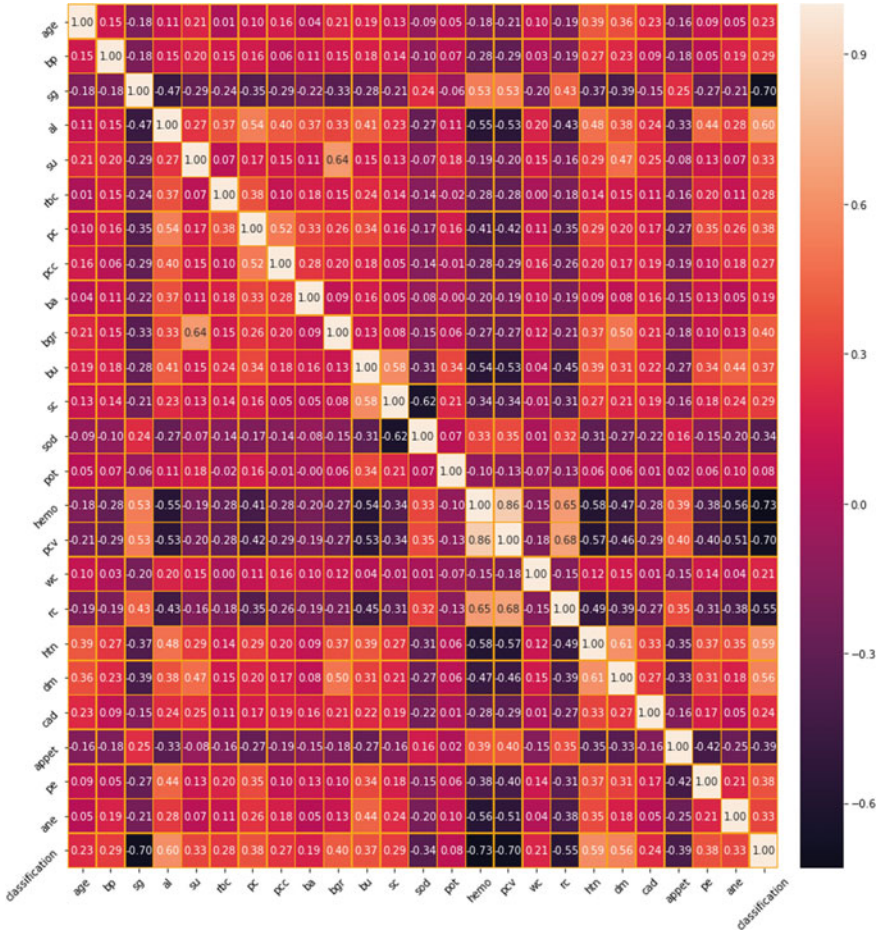

Fig. 1 Dataset without NaN Values

4.2 Naïve Bayes

We have applied Navie-Bayes classification algorithm by using following code and achieved an accuracy of 94.16%.

```
from sklearn.naive_bayes import GaussianNB
nb=GaussianNB()
nb.fit(x_train,y_train)
```

The confusion matrix for the above algorithm was visualized on heatmap is presented in Fig. 3.

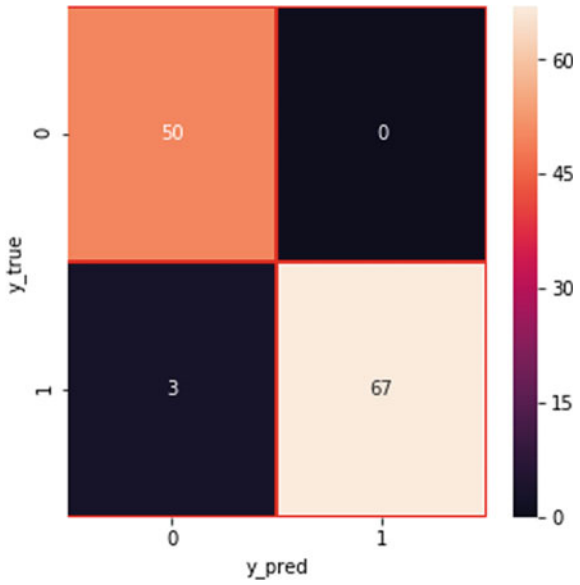

Fig. 2 KNN confusion matrix

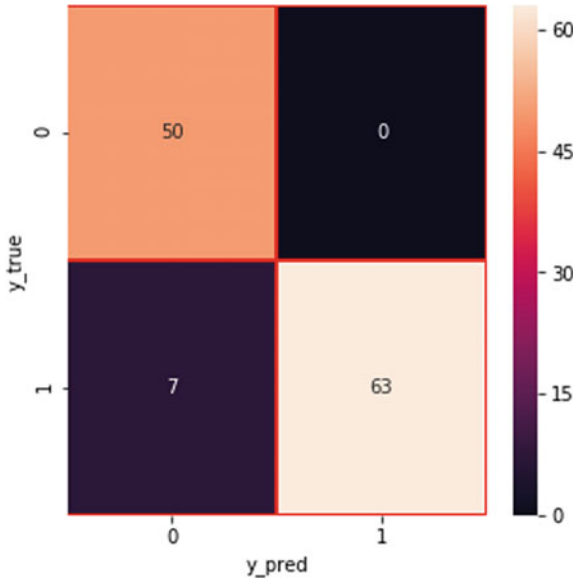

Fig. 3 Naïve Bayes confusion matrix

4.3 Support Vector Machine (SVM)

We have applied support vector machine classification algorithm by using following code and achieved an accuracy of 92.5%.

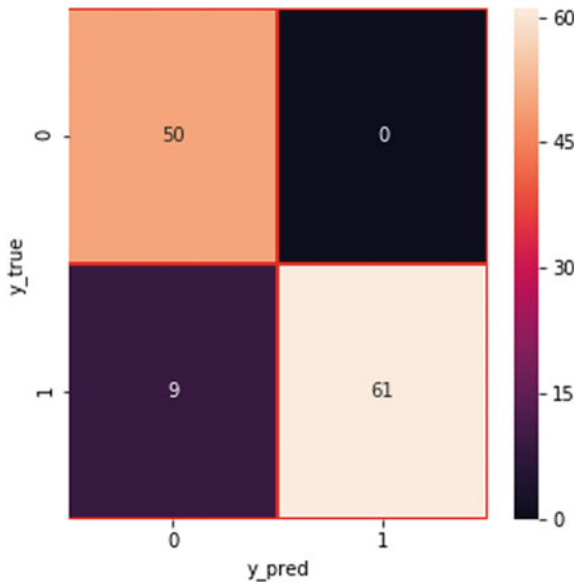

Fig. 4 Support vector machine confusion matrix

```
from sklearn.svm import SVC
svm=SVC(random_state=1)
svm.fit(x_train,y_train)
```

The confusion matrix for the support vector machine algorithm was visualized on heatmap is shown in Fig. 4.

4.4 Logistic Regression

We have applied logistic regression algorithm by using following code and achieved an accuracy of 95.00%.

```
from sklearn.linear_model import LogisticRegression
lr = LogisticRegression()
lr.fit(x_train,y_train)
```

The confusion matrix for the logistic regression algorithm was visualized on heatmap is shown in Fig. 5.

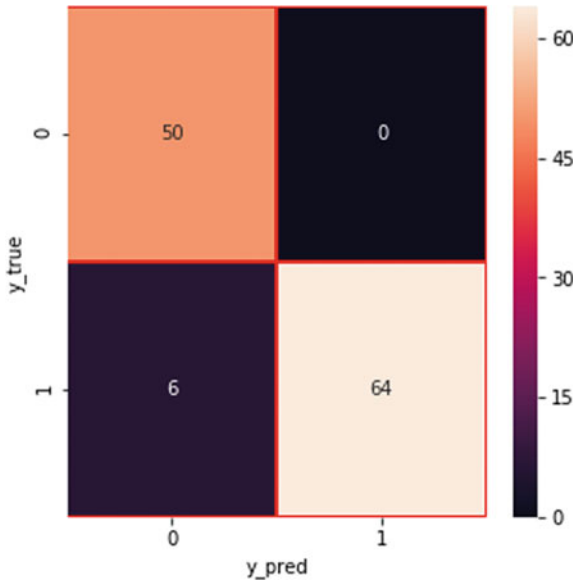

Fig. 5 Logistic regression confusion matrix

5 Result Analysis

The pre-processing of the dataset was the major part which lead to the good accuracy of our model. We have chosen the suitable algorithms for our model and the dataset and applied it.

After applying all the algorithms and analyzing, we got to know that all the algorithms gave good results but KNN performed exceptionally well. Fig. 6 shows the accuracy comparison of all the algorithms.

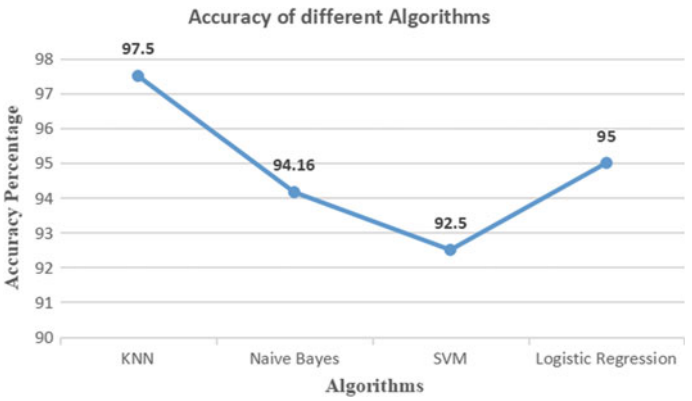

Fig. 6 Accuracy comparison of different algorithms

We have used the dataset from online source which was publicly available on UCI repository. We have used four different algorithms and got good accuracy. KNN algorithm gave us good result which is around 97.5% precision, Naive Bayes showed the precision of 94.16%, SVM also showed the precision of 92.5%, and finally, logistic regression showed the precision of 95%.

6 Conclusion and Future Work

In our research, we tried to obtain a good accuracy by applying different algorithms. From the result analysis, we found KNN algorithm produces the best accuracy of 97.5% followed by the accuracy of 95% by logistic regression algorithm. In future, we can work on huge real life dataset and can develop a healthcare system prototype for chronic kidney disease patients.

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Analysis and Prevention of Road Accidents

Bishnu Pada Saha and Jitendra Kumar Rout

Abstract In today's world, the frequency of occurrence of road accidents has increased exponentially. The news channels broadcast at least one case of road accident every day. So, it is very much required to find out the root cause of accidents so as to prevent them. This report will give a brief idea about analyzing the reasons behind the occurrence of road accidents and its analysis. It will also brief about the systems that has been created to provide safety measures after the occurrence of accidents. Based on our analysis, we discussed about some of the advantages and disadvantages of the existing accident alert system and shared our opinion that will have an impact in preventing the occurrence of road accidents. Finally, the future work is to include IOT techniques and sensors to analyze the cause of accidents as well as prevent the same.

Keywords Road accidents · Data analysis · Data mining techniques

1 Introduction

The second largest network of roads in the world is in India. The occurrence of accidents on road are quite frequent and cause deaths every year. In recent years, the increment of occurrence of road accidents in being on a yearly basis because of very high speed traveling. So, great concerns have been raised by the traffic safety across the world. It became a challenge for the traffic administrations to introduce better policies for the prevention of accidents. According to the encyclopedia, road traffic accidents have been defined as a vehicle accident that has occurred on a national highway (i.e., accident originating on a highway, accident terminating on a highway, or vehicle partially being involved on the highway) [1]. The accidents also includes

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various ways of collision such as vehicles with animals, vehicles with pedestrians, or vehicles with fixed obstacles. Accidents caused due to single vehicle (vehicle alone only and no other obstacles or road user involved) are also included.

Some of the data mining approaches that are not suitable for collected datasets representing road accidents has been applied to generate hidden relationships and patterns between various factors due to which road accidents occurred with fatal consequences [2]. The obtained results from data mining approaches describes about the most important factors or often repetition of patterns. The most dangerous roads have been identified from the generated pattern in terms of accidents so that necessary measures can be prepared to prevent road accidents.

The rest of the report is divided into following sections. Section 1 covers the basic introduction, the objectives of this report is there in Sect. 2, whereas Sect. 3 presents the literature review. Section 4 gives an explanation of the entire work to be done. The results and discussions are present in Sect. 5. Section 6 concludes the analysis along with the future work.

2 Objective

The main objectives of this work are:

- To analyze the root cause for road accidents using data mining techniques, in order to avoid them.
- To create a proper dataset containing all the factors due to which accidents occurs.
- To find a solution for preventing road accidents using ML techniques.
- To develop various models based on analysis report that can prevent the cause of accidents.
- To extend the work using IoT techniques.

3 Literature Survey

The number of fatalities occurred due to accidents on road have a huge impact in the society. Until now, the researchers mainly focused on understanding the factors due to which the accidents occurs [3, 4]. Mohan [3] described about an annual average growth rate of vehicle registration, vehicle sales, and road traffic fatalities in India and predicted the crash patterns so that data is always available for scientific analysis. The author also presented a graphical visualization of factors causing accidents such as age of driver, time of day, etc. Singh et al. [4] presented a review report analysis of road accidents data using different data mining techniques and mentioned about most frequently used analysis such as classification, decision tree, and artificial neural networks. The paper also discussed about the accuracy of different techniques used. The system developed by Patel et al. [5] will help provide emergency services by contacting nearby hospitals and stations and also the respective family members and

friends, so that proper action can be taken in quick time to avoid fatal loss. A methodology has been proposed by Singh and Kaur [6] that used the data mining techniques such as association rule mining (Apriori) and Naive Bayes classification. It produced statistical results that compare mortality rate between the rural and city. The statistics also provide some limiting factors that would help the public to determine the metrics of accident. Li et al. [7] have performed an analysis on road accidents in United States using some data mining techniques such as Naive Bayes for classification, Apriori for association and K-means for clustering. Fatality analysis reporting system (FARS) datasets were used for this study. Sukhadiya and Kumawat [8] used modified Apriori algorithm for analysis of road accidents. The main goal was to reduce the time taken by CPU for calculating support. The work used some checkpoint techniques which removed the non-frequent candidates at each checkpoint to reduce the CPU time. In a similar note, Mahata et al. [9] used the spatio-temporal analysis. This analysis resulted in the exponential increase of the growth rate of the number of road traffic Accidents. The results suggests to make city-based strategies to prevent accidents.

4 Proposed Work

In order to analyze and prevent road accidents, we are working on analysis of road accidents data to predict the factors that are causing more accidents and deaths simultaneously. For this analysis work, datasets are collected from government site [10]. Now, based on the type of data, we will be performing various data mining techniques and find out the results. The results which gives best accuracy will be used for further analysis. A part of our research work is discussed in the later sections. This will give a brief idea on how to analyze datasets using various techniques in different ways. Section 5 will also describe about the pros and cons about the research works. It also provides information about how to overcome those disadvantages for better results.

4.1 Experimental Setup

Dataset Description: The attributes of all the datasets describes the factors due to which accidents occur. Each factor has three cases: total number of accidents, persons killed, and persons injured [10]. The first dataset shown in Table 1 describes about the accidents occurred due to accident nature of the year 2014 and 2016. It contains 29 attributes that describes the factors due to which accidents occur and 36 records. The second dataset shown in Table 2 describes about the accidents occurred due to the road features of the year 2014 and 2016. It contains 14 attributes that describes the factors due to which accidents occur and 36 records. The third dataset shown in Table 3 describes about the accidents occurred due to weather conditions of the

Table 1 Acc classified according to nature of Acc 2014 and 2016

State/ UT	Overturning—Total Acc 2014	Overturning—Persons killed 2014	Overturning—Persons injured 2014	Head on collision—Total Acc 2014	Head on collision—Persons killed 2014	Head on collision—Persons injured 2014
Andhra Pradesh	2684	784	3353	6045	1860	7068
Arunachal Pradesh	53	22	74	14	15	45
Assam	1608	535	1679	719	268	618
Bihar	912	478	764	1242	713	893
Chhattisgarh	1888	552	2126	2016	605	1529
Goa	1169	71	475	954	54	399
Gujarat	2449	843	2375	4856	1709	4835
Haryana	1608	647	1354	1615	556	1622
Himachal Pradesh	458	129	777	233	58	335
Jammu and Kashmir	1039	189	1632	227	45	259

Table 2 Acc classified according to road features 2014 and 2016

State/ UT	Single lane—Accident 2014	Single lane—Killed 2014	Single lane—Injured 2014	Two lanes—Accident 2014	Two lanes—Killed 2014	Two lanes—Injured 2014
Andhra Pradesh	8634	2958	13541	10327	2994	10122
Arunachal Pradesh	90	60	152	115	59	156
Assam	3888	1217	3195	2432	1035	2510
Bihar	3731	1815	2475	4156	2096	3092
Chhattisgarh	7961	2244	7762	4696	1524	4661
Goa	2523	187	1091	1706	103	788
Gujarat	10978	3101	10673	7475	2669	7101
Haryana	4090	1565	3485	3420	1451	2875
Himachal Pradesh	1183	528	2322	1875	671	3254
Jammu and Kashmir	3761	548	4129	1935	419	3654

Table 3 Acc classified according to type of weather condition 2014 and 2016

State/UT	Fine—Total Acc. 2014	Fine—Persons killed 2014	Fine—Persons injured 2014	Mist/fog—Total Acc. 2014	Mist/fog—Persons killed 2014	Mist/fog—Persons injured 2014
Andhra Pradesh	14591	4586	17065	724	219	925
Arunachal Pradesh	71	30	110	14	10	26
Assam	3575	1318	3216	494	150	368
Bihar	2343	1218	1626	1713	881	1081
Chhattisgarh	5000	1354	4584	382	149	376
Goa	3556	257	1585	0	0	0
Gujarat	15008	4876	14431	643	176	639
Haryana	5519	2043	5261	724	263	716
Himachal Pradesh	2070	736	3635	90	45	232
Jammu and Kashmir	5290	816	7297	16	7	19

year 2014 and 2016. It contains 41 attributes that describes the factors due to which accidents occur and 36 records.

Datasets Snapshot: Following are the few snapshots of the datasets that are used in our research work.

4.2 Preprocessing

- There are few records having NA (Not Available) values such as the record of DELHI state. These NA values will create ambiguities in the results and will give error message. So these records have been removed to get appropriate results.
- There are some records as well that have NA (Not Available) values along with numeric values. That record will be causing ambiguity but it cannot be removed because it is having some numeric values as well. So, the NA values in that record will be converted to 0.
- Initially, the datasets contained information about accidents occurred in the year 2014 and 2016. So for simplicity, dataset of the year 2014 have only been used to analyze the results.

4.3 Implementation

The datasets contain information about the factors for accidents occurred in various states of INDIA [10]. For each factor, there are three different outcomes such as Total Accidents, Persons Killed, and Persons Injured. So, in this research work, all the three outcomes are taken into account.

Part 1

- From each dataset, mean of Total Accidents attribute due to respective reasons, mean of Persons Killed attributes due to accidents caused and mean of Persons Injured attribute have been calculated.
- Suppose it may happen that in 1 lane roadways, accidents are more and persons killed along persons injured are less but in 2 lane roadways, accidents are less and persons killed along persons are more. Then 2 lane roadways will be consider as more no of persons are killed and injured although number of accidents are less. So, all the three cases of each factor are taken into account.
- For each dataset, a bar plot has been created based on the total accidents, persons killed, and persons injured due to total accidents as shown in Figs. 1, 2, 3 and 4.
- From these bar plots, it has been depicted that due to 1–2 yr, 2–4 yr and 4–6 yr of age of vehicles; over turning, head on collision, and other accident nature; single lane and dual lane roadways; defective brakes, and other serious mechanical defect in vehicles, more number of accidents are caused, more persons are killed and more persons are injured, based on the mean values.

Part 2

These mean values of each factor are then considered and used to create a training dataset df road1.csv as shown in Fig. 5, having only the highest mean values of Total Accident, Persons Killed and Persons Injured from each dataset. In the training/testing dataset, the data have been classified into More or Less based on whether the value of accidents is greater than or less than mean, from each dataset.

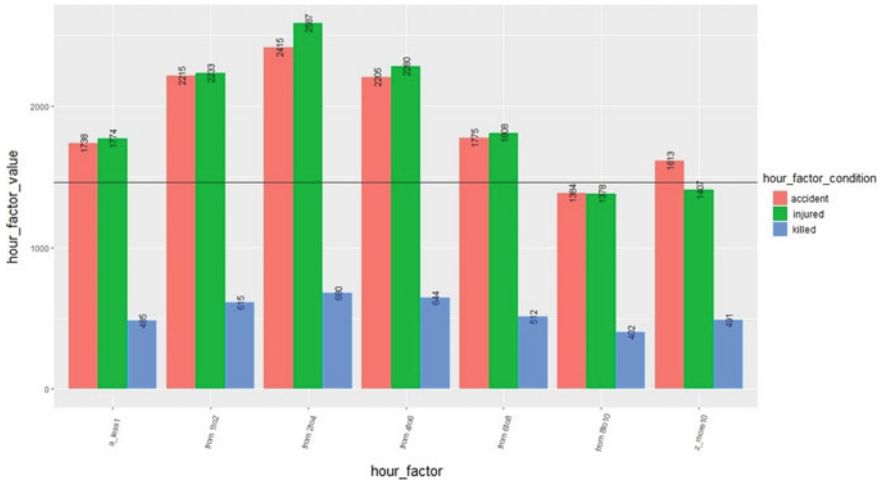

Fig. 1 Mean of total accidents, persons killed and persons injured due to age of vehicles in a grouped bar plot

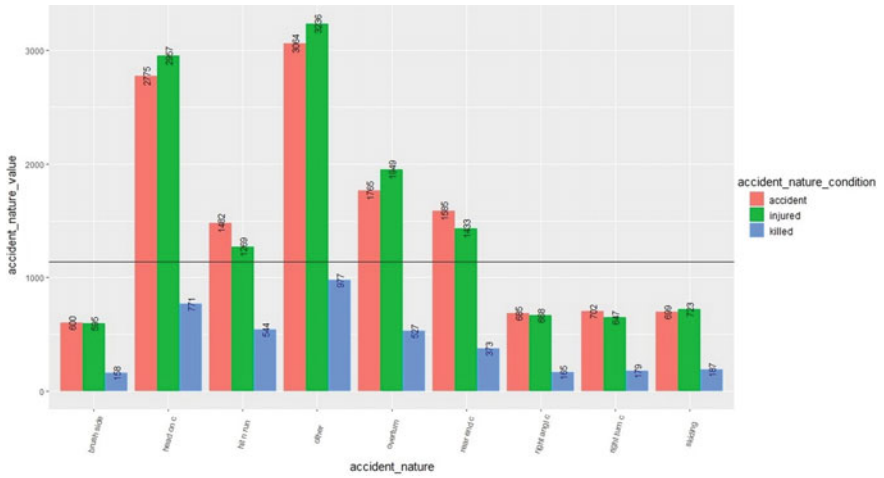

Fig. 2 Mean of total accidents, persons killed, and persons injured due to accident nature in a grouped bar plot

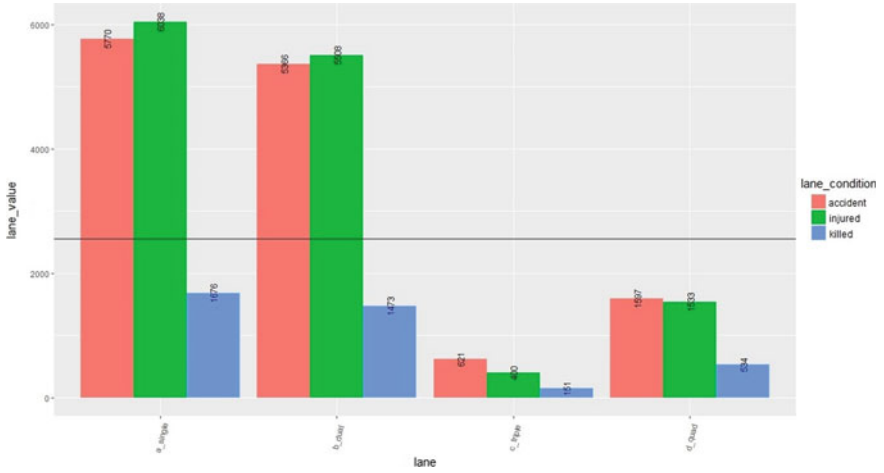

Fig. 3 Mean of total accidents, persons killed and persons injured due to road feature in a grouped bar plot

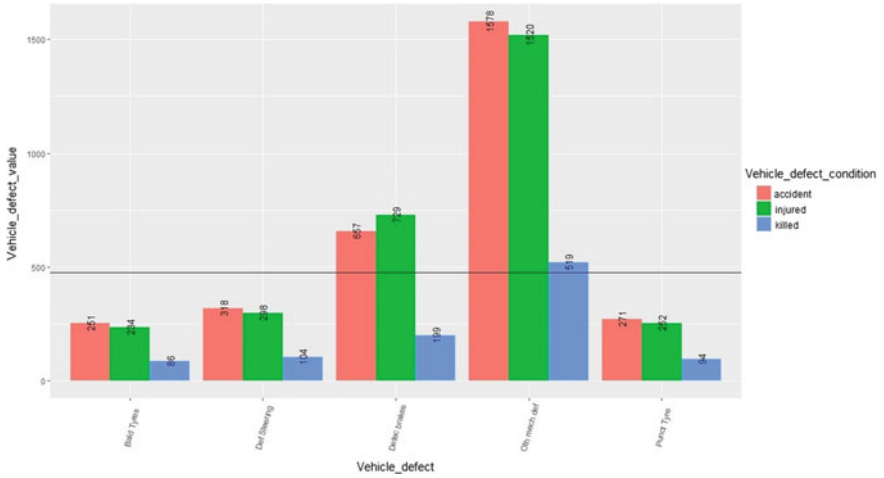

Fig. 4 Mean of total accidents, persons killed and persons injured due to vehicle defect in a grouped bar plot

Also, a target attribute predicted output has been calculated based on more number of Yes in a record. The predict output attribute depicts that which state needs to be concerned more about the accidents caused.

	States	From_1to2_Years	From_2to4_Years	From_4to6_Years	Over_turning	Head_on_collision	Other_Accident_nature	Single_lane	Dual_lane	Defective_brakes	Other_serious_mechanical_defect	Predicted_output
1	Andhra Pradesh	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	More
2	Arunachal Pradesh	No	No	No	No	No	No	No	No	No	No	Less
3	Assam	No	Yes	No	Yes	No	Yes	Yes	No	No	No	Less
4	Bihar	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	More
5	Chhattisgarh	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	More
6	Goa	No	No	No	Yes	No	No	No	No	No	No	Less
7	Gujarat	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	More
8	Haryana	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	More
9	Himachal Pradesh	No	No	No	No	No	Yes	No	No	No	No	Less
10	Jammu & Kashmir	No	No	No	No	No	No	Yes	No	No	Yes	Less
11	Jharkhand	No	No	No	No	No	Yes	No	No	No	Yes	Less
12	Karnataka	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	More
13	Kerala	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	More
14	Madhya Pradesh	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	More
15	Maharashtra	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	More
16	Manipur	No	No	No	No	No	No	No	No	No	No	Less
17	Meghalaya	No	No	No	No	No	No	No	No	No	No	Less
18	Mizoram	No	No	No	No	No	No	No	No	No	No	Less
19	Nagaland	No	No	No	No	No	No	No	No	No	No	Less

Fig. 5 Training/testing dataset df road.csv

5 Results and Discussions

Now, the training dataset is used to predict the reason due to which more number of accidents occurred and also more number of people were killed and injured. The result obtained is shown in Fig. 6. Initially, the dataset was not supporting any classification process as there were no class labels. So, after this analysis, the generated training dataset is then further classified using decision tree algorithm and predicted the path that describes the reason causing more accidents. In this analysis, the value of mean may give biased results. This is because of the highest value and the lowest value of that attribute. If there are maximum number of values in an attribute that have higher range and few have lower range, then the mean value will differ a lot. Due to

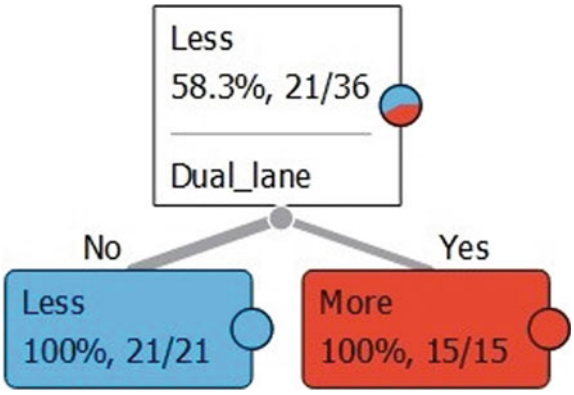

Fig. 6 Prediction using decision tree algorithm

this biased results, there may be some states that will require more analysis may be ignored.

6 Conclusion and Future Work

From the above report, it can be concluded that road accidents are gradually increasing day by day without a sign of decrement. It used some statistical analysis for providing class labels to dataset and so that decision tree algorithm can be performed. The result provided a way to give class labels to non-categorical data and use them for further analysis. The study on analysis of road accidents cause identified the key factor causing accidents and provide instructional methods for the prevention and reduction of road accidents, which could greatly reduce personal casualty and property loss by road traffic accidents.

The alert system is good for providing necessary safety measures after the occurrence of accidents but the focus must be on preventing the occurrence of accidents. Based on the system provided in the research work [5], the focus was on the solution after the occurrence of accidents. But this system lacks in preventing the occurrence of the accidents since this will help in providing necessary actions to be taken after the occurrence of accidents. So, the main motive is to focus on preventing the occurrence of accidents in different ways based on given analysis or by producing an analysis with different techniques and with better accuracy. So, a better solution can be implemented by integrating some IoT techniques. Furthermore, analysis will be finalized by using all the three cases of each factor for a better analysis of the key factor causing accidents.

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Brain Tumor Segmentation from 3D MRI Slices Using Cascading Convolutional Neural Network

Suchismita Das, Mahesh Kumar Swain, G. K. Nayak, and Sanjay Saxena

Abstract Brain tumor accounts for 80–90% of all primary CNS tumors. Brain cancer is tenth leading cause of death. Automatic detection and classification can help in early diagnosis and deliver efficient treatment. Recent developments in medical imaging modalities such as MRI provide insightful image of our brain. Due to large amount data and variability of data, diagnosing in faster and proper manner is not humanly possible. In this paper, we focus on segmentation of brain tumor of 3D MRI images using 3D CNN in cascading format. Whole tumor is extracted from the images through the first CNN model, then the output is fed to the next CNN model to extract the core tumor and finally, it is fed to the last CNN of cascading network to segment the enhanced tumor core. To improve the brain tumor segmentation, three neural networks belonging to the class of convoluted neural networks (CNNs) were connected having 20 interconnected kernel slices with four downsampling slices to trade off simplicity with feature extraction. The proposed method was evaluated by considering Brats 2015 3D dataset consisting of 274 MRI images with their ground truth having different four modalities. The activation function used was Relu and the results obtained were calculated over DICE coefficient (F-measure) which was found to be 0.78 for core tumor in flair modalities.

Keywords Medical image processing · Image segmentation · Deep learning · CNN · Brain tumor

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1 Introduction

Medical image analysis is an important and evolving field. Computer-aided diagnosis and detection can increase treatment of deadly diseases and abnormalities exponentially. It could save time and money for hospitals and patients, and improved accuracy, especially for cancer treatments. Tumors are abnormal growth of tissue or cells. These glioma cells are categorized as low grade gliaoma (LGG) and high grade glioma (HGG). High grade glioma cells are considered to be more aggressive and highly malignant. Malignant tumor are one type of tumor which invades neighborhood cells or tissue, thus exhibiting unnatural division and spreading. These types of tumors are called cancer. Brain tumor or cancer can induce degradation cognitive function, coma, and even death. Automated tumor detection using deep learning or machine learning architectures may give access to early detection hence early treatment preventing further damage. Traditional machine learning model, frameworks, or architectures showed inefficiency while dealing with large number of data and variability of data. Deep learning models, especially models related to computer vision can provide accurate results by effectively dealing with the above-mentioned conditions without supervision.

Due to recent developments in medical imaging modalities such as MRI, computed tomography scans, ultrasound or X-ray, we can produce a high resolution image and determine accurate systems functioning in human body. For detecting tumor, MRI brain scans are used widely. They provide different regions of image in different contrast. Thus brain MRI scans are extensively used in deep learning models. Given an input of an MRI brain volume, neural network outputs a segmentation of the volume that separates the tumor from the rest of the brain [1]. The final output is the same shape as the input, but each pixel of the output, rather than containing visual information, contains the unscaled probability that the corresponding pixel in the input belongs to the tumor. CNN is mostly used in computer vision-related models. It produces a better result in terms of accuracy from the traditional machine learning models. A CNN architecture is formed by stacking different convolutional layer. The parameters of layer consist of a set of kernels. A convolution operation is performed between the kernel and pixel of the image. Many different kinds of small functionaries are used such as padding, activation function, and pooling are used to increase accuracy.

The main contribution of the paper as follows:

1. A brain tumor segmentation by considering the Flair MRI images as 3D volumes slices to increase the accuracy of the segmentation method.
2. A three layer of CNN is used to further improve the accuracy and dice score of the segmented volume.
3. The method is evaluated on standard dataset, i.e., BraTS 2015 dataset to show the performance of the proposed method is satisfactory.

2 Literature Survey

Various models, frameworks, or architectures have been developed using machine learning and deep learning to improve the segmentation results. Computer-aided diagnoses of disease depend on acquisition and interpretation of images. Due to recent development in imaging modalities, we can get a proper high resolution image. Automated interpretation is still an evolving but computer vision paved a new pathway. Traditional algorithms of machine learning rely heavily on features or structures crafted by experts. Due to variation of data, traditional methods are getting obsolete. Deep learning is proven reliable in most of fields, especially where the data is large and variable or convolutional neural network is widely used in computer vision. CNN is one of most popular deep learning architectures. The advantage of CNN from the traditional methods is that it can automatically detect features without human supervision. Ali Sharif Razavian et al. [2] compared result of series of experiments on CNN and came to conclusion that CNN should be used for most visual recognition tasks. After extensive experiments [3], researchers have concluded that 3D CNN produce significantly better results than 2D CNN. By fine tuning CNN [4], one can improved detection of medical abnormalities based on non-medical learning.

3 Proposed Methodology

We proposed a segmentation algorithm to segment the whole tumor core accurately from the 3D MRI volumes using deep learning architecture. This method has the following steps: Data preprocessing to improve the accuracy, a training step to pretrained flair MRI modality through three cascading CNNs to classify each pixel based on their extracted features.

3.1 Data Preprocessing

In brain MRI images, there are a large variation in intensities as the images as acquired through different scanners and also at different times for different subjects. The brain segmentation efficiency and performance are affected greatly due to this intensity variation. To reduce this artifacts and improve the performance of the proposed method, normalization is applied to the dataset to make the mean intensities and variation values near to 0 and 1, respectively. This is computed though the following formula (1):

$$I_{\text{normalized}} = \left(I_{\text{original image}} - \mu\right)/\sigma \tag{1}$$

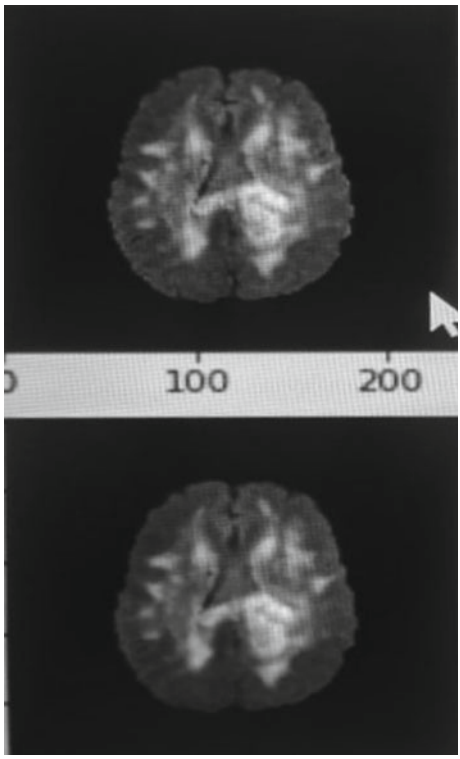

Fig. 1 Original image (above), normalized image (below)

$I_{\text{original image}}$ represents the intensity values of the original images and μ and σ represent the mean and standard deviation of the intensities of original images. Figure 1 shows the original image and the normalized image. Finally, the normalized image is fed as the input to the first convolutional neural network in the cascading network.

3.2 Brain Tumor Segmentation by Cascading CNNs Model

The design of the CNN is of utmost importance owing to the fact that it constitutes the heart of the solution. However, there are certain things one should keep in mind while designing the CNN. 2D neural networks are comparatively less complex and hence lesser attention can be given during their design. However, with 3D neural networks, the scenario is completely different. 3D neural networks are much more complex in nature. There are three things to consider while designing a 3D neural network, namely the size of the receptive field, memory consumption, and complexity of the network [5]. The size of the receptive field is proportional to the memory consumption

and training and testing size. A larger receptive field is capable of capturing global features while smaller receptive field is capable of capturing only local features [6]. 2D networks such as U-net have a large receptive field and hence can detect features more a much larger context. Therefore, a trade off had to be considered while designing the CNN.

$3 \times 3 \times 1$ 3D kernels have been used in the design of the CNNs. Twenty 3D kernels of size $3 \times 3 \times 1$ and four 3D kernels of size $1 \times 1 \times 3$ have been used in the design of each of the architecture. Figure 2 demonstrates the architecture of different CNN models as well as the different stages of each of the network. The dilution at each stage is different between the CNN 3 and the other two nets. Three different networks have been used sequentially and hierarchically to segment the 3D MRI images. The segmentation occurs in three different stages and each of the nets is singularly responsible at each stage.

Stage 1 (CNN 1): The multi-modal 3D volumes of the image are first segmented using the first network, i.e., CNN. The CNN 1 produces a localized version of the tumor. In other words, the tumor region is virtually cropped. The result acts as a crisp binary mask for the next stage. In the training stage, the localized region is generated based on the ground truth of the training images.

Stage 2 (CNN 2): The output of the previous network serves as the input of the CNN 2 used in this stage. As the receptive area has now decreased significantly, more detailed features in this region are taken into account by the CNN 2. The result acts as a crisp binary mask for the next stage.

Stage 3 (CNN 3): The output of the previous network serves as the input of the CNN 3 used in this stage. As the receptive area has now decreased significantly, more detailed features in this region are taken into account by the CNN 3. The

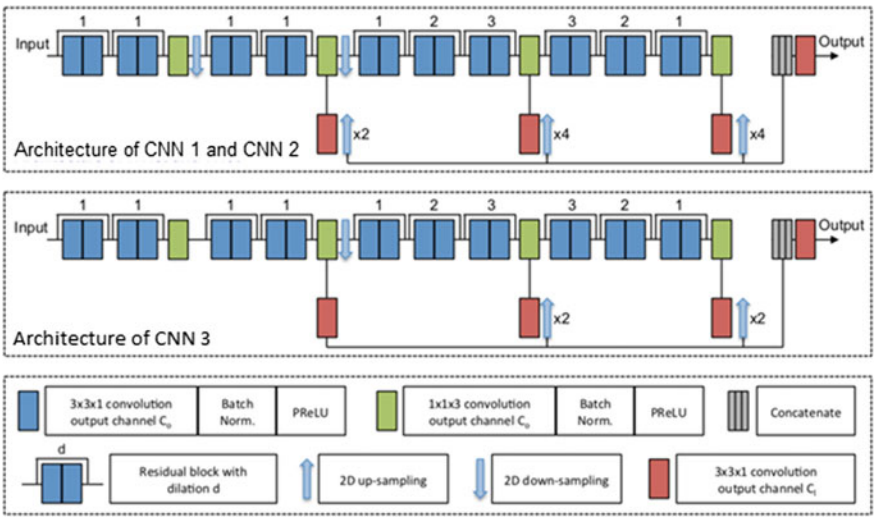

Fig. 2 Architecture of CNN 1, CNN 2, and CNN 3

result acts as a crisp binary mask for the next stage. The first two networks use 20 intra-sliced convolution and four inter-sliced convolution layers with two 2D down sampling layers [7]. Two layers of down sampling are employed to avoid large image resolution.

3.3 Training and Implementation Details

The proposed method is implemented using Python 3.6 in a computer having 4 GB RAM using Windows 7 OS. For deep learning networks, Tensorflow 2.0 and Keras libraries are used and for dealing with MRI images, NiBabel library is used. The training was done on a Computer Nvidia GTX 1050 GPU with 640 CUDA cores. The training time was 2 days while testing of each images took around 5 min.

4 Experimental Results

The proposed algorithm was experimented on Brats 2015 datasets which has total of 274 images in four different modalities:: Flair, T1, T1C, and T2. Out of 274 subjects, 220 HGG and 54 LGG are considered for this evaluation. For the study, 75% of the patients (165 HGG and 40 LGG) were used for training the multiple CNNs models and 25% (55HGG and 14 LGG) were assigned to the testing set. The segmentation involved in extracting the core tumor and enhanced tumor from the flair modalities. Each of the data is given with the its respective ground truth images. All of the images are considered with the original size given as in the Brats dataset, i.e., $240 \times 240 \times 155$.

The model after training was saved and reused every time for testing of images. The resultant segmented images were 3D in nature which meant they had to be viewed using special tools. Fiji (an extended version of Image J) was used to view the slices of the MRI. The slices containing the tumor cells are demonstrated in Fig. 3. The segmented images start segmenting the whole tumor and then proceed to the tumor core and then finally to the enhanced tumor core. The evaluation is measured through the metric dice coefficient which is defined as 2 times of the Area of Overlap divided by the total number of pixels in both images. A few segmented images have been compared with the ground truth to evaluate the dice score coefficient [8] average which was found to be 0.78.

5 Conclusion and Future Scope

3D brain MRI images were collected from the Brats2015 challenge. Three neural networks belonging to the class of convoluted neural networks (CNNs) were

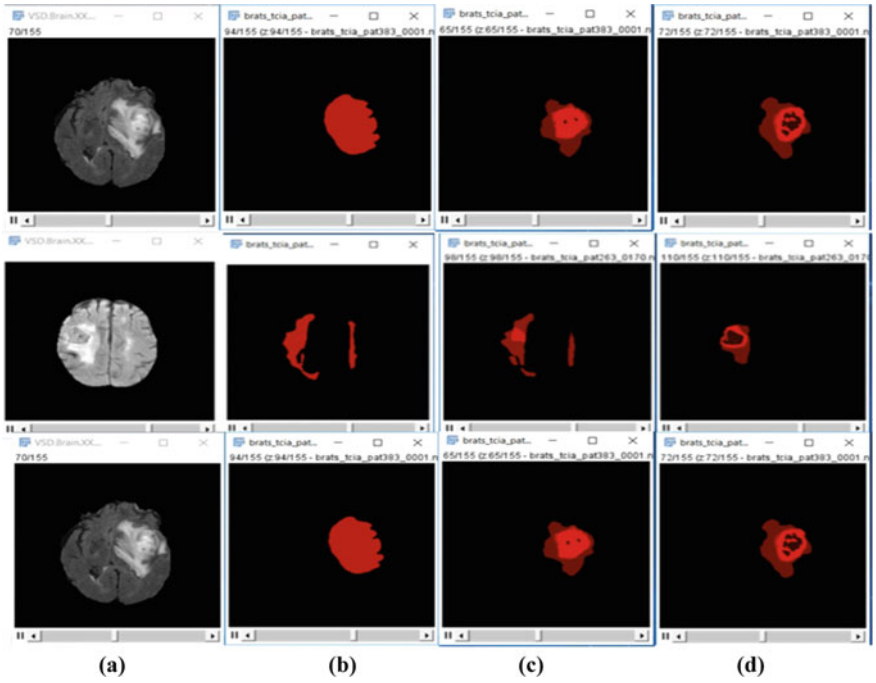

Fig. 3 Segmentation results of proposed algorithm. **a**–**d** Original MRI (Leftmost image), segmentation of whole tumor, segmentation of tumor core, segmentation of enhanced tumor core, respectively

connected having 20 interconnected kernel slices with four down sampling slices to trade off simplicity with feature extraction. The activation function used was Relu [9] and the results obtained were calculated over DICE score coefficient which was found to be decent. Further, we are trying to use all the modalities of the MRI images which has high variability. The framework to be used will mostly depend upon encoder and decoder type of architecture. It can be considered as the limitation of the proposed method as the training stage of the method is time consuming, but the prediction phase works faster for the testing dataset to provide semantic segmentation. This method can segment core and enhanced tumors using deep learning which can compete with the state-of-the-art machine learning methods, but still there is a way to improve the performance by considering different deep learning architecture.

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Invoice Deduction Classification Using LGBM Prediction Model

Laharika Tutica, KSK Vineel, Sushruta Mishra, Manoj Kumar Mishra, and Saurabh Suman

Abstract Deductions are predominantly the short payments done for a generated invoice usually by the customer as a compensation or for the lack of products or services. Possible reasons for deductions to happen include shortage, damage, late delivery, and other-related factors. The machine learning approach has a huge impact on the deduction domain as eliminates the manual effort of a deduction analyst without compromising much on the accuracy. A deduction analyst can save so much on time as now he/she does not have to go through the complex procedure of deduction validity or invalidity. Also this solution will help in speeding up the business process which will lead to customer satisfaction due to on-time delivery. In this research, various machine learning techniques like LGBM and random forest are used for the analysis. It was observed that LGBM model provided optimum result thereby helping business analysts to take decision with respect to invoice payments.

Keywords Deductions · Machine learning · LGBM · Random forest

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1 Introduction

Deductions are predominantly the short payments done for a generated invoice usually by the customer as a compensation or for the lack of products or services. For example, when a customer does not make a full payment to the client as much as the actual amount present in the generated invoice (also called an open invoice), a deduction results. Deductions are also known as dispute or chargebacks; intrinsically, these terms are used in the industry but all are meant to be identical. An example will enlighten us more about the deduction.

There are possibilities of two cases for the cause of deductions which are listed below.

Case 1: An invoice of 100$ is raised by the company *X* (let's assume) to a company *Y* (let's assume) and a payment of 80$ is made by the *Y* to *X* then there comes a difference of 20$ which will result in deduction.

Case 2: An invoice is raised by the company *X* to the company *Y* of 1000$ and due to some discrepancy *Y* do not want to pay any amount (due to some reasons the company does not pay the full amount) then company *Y* will wait for the company *X* to issue credit memo document (alias: credit invoice) worth of 300$ and then the payment is processed for rest 700$.

Fig. 1 depicts an overview of The Deductions Cloud. It is divided into 3 phases, i.e., the company(seller), the work flow and collaboration engine(internet/cloud) and the customer(buyer/payer).

The ERP is the main source where the whole data is stored and accessed by the different organization in a better organized way to do the analysis on variety of data received, the ERP systems basically integrate all the data and process of

Fig. 1 Deduction cloud overview

the organization into one unified system and also helps to automate the business functions.

Deductions cloud enables a proactive deduction management operation, i.e.,

- The solution streamlines processing
- Shortens resolution cycle time
- Reduces processing costs
- Increases recovery rates on invalid deductions
- Provides automation
- Process standardization
- A platform for cross-departmental and customer collaboration.

The processes which are being held in the cloud is to get the clean and cured data which will make a user for the better understanding of the validity of the deduction which is the ultimate result or the solution to be achieved. The cloud also provides the foremost robust automation engine available to capture deduction data from customers and provide the knowledge required for resolution. Backup documentation, like proof of delivery (PODs), bill of lading (BOLs) are captured automatically and linked to the corresponding deductions to scale back manual research. Corresponding trade promotions also are identified and suggested for settlement.

1.1 Reasons Behind Deduction Occurrence

Possible reasons for deductions to happen include the following:

- Shortage: Insufficient amount of goods in the inventory resulting in less number of goods delivered to the customer.
- Damage: Delivery of damaged or defective goods to the customer.
- Wrong products being delivered: Goods might get exchanged or wrongly delivered due to human error.
- Late delivery: Delayed delivery of goods than the expected date.
- Ongoing promotion: Reduction in the price of the goods in order to promote their product or due to early payments by the customer to avail a discount offered by the seller.

One deduction analyzing and dissecting each and every deduction being made to be a valid or an invalid one and also furnishing with apt solutions for every valid deduction is humanly very time-consuming and difficult since the data size is very huge.

Hence, the solution impact on solving the deductions problem using machine learning algorithms is:

- The machine learning approach has a huge impact on the deduction domain as eliminates the manual effort of a deduction analyst without compromising much on the accuracy.

Table 1 Data insights of the invoice data used

Account used	Company (provided by the organization to classify the deductions)	
Dimension	(136,530 × 26)	
Class	0	Invalid deduction
	1	Valid deduction
Class distribution	Invalid deduction (Class 0)	1947 records
	Valid deduction (Class 1)	134,583 records
Invalid deduction ratio	2.7% of the total records	
Features used	['original dispute amount', 'company code', 'deduction created month', 'ar reason code']	
Output label	['fk action code id'] and ['correspondence flag'] **Action code = "Denied to Customer-840, Refused to Pay-843", Correspondence_flag = 1; then that deduction is considered as invalid. (Just an illustration for better understanding.)	
Training data size	Data from January, 1, 2016 to June, 30, 2017 [124,258 records]	
Testing data size	Data from July, 1, 2017 to February, 2, 2018 [12,272 records]	

- A deduction analyst can save so much on time as now he/she does not have to go through the complex procedure of deduction validity/invalidity.
- Many deductions can be sorted out in short span of time effortlessly.
- Also the client can save money by employing less number of deduction analysts for research process, instead those analysts can be put into some other useful work.
- Also this solution will help in speeding up the business process which will lead to Customer Satisfaction due to on-time delivery.

2 Data Insights

See table 1.

3 Explanation of Output Variable

Since it is a problem of supervised binary classification where output variable primarily consists of either '0' or '1' as the integer values by corresponding to the invalid deduction and valid deduction, respectively.

Output Label: Class 0: Invalid deduction
Class 1: Valid deduction

```
df['is_valid'] = np.where((df['fk_action_code_id'].isin([840,843])|(df['correspondence_flag']==1)),0,1)
```

An output variable is created according to the conditions accorded here, the following condition for the deduction to be invalid was Action code = 'Denied to Customer-840, Refused to Pay-843' and 'Correspondence_flag = 1'.

4 Related Work

Smirnov [1] summarized that random survival forests model, which additionally uses historical payment behavior of debtors, performs better in ranking payment times of late invoices than traditional Cox Proportional Hazards model. Tater et al. [2] propose a different approach to the matter and instead of predicting invoice in accounts receivable, they particularize in accounts payable, working on invoices that were already delayed. Similarly, Younes [3] focuses on accounts payable case and attempts to deal with the difficulty of invoice processing time interval, understanding the overdue invoices, and thus the impact of delays within the invoice processing. Invoice payment prediction could even be modeled as a classification problem, but there is just a little body of work that addresses this problem. One of the few works that investigate this is often Zeng [4], where the authors formulate the matter as traditional supervised classification and apply existing classifiers thereto. Dirick et al. [5] tested several survival analysis techniques in credit data from Belgian and Great Britain financial institutions. The matter of predicting invoice payment has been traditionally tackled using statistical survival analysis methods, such as the proportional hazards method [6]. Sushruta et al. [7] developed a resampling-based pre-processing technique to deal with the skewing of unbalanced datasets and classified various sorts of tumor in patients. Soumya et al. [8] used LVQ technique for instance and analyze the clustering deviation issue on carcinoma dataset.

5 Machine Learning Algorithms Used in Study

In this study, some popular and efficient machine learning algorithms are used for binary classification of deductions for invoice which include logistic regression, random forest, and LGBM classifier.

5.1 Logistic Regression

Logistic regression looks almost like rectilinear regression which is borrowed from the sector of statistics like many other machine learning models despite having a

reputation like regression it is not used for predicting the continual values(like height, weight, etc.) rather it is used for the binary classification(like 0 or 1, Yes or No, etc.) problems. This method fits an S-shaped logistic function, i.e., the Sigmoid-Function which is an S-shaped curve which will take any real-valued number and map it into a worth between the range of 0 and 1, but never exactly at those limits. These values between 0 and 1 will then be transformed into either class 0 or 1 employing a threshold classifier. Its ability to supply probabilities and classify new samples using continuous and discrete measurements makes it a 1 of the favored machine learning method. But sometimes, using this system may cause overfitting. And also it gives low predictive performance which is why, despite being a really popular machine learning technique, it is not always relied upon.

5.2 Random Forest

The random forest can work for classification and as well as regression problems. This machine learning algorithm helps to select the required output from the decision trees (Capable to work for both categorical and continuous input and discrete variables) which is the base class of the random forest. This uses a technique of splitting into n number of trees and decides by selecting one class out of it. The multiple trees chooses the classification having the most votes (over all trees of the forest) and when it comes to the regression, the forest takes out the average of outputs of different trees. This learning method has a power of handling large data sets with higher dimensionality. But since this machine learning method generates n number of trees, it needs more computational power and resources which is not cost efficient. The train data set takes longer training time and hence it is not time efficient.

5.3 Light Gradient Boosting Machine (LGBM)

Boosting is an example of ensemble learning and a technique where we convert a set of all the weak learners into strong ones. LGBM is a gradient boosting technique that uses tree-based learning algorithms.

It is designed to be distributed and efficient with the following advantages:

- Faster training speed and higher efficiency.
- Lower usage of memory and comparatively better accuracy.
- Support of parallel and graphical processing unit learning.
- Capable of handling huge-scale data.

This algorithm also helps us to find out the regression problems (for numeric outcomes) and also to find out the classification problems (for categorical outcomes).

Boosting helps to give good weight-age to the data so that we can find some hidden inferences from the data. Gradient boosting is a specialized type of boosting framework—where it performs on reducing error subsequently.

6 Proposed Work

The Workflow performs the following tasks (Fig. 2):

6.1 Data Extraction and Pre-processing of the Invoice Data

The raw data was extracted and acquired from the central database, known as data acquisition. After extraction, the acquired invoice data was pre-processed, i.e., to handle the various missing data, outliers present, and the long tails (data at the extreme ends of the domain range). Once the pre-processing is done, data transformation takes place which involves enriching and standardizing the data, converting the data format compatible with the training algorithms. Later, train-test splitting is performed. Since the entire data cannot be used to train the model which would lead to overfitting of the model and result in wrong predictions for the unknown data with less accuracy rates, the data set is usually split into train data and test data where the test data is kept hidden from the model while training the model.

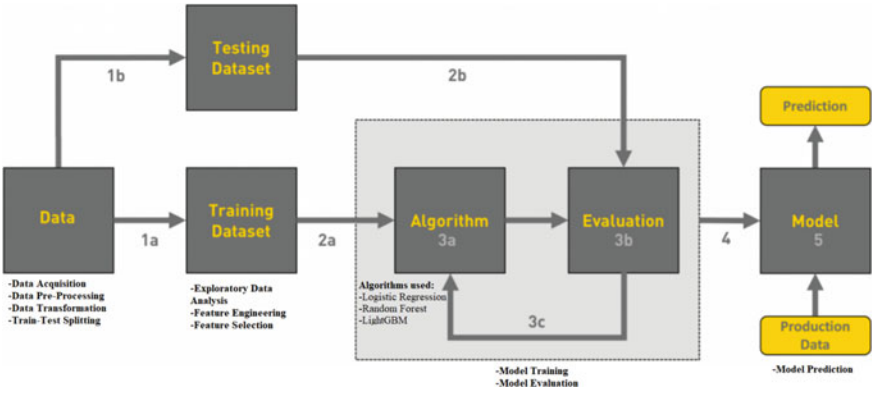

Fig. 2 Workflow of the proposed work

6.2 Training the Invoice Data

The EDA is performed on the train data set to know the past nature. It helps to gain some inferences and insights from the data set and after the EDA, so that, we can have assumptions required for model fit and testing purposes, we can also transform the variables accordingly as and when required. The process of creating new features from the existing columns is called feature engineering. The new features should be created in such a manner that they should have a large impact on the data set to give a good accuracy and metric scores. The features which are taken into the final set of features is called feature selection because the feature importance of those features is good so we should select the features wisely which could help to give a better accuracy rate despite being in a less number.

6.3 Algorithm and Evaluation Using Various Machine Learning Algorithms

Based on the features selected and the problem statement given, various machine learning algorithms could be implied. The algorithm which results in giving the best accuracy and precise metric scores is chosen to be the final technique and the train dataset is trained and evaluated using that particular algorithmic technique. In this proposed work, various machine learning algorithms like logistic regression, random forest, and LightGBM were applied and the best results were found out to be using the LightGBM technique.

6.4 Model Prediction Using the Best Suited Machine Learning Algorithm

Once the machine learning algorithm to be used is finalized based on the recall and precision results calculated, the model is provided with the test data set which is kept hidden from the model while training and the accuracy rate is calculated.

The noted accuracy rate, precision, and recall scores calculated will be the final results obtained.

7 Result Analysis

The system model was implemented with our machine learning classifiers. There are several performance metrics that may be considered for valid and invalid deduction prediction.

Table 2 Precision and recall comparison analysis

Techniques	Class	Precision	Recall
Logistic regression	0	0.03	0.63
	1	0.99	0.74
Random forest classifier	0	0.05	0.82
	1	1.00	0.82
Light Gradient boosting machine	0	0.07	0.83
	1	1.00	0.88

7.1 Recall of Invalid Class

We mainly focused on the recall of invalid class as we did not want to miss out a single invalid deduction because predicting invalid deductions as invalid is our first priority.

7.2 Precision of Valid Class

We want our prediction to be as precise as possible. We wish that every class that we classify as valid should actually turn out to be valid.

Table 2 shows that the precision and recall metrics are comparatively much better and accurate when LGBM Technique is used for the model.

Some **other metrics** taken into consideration.

7.3 Leakage

The metric tells about the percent or value of the loss that may occur while evaluating the deductions for the company, it should be minimal or negligible(i.e. ≤ 0.001).

7.4 Autoclear

The metric tells the predicted deduction (prediction from our side whether the deduction is valid or invalid) is same as to the actual deduction (true value), so here how larger the value will be that accurate our prediction is (i.e., Actual = 1 and Predicted = 1).

Table 3 Leakage, autoclear and effortless metrics

Techniques	Leakage	Autoclear	Effortloss
Logistic regression	0.05097327	65.416986	33.348404
Random forest classifier	0.00016458	17.952017	80.813630
Light gradient boosting machine	0.00869187	51.199582	47.566064

7.5 Effortless

The metric tells the predicted deduction (prediction from our side whether the deduction is valid or invalid) is not same as the actual deduction (true value), so here how small the value will be that accurate our prediction is (i.e., Actual = 1 and Predicted = 0).

Let's visualize and compare the results obtained with regards to these metrics:

Table 3 shows us that when the metrics like Leakage, Autoclear and Effortloss are compared with respect to various machine learning algorithms, LGBM technique gives the best results required. According to the study and research work typical business problem with structured tabular data coming from relational database, the LGBM technique is highly preferable because:

1. Light Gradient Boosting Technique (LGBM) is deployed on the basis of decision trees algorithm and splits up the tree leaf-wise which results in much better accuracy as other boosting techniques splits the tree level-wise or depth-wise which have failed to provide good scores.
2. This technique is very fast when it comes to the time consumption for prediction of accurate results in classification problems.
3. Models while making use of LGBM technique consume less memory.
4. And have a good compatibility with larger data sets, i.e., a significant reduction in training time as compared to **XGB** (eXtreme Gradient Boosting).

Hence, out of many classifier techniques used, the LGBM technique has resulted in the best & accurate values.

8 Conclusion

In recent times, machine learning can be helpful in simplifying the process of invoice generation. Here, in this research, various machine learning models were used and implemented for predicting whether a deduction is valid or invalid. It was observed that LGBM model improves on XGBoost. The LightGBM paper uses XGBoost as a baseline and outperforms it in training speed and, therefore, the dataset sizes it can handle. The accuracies are comparable. LightGBM, in some cases, reaches its top accuracy in under a moment and while only reading a fraction of the entire data set.

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Enhancing Heart Disorders Prediction with Attribute Optimization

Sushruta Mishra, Anuttam Dash, Piyush Ranjan, and Ajay Kumar Jena

Abstract The wide application of machine learning in dominant domains such as marketing, telecommunication, agriculture, and other industries has made an impact on its use in several other time critical applications. Health care is one of the vital sector where machine learning is finding acceptance in disease diagnosis. Though the medical zone is rich in raw information, but somehow not all information are successfully extracted that is needed to disclose uncertain trends & efficient decision making. Extraction of these uncertain patterns and associations usually turns unexploited. Modern optimization methodologies may be helpful in dealing with this scenario. In this research work, it is intended to use classification-based modelling algorithms which include Naïve Bayes, decision trees, artificial neural network (ANN), and support vector machine (SVM) with the use of health-related attributes like age, gender, level of blood pressure, and blood sugar, it can be used in predicting the probability of patients inheriting various disorders related to heart. Eventually, genetic algorithm is used as a feature optimizer which extracts the relevant attributes for classification. It is observed that with the use of genetic algorithm, the classification performance is enhanced with the implementation of the above classifiers.

Keywords Naïve bayes · Artificial neural network · Genetic algorithm · Data mining · Classification accuracy

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1 Introduction

The process of extracting out the patterns, trends, and structures within the data available in pre-existing databases and thereby using them to build statistical models for generating information from them is known as data mining. In order to extract hidden patterns and structures within the data, it uses several disruptive technologies like statistical learning, machine learning, database technologies, etc. According to the report of World Health Statistics 2012 report, one in every three adults across the world has high blood pressure condition which is responsible for triggering almost half of the total number of deaths caused due to heart disease. Cardiovascular disease (CVD) is the major reason which generally influences not only the heart attack but also heart. Heart, one of the important muscular organs facilitates pumping of blood in the entire human body. Stroke, coronary heart disease, and cardiovascular diseases are the widely known examples of heart diseases. A condition of human heart caused due to contraction and hardening of the blood vessels connected to the brain or also sometimes by high blood pressure [1, 2] is referred to as a stroke. A lot of casualties are reported only due to heart diseases not only in India but also in other countries. In USA, an individual at every 34 s dies due to a heart disease. Some types of heart diseases are cardiomyopathy, coronary heart disease, and cardiovascular disease. Cardiovascular disease affects the heart by disturbing the routine of blood circulation in the human body. Thus, there is a need for efficient and accurate diagnosis. The doctor's experience and knowledge are determinant of the accuracy of the diagnosis of the disease, it might lead to unwanted treatment costs in some cases. Thus, there is a need for an automatic medical diagnosis system. This paper is an effort to elaborate various information extraction methods that may be used in these intelligent model-based systems.

2 Literature Survey

A Web-based automated system which uses different kinds of health-related attributes like age, gender, blood pressure level, blood sugar level, etc., which help in predicting occurrence of a heart disorders in an individual [3]. The complex what-if queries are addressed by the Naïve Bayes algorithm. The platform in which the system has been made is PHP which further makes it flexible and expandable. Hybrid approaches are found to be more efficient and accurate than a single model in terms of predicting heart diseases which is again confirmed by survey [4]. The data mining techniques that have been evaluated by the author using accuracy and sensitivity [5] as measures are namely artificial neural networks (MLP), Naïve Bayes, decision tress (C4.5). We observed that a greater number of attributes result in a better performance of Naïve Bayes, artificial neural networks than decision trees. The efficiency of different algorithms of decision trees like C5.0, ID3, C4.5, and J48 in predicting the different kinds of heart disorders has been identified [6]. ID3 mainly aims to construct decision trees

by using a definite number of instances of training. J48 decision tree has been built on top of ID3 algorithm. The latest version of ID3 algorithm is C4.5 to which C5.0 is an extension. Attribute selection measure results in the split criteria: Information gain can be complimented by the algorithms performance: K-NN, neural network, Naïve Bayes, decision tree which is used in the heart disease samples [7].Some of data mining techniques utilized for diagnosing heart diseases are Simple Cart, Bayes Net, J48, Naive Bayes and REPTREE [8]. We have used classifiers like decision tree, Naïve Bayes, classification by clustering [9] to identify heart diseases. To reduce the features from 13 to 6, we have used genetic model. It was observed that among the three classifiers: Naive Bayes, Simple Cart and REPTREE, Naive Bayes is found to be the best. By using clustering and integration of feature subset selection and with high construction time, a better attribute reduction with considerably same construction time has been achieved by Naive Bayes as compared to the other two classifiers. We have intended to broaden our work to predict the severity of the disease by using fuzzy numerous techniques of data mining such as association rules, cluster analysis, classification, fuzzy systems [10].

3 Data Source

To predict the possibility of heart disease in an individual, we use health profiles like age, blood pressure, blood sugar, sex, etc. It helps in the exploration of different important aspects like patterns and structures within the health factors related to heart disease. We have used open-source heart disease database to predict the possibility of heart disease in an individual based off of his health attributes as shown in Table 1.

4 Proposed Work

The proposed work as illustrated in Fig. 1 constitutes the significance of feature optimization on the classification performance of heart disease prediction. Here, classifiers used are decision tree (DT), artificial neural networks (ANN), Naïve Bayes (NB), support vector machine (SVM). The heart disease data samples are gathered from UCI repository and the anomalies are eliminated. It is divided into the respective training and testing set of data. On the one hand, the input data is directly subjected to classification through the above classifiers and their performance is determined by using classification rate metric. On the other hand, the dataset is implemented using genetic algorithm as the attribute optimizer. It identifies and removes the less relevant attributes and the result is an optimized dataset. This optimized data is applied to classifiers for performance analysis. It is observed that genetic algorithm optimizes the heart disease dataset and the performance of classification is enhanced.

A popular classifier that is quite simple and easy in terms of implementation is decision tree. High-dimensional data can be easily handled with no requirement of

Table 1 Heart disease dataset

Attribute	Description
Age	Age in years
Sex	Sex (1 = male; 0 = female)
cp	Chest pain type
trestbps	Resting blood pressure
chol	Serum cholestoral in mg/dl
fbs	(fasting blood sugar >120 mg/dl)
restecg	Resting electrocardiographic results
thalach	Maximum heart rate achieved
exang	Exercise induced angina
oldpeak	ST depression induced by exercise relative to rest
slope	The slope of the peak exercise ST segment
ca	Number of major vessels (0–3) colored by flourosopy
thal	3 = normal; 6 = fixed defect; 7 = reversable defect
num	Diagnosis of heart disease

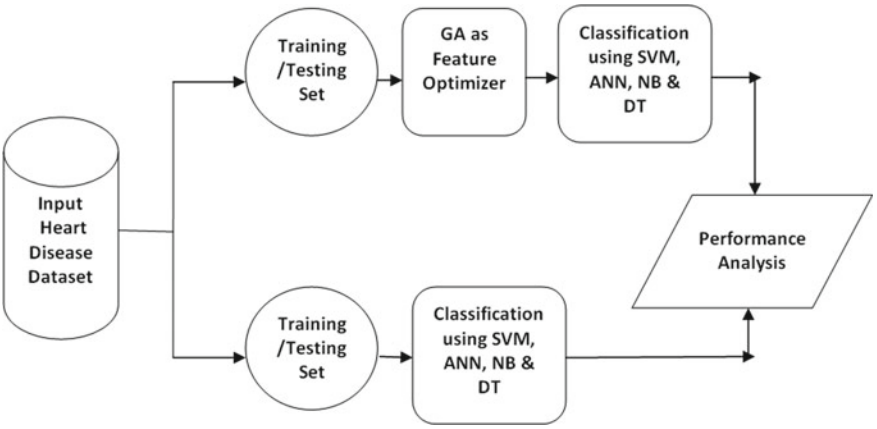

Fig. 1 Proposed system model for heart disease prediction

domain or parameter knowledge. The results produced are very easy to interpret and readable. Decision trees are used to go through the features to analyze the patient's profile. Naïve Bayes is a classifier model that considers zero dependency among attributes. Naive Bayes assumes that the value of attributes in a given class is independent of other attribute values which is also known as conditional independence. We do not require any Bayesian methods in order to work with Naïve Bayes. This is also considered to be the advantage of Naïve Bayes.

Genetic Algorithm [5] is a natural evolutionary methodology. The genetic algorithm is a population-based search which starts initially with zero number of attributes and an initial population which is created by random generation rules. It is based on the idea of reproduction, natural selection, and survival of the fittest. Parents produce off-springs using genetic cross-over, mutation, and selection. The process continues to a point where it produces a population P with evolution where each and every rules of P is satisfied by the fitness value threshold. We take initial population size of 20 instances, probability of cross-over as 0.6, and probability of mutation as 0.033 and the process continues for twentieth generation. We get a total of six attributes from an initial 13 number of attributes by using genetic algorithm. Finally, after getting six attributes from initial 13 attributes by attribute reduction, we use different classifiers on the dataset to predict the heart disease.

5 Results Analysis

Here, various classification algorithms are presented and implemented for determining classification performance of heart disease data samples. The first analysis comprises of using classifiers alone without using any attribute optimization method like genetic algorithm. It is observed that classification with artificial neural network gives the best classification accuracy rate of 89.7% while support vector machine produces the least accuracy rate of 84.2% as shown in Fig. 2. In the second analysis as shown in Fig. 3, genetic algorithm is used as an attribute optimization tool. Here, again it is observed that using genetic algorithm with artificial neural network produces the optimal classification performance with 90.6% accuracy rate. Also with support vector machine, it is seen that the classification efficiency is the minimum with 87.8%.

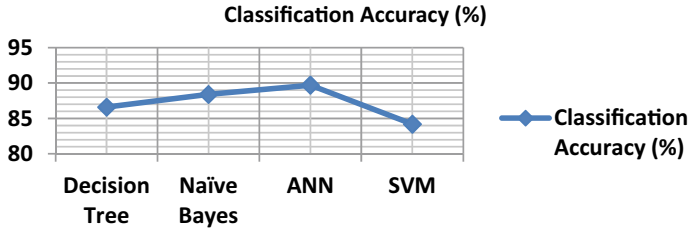

Fig. 2 Classification without attribute optimization

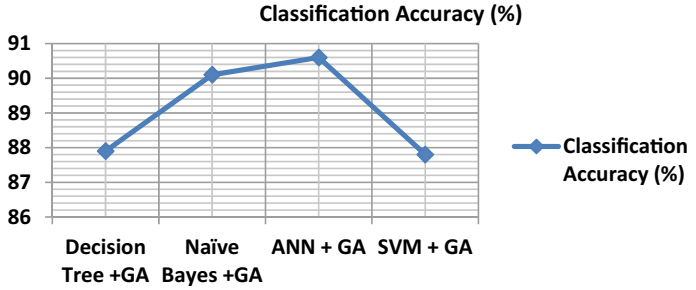

Fig. 3 Classification with genetic algorithm as attribute optimization

6 Conclusion

The objective of this paper is to discuss the different techniques of data mining that could be used to predict the presence of heart disease. Analysis suggests that different technologies that use different number of attributes reach results of varying accuracy. The accuracy depends on tools used for implementation. Additionally, genetic algorithm has been used as the attribute optimization agent. We observed that the use of genetic algorithm is helpful in optimization of classification performance of heart diseases. Although there are evidences of successful application of techniques of data mining to help the healthcare professionals or doctors to diagnose heart diseases, this paper provides a faster and simpler data mining model. The model has been developed by thoughtful analysis of different prediction models in data mining with the objective of finding the greatest model for further work.

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Variable Optimization in Cervical Cancer Data Using Particle Swarm Optimization

Lambodar Jena, Sushruta Mishra, Soumen Nayak, Piyush Ranjan, and Manoj Kumar Mishra

Abstract Samples of data may consist of numerous attributes and variables which are irrelevant and redundant. Some of those attributes may not be of any vital use in classification and the irrelevant attributes can decrease the efficiency. Thus, the feature reduction process can be considered as a problem in machine learning which selects less quantity of vital attributes to obtain higher accuracy rate. This process minimizes the attributes count by eliminating less relevant and noisy samples from the data set to achieve better classification accuracy. This work uses particle swarm optimization (PSO) search algorithm for feature reduction in cervical cancer data set. The experimental result shows that the irrelevant features are removed and only 17 useful features are selected, out of which 36 in the cervical cancer data set.

Keywords Particle swarm optimization (PSO) · Feature reduction · Machine learning · Data mining

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1 Introduction

In the domain of machine learning, classification is one of the important functionalities that help in categorizing every instance of data samples on the basis of attributes. There are several classification problems where numerous attributes are not needed to yield optimal prediction rate. Sometimes, it is tough to identify the usefulness and relevancy of attributes without prior knowledge in a huge data set which consists of many features. Hence in these scenarios, attribute optimization is a effective pre-processing medium to handle classification problems. Attribute optimization is helpful in reducing the number of attributes and thereby minimizing the training period enhancing the performance of classification. Global search approach is an effective technique used to handle attribute selection issue with more efficiency. Evolutionary computation methods are popular for their global search capability. Among the widely used evolutionary approaches, particle swarm optimization (PSO) is most frequently used technique which is based on swarm intelligence. It is comparatively less expensive and quickly converge. Hence, PSO technique is an effective technique which can be successfully applied as an attribute optimization tool.

2 Background

Kennedy and Eberhart [1] have discussed a population-based stochastic optimization method called particle swarm optimization (PSO). PSO helps in simulating social behaviour of living organisms like fish schooling and bird flocking which analyses an automated evolving system model. Here, every single candidate solution is termed as a particle in entire search space. Every particle makes optimum use of its individual memory and skills obtained by the swarm to determine the optimal solution. Every particle is associated with fitness values and these are demonstrated through a fitness metric which is to be maximized and possess velocities which help in movement of these particles. Every particle adapts itself as per its own experience and its neighbouring particle's experience which helps itself in adjusting its position. It thus makes use of the optimum coordinate faced by itself as well as its neighbour. These particles traverse through the search space by following the direction of these optimum particles. The random population of these particles is randomly distributed throughout search space so as to create the initial swarm population. After each round, updation of a particle takes place by the use of two optimum values which include pbest and gbest. Coordinate position of every particle is tracked in domain of the problem that is normally associated to the optimal solution that has obtained the most by the particle. This value(fitness) is restored and is termed as pbest. In case the entire population is considered as a topological neighbour of a particle, its best value is termed as gbest value which is the global best value. The overall pseudocode of PSO algorithm is noted here.

```
P = Particle_Initialization();
For i=1 to it_max
  For each particle p in P do
    fp = f(p);
    If fp is better than f(pBest)
        pBest = p;
    end
  end
  gBest = best p in P;
  For each particle p in P do
     v = v + c1*rand*(pBest – p) + c2*rand*(gBest – p);
     p = p + v;
  end
end
```

3 Related Work

Several attribute optimization approaches have been developed in recent times. A hybrid algorithm, SAGA, has been used by Gheyas et al. [2] to search for an optimum attribute set among a high dimensional space of feature. Unler et al. [3] have used a modified discrete particle swarm optimization (PSO) algorithm which dynamically extracts the significance as well as association of the attributes involved in the subset of features. Liu et al. [4] have suggested an improved method for feature selection by integrating multi-swarm PSO and support vector machines (SVM) with F-score method for better prediction accuracy. Sushruta et al. [5] discussed the impact of data redundancy and replication on the overall performance of clustered wireless sensor networks. Hodashinsky et al. [6] have presented a hybrid mechanism for attribute selection on the basis of a combination of random and heuristic search strategies. Recently, EC techniques are being applicable in handling attribute selection problems like GAs, GP, and ant colony optimization (ACO). Chakraborty et al. [7] proposed a feature selection algorithm based on GAs, using a fitness function based on fuzzy set. In [8], it is proposed that the same fitness function PSO achieves better result (performance) than GA algorithm. Several research outcomes have demonstrated that PSO technique is an effective search approach to select relevant attributes. Thus, we have used PSO for feature selection in our data set. For feature reduction using PSO, we have used cervical cancer data set. The cervical cancer data set comprises historic medical records, habits, and demographic information of 858 patients on 36 attributes. The PSO search with correlation-based feature selection (CFS) is a subset evaluator (an attribute subset evaluator) and the data set taken is tested for feature selection. The PSO search evaluates all training data initially. Later, it works with the following parameters shown in Table 1.

4 Result and Discussion

The result of feature selection based on cervical cancer data set using PSO search algorithm is shown below. Merit corresponds to the error rate of classification. Similarly, the scaled fitness of each chromosome is reported in the scaled column. Here, the linear scaling techniques are used to scale the values. Tables 2 and 3 show the result of initial population and result of generation 20, respectively.

Table 1 Evaluation parameters

Parameters	Values
Initial samples:	Empty set
Population set:	20 chromosomes
Count of rounds:	20
Mutation kind:	Bit-flip
Mutation probability:	0.01
Inertia density:	0.33
Social density:	0.33
Individual density:	0.34
Report count:	20
Quantity Seed:	1

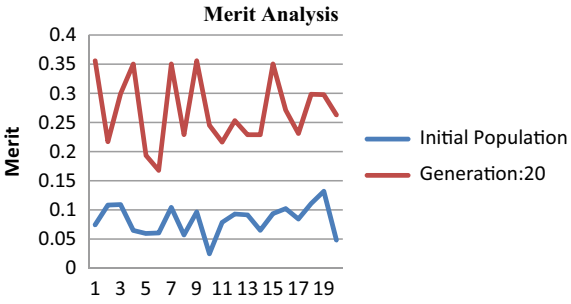

Fig. 1 Merit value analysis at initial population and at generation 20

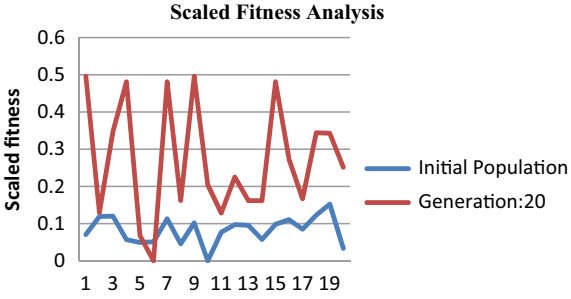

Fig. 2 Scaled fitness value analysis at initial population and at generation 20

Table 2 Initial population

Merit	Scaled	Subset
0.07436	0.07077	4 9 15 17 20 21 30 31
0.10803	0.11873	3 5 6 9 10 12 17 19 25 28 29 35
0.10886	0.1199	6 8 9 11 12 16 25 27 32
0.06476	0.0571	2 8 16 17 20 21 24 25 27 29 30 31 32
0.05938	0.04945	1 26
0.06029	0.05074	4 16 29
0.10405	0.11305	2 4 5 6 7 9 10 12 13 14 15 16 17 19 20 21 22 23 24 32 33 34 35
0.05691	0.04593	1 2 13 17 22 27
0.09642	0.10219	13 25
0.02466	0	7
0.07856	0.07676	4 12 15 18 21 22 34
0.09281	0.09705	1 4 5 6 9 10 11 14 17 18 19 20 22 24 27 28 30 31 32 33
0.09143	0.09509	5 6 7 10 11 13 14 15 16 18 20 23 24 26 28 29 31 32 33 35
0.06486	0.05725	1 3 5 7 10 12 15 18 19 21 23 26 29 32 35
0.09361	0.09818	1 4 5 6 23 31 34
0.10216	0.11036	3 4 5 6 8 9 12 17 20 22 24 26 27 30 31 33 35
0.08438	0.08505	1 2 3 4 5 6 8 9 11 12 13 16 18 20 22 25 26 27 28 29 30 31 32
0.11081	0.12268	1 2 5 6 7 9 10 12 14 17 18 19 20 23 29 30 31 32 34
0.13178	0.15255	2 4 5 6 9 11 12 13 18 19 20 23 24 26 27 29 32 33
0.04813	0.03342	8 11 21 24 26

The PSO search algorithm selects 17 relevant features out of 36 features in the original data set. The attributes selected by PSO search are: {9, 12, 13, 14, 17, 18, 20, 23, 25, 26, 29, 30, 31, 32, 33, 34, 35}. That is, the selected attributes are {Hormonal Contraceptives, STDs, STDs (number), STDs: condylomatosis, STDs: vulvo-perineal condylomatosis, STDs: syphilis, STDs: genital herpes, STDs: HIV, STDs: HPV, STDs: Number of diagnosis, Dx: Cancer, Dx: CIN, Dx: HPV, Dx, Hinselmann, Schiller, Citology} from the data set. The attributes which are reported by PSO search as irrelevant are neglected here. The merit and scaled fitness comparison analysis of initial population with generation 20 is shown in Figs. 1 and 2, respectively.

5 Conclusion

This work uses PSO search algorithm to perform feature selection. For an efficient classification model, pre-processing like feature reduction and dimensionality reduction is required. Experimental results show the process of feature subsets in different

Table 3 Values of generation 20

Merit	Scaled	Subset
0.35569	0.49604	12 13 14 17 18 20 23 25 26 29 30 31 32 33 34 35
0.21682	0.12964	4 9 12 13 14 17 18 20 21 23 25 26 29 30 31 32 33 34 35
0.2992	0.34698	4 12 13 14 17 18 20 23 25 26 29 30 31 32 33 34 35
0.35008	0.48123	12 13 14 17 18 20 23 25 26 30 31 32 33 34 35
0.19335	0.06771	6 12 13 14 16 17 18 20 23 25 26 29 30 31 32 33 34 35
0.16768	0	4 8 10 12 13 14 17 18 20 22 23 25 26 30 31 32 33 34 35
0.35008	0.48123	12 13 14 17 18 20 23 25 26 30 31 32 33 34 35
0.22903	0.16185	11 12 13 14 17 18 20 23 25 26 28 29 30 31 32 33 34 35
0.35569	0.49604	12 13 14 17 18 20 23 25 26 29 30 31 32 33 34 35
0.24506	0.20415	4 11 12 13 17 18 20 23 25 26 29 30 31 32 33 34 35
0.21628	0.12822	9 11 12 13 14 17 18 20 23 25 26 30 31 32 33 34 35
0.25301	0.22513	4 12 13 14 18 20 23 25 26 27 29 30 31 32 33 34 35
0.22886	0.1614	9 12 13 14 17 18 20 21 23 25 26 29 30 31 32 33 34 35
0.22887	0.16143	9 12 13 14 17 18 20 23 25 26 29 30 31 32 33 34 35
0.35008	0.48123	12 13 14 17 18 20 23 25 26 30 31 32 33 34 35
0.27118	0.27307	12 13 14 17 18 20 23 25 26 27 29 30 31 32 33 34 35
0.23095	0.16693	11 12 13 14 18 20 23 25 26 27 30 31 32 33 34 35
0.29811	0.34412	12 13 14 17 18 20 23 25 26 30 31 32 34 35
0.29763	0.34285	4 12 13 14 17 18 23 25 26 29 30 31 32 33 34 35
0.26295	0.25135	11 12 13 14 17 18 20 23 25 26 30 31 32 33 34 35

generations. Finally, our method produces the much needed effective features that will be used for classification task. Taking relevant attributes selected by PSO search in to consideration is the objective of our further study. In future, the model can be compared to other feature selection methods. Also, classification algorithms can be implemented after feature selection.

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A Hybrid DTNB Model for Heart Disorders Prediction

Soumya Sahoo, Mamatarani Das, Sushruta Mishra, and Saurabh Suman

Abstract The cardiac disease plays a major cause of death worldwide. The medical experts are facing the difficulties to foresee the heart attacks, because it seems to be a complicated job and also requires huge skill and knowledge. Today's health division consists of some crucial information which becomes significant to make decisions. To predict heart attacks disease, algorithms like J48, Naïve Bayes, REPTREE, CART, and Bayes Net of data mining get used and also applied in this research. The study result shows 99 percent predictive accuracy. Data mining allows trends in the data set to be predicted by the health sector.

Keywords Heart disorders · Decision tree · REPTREE · Naïve bayes · SMOTE

1 Introduction

Classification is a widespread problem in current scenario that includes many diverse applications. The objectives of data classifying method are for forecasting exactly the goal label or category for the given structured dataset. The foremost confront is to face many healthcare organization is to provide eminence service such as correct diagnosis of patients and providing treatments at sound costs. Data mining technique carries solutions to a number of important and vital healthcare issue. Doctors must need to foresee heart disease prior to the suffering of patients [1]. Reasons

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raising the chances of heart attack involve smoking, short of physical activity, high BP along with cholesterol, unhealthy diets, too much alcohol use, more sugar level, etc. [2, 2]. In general, the findings of cardiac disease are related to multifaceted grouping of medical and pathological data, resulting in extreme health check costs that affect the value of health supervision [4]. For heart disease prediction in the last decades, data mining was playing an challenge for every researcher. A visible and effective approach in the study of classification of heart disease is to search the conceal clinical information among various expressions of the fit and the heart-diseased persons of the present clinical data. Classification of heart syndrome gives the essential root for patient treatment. Machine learning and Statistics are two key methods to predicting the scenario of cardiovascular trouble base on clinical data [5, 6]. In this regard, data mining plays as a good model for forecasting of mentioned disease [7].

2 Literature Survey

The investigators [8] implemented patterns identification and ways of information processing in forecasting model within the sphere of heart-related diagnose. The investigations were implemented by the use of Naïve-Bayes, decision tree, k-nearest neighbourhood along with ANN classifier and the outcome demonstrates that Naïve Bayes technique performed better than other implemented techniques. Investigators [9] use the k-means clustering algorithm in a heart disease store for extracting information related to heart disease, and apply the MAFIA algorithm (maximum repeated element set-algorithm) to algorithm to compute weightages of the repeated pattern related to heart failing rate forecasting.. The researcher [10] suggested a diffuse neuronal layer method to foresee appearance of simulated coronary heart disease in the MATLAB. The researchers [11] suggested a new approach to mining association rules related to the sequential numbers and the set of transactional data pooled for coronary illness forecasting. Implementation method of the this specific method was done in programming C language and the system's primary memory necessity was less. The specialists [12] utilized the information mining calculations REP tree, Bayesian network, recurrent network, association-classification along with evolutionary approach for anticipating as well asinvestigating coronary illness in terms of heart disease from the available data. Experimentation done in [13] by the investigators in a data set created a replica using neural networks and fusion of intelligent model, where the results show that the fused intelligent model enhanced the correctness of the forecast The researchers [14] prepared class association rules using the selection of subsets of features to forecast a model of heart disorders. The rule determines the association among the value of the features and the classification forecast the divisions in the patient data set. Here, heart disorders samples are used as depicted in Table 1 where total of 303 instances are present among which 164 are that of healthy people while 139 belonged to heart disease. Fourteen medical characteristics are being registered for every case.

Table 1 Heart-C dataset details

Attribute	Details	Values
Age	Age value	Continuous
Gender	(1 = male; 0 = female)	0, 1
CP	Chest pain type	1, 2, 3, 4
Tresbp	Resting blood pressure(in mm Hg)	Continuous
Chol	Serum cholesterol in mg/dl	Continuous
Fps	(Fasting blood sugar 0.120 mg/dl) (1 = true; 0 = false)	0, 1
Restec	Electrocardiography results	0, 1, 2
Thalah	Highest achieved heart rate	Continuous
Exng	Exercise inducing angina (1 = yes; 0 = no)	0, 1
Oldpk	ST sadness induce due to doing exercise relative to rest	Continuous
Slope	The slope of the peak exercise	1, 2, 3
Ca	Count of major vessels (0–3)	Continuous
Thal	Normal, fixed defect, reversible defect	3, 6, 7

3 Proposed Work

Our research constitutes development and implementation of a hybrid classification technique for effective predicting the heart diseases disorders in the sufferers. Raw dataset comprises of 303 samples of patients. Once the data samples are cleansed, it is subjected to preprocessing using SMOTE method. It results in eliminating any missing values and inconsistencies in the dataset. The synthetic minority oversampling technique (SMOTE) is an vital method to oversample the positive division or the minority class. The resultant dataset is applied to two separate techniques. In the first technique, it is applied to both Naïve Bayes and decision table separately. In the second technique, it is subjected to a hybrid grouping of both Naïve Bayes and decision table called as DTNB classifier. In this study, a hybrid integration of decision table and Naive Bayes called DTNB classifier is used. In each round, this classifier partitions the features of datasets into two distinct sub-samples of data on merit basis. One sub sample is for naive bayes while the other one is for decision table. Then a forward selection procedure is applied where the chosen variables of dataset are evaluated by Naive Bayes as well as the remaining data are modelled by decision table. Subsequently, in every phase of the process, a less relevant attribute is eliminated from the attribute set. The performance analyses of both cases are taken into account. Several performance indicators are used for this purpose like error rate, accuracy rate, etc. The proposed model is represented in Fig. 1.

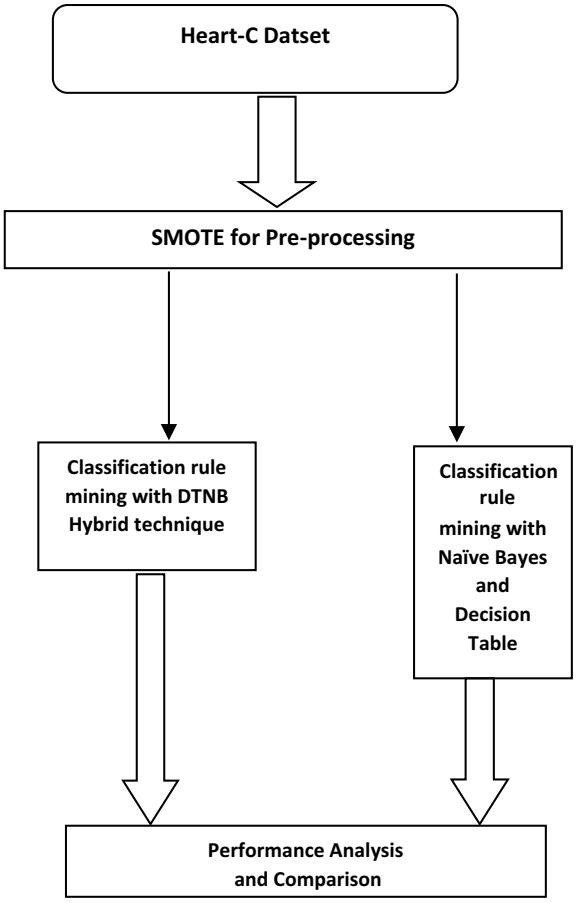

Fig. 1. Proposed DTNB model for heart disorders prediction

4 Results and Discussions

Our result is based on analysis of Heart-C dataset on machine learning algorithms. We have applied SMOTE as a filtering technique to eliminate the redundant attributes and get an optimized result set. There exist two scenarios here. In the first case, no filtering technique has been used while in the second case, SMOTE is used as a pre-processing method. Various performance metrics are applied to estimate the efficiency of the developed model. As it can be seen the classification accuracy is the most optimal with DTNB classifier with 85.3741% when no filtering technique is applied. When SMOTE is applied to the dataset, the classification accuracy has increased to 89%. The error rate is computed in the form of mean absolute error (MAE). The MAE value for DTNB is found to be 0.1051 while when preprocessing is applied, it was 0.1141. The kappa statistics without preprocessing is 0.6836 but

Table 2 Heart-C dataset analysis

Classifier	Accuracy	MAE	Kappa statistics	RMSE	Delay (in seconds)
NB	85.034	0.0657	0.6727	0.2179	0.03
DT	83.333	0.122	0.6738	0.2352	0.13
DTNB	85.3741	0.1051	0.6836	0.218	0.88

Table 3 Heart-C dataset analysis

Classifier	TP rate	FP rate	Precision	F-measure	MCC
NB	0.850	0.183	0.849	0.850	0.673
DT	0.833	0.197	0.833	0.833	0.638
DTNB	0.854	0.165	0.864	0.858	0.697

on applying SMOTE technique it is determined as 0.7807 as shown in figure. The F-measure metric is an effective parameter to evaluate the effectiveness of a classifier. Without SMOTE, its value has been evaluated to be 0.858 while when SMOTE is applied, it is calculated as 0.894. The latency analysis is also performed to test our developed model response time. Without SMOTE, the delay is 0.88 with DTNB classifier. When SMOTE is applied, it is 0.02 which is even minimum. The results are presented in following figures.

4.1 Result Analysis Before Using SMOTE

See Tables 2 and 3.

4.2 Result Analysis After Using SMOTE

See Tables 4 and 5; Figs. 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11.

Table 4 Heart-C dataset analysis

Classifier	Accuracy	MAE	Kappa statistics	RMSE	Delay (in seconds)
NB	87	0.0573	0.7384	0.1871	0.03
DT	86.75	0.1096	0.7352	0.2161	0.27
DTNB	89	0.1141	0.7807	0.2076	0.02

Table 5 Heart-C dataset analysis

Classifier	TP rate	FP rate	Precision	F-measure	MCC
NB	0.870	0.133	0.870	0.870	0.739
DT	0.868	0.129	0.870	0.868	0.737
DTNB	0.890	0.104	0.900	0.894	0.790

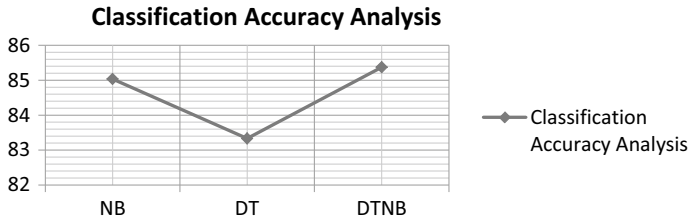

Fig. 2 Classification accuracy analysis without SMOTE technique

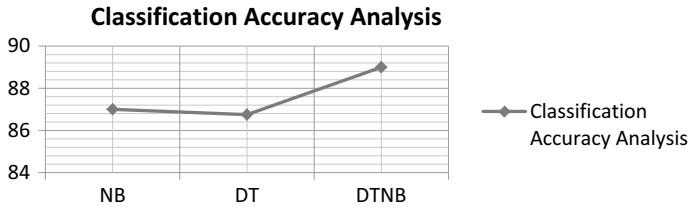

Fig. 3 Classification accuracy analysis with SMOTE technique

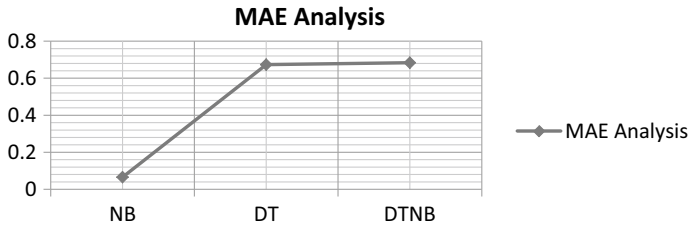

Fig. 4 MAE analysis without SMOTE technique

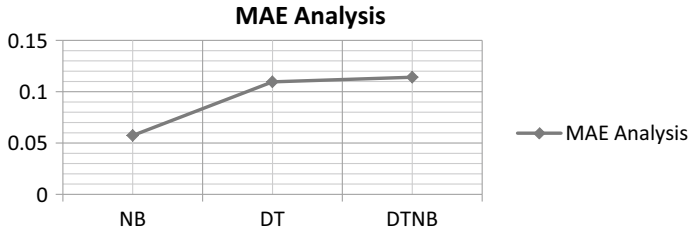

Fig. 5 MAE analysis with SMOTE technique

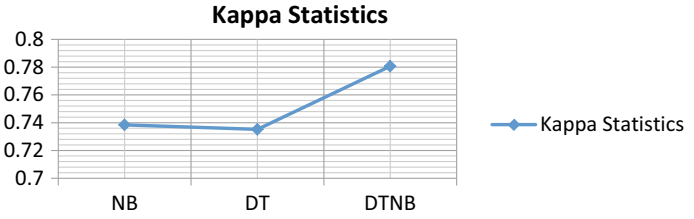

Fig. 6 Kappa statistics analysis without SMOTE technique

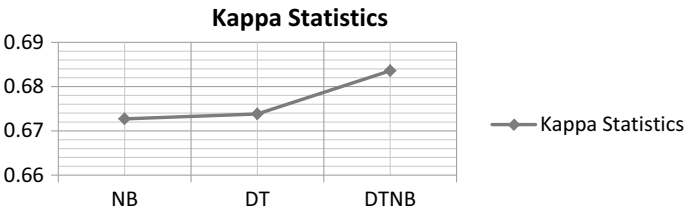

Fig. 7 Kappa statistics analysis with SMOTE technique

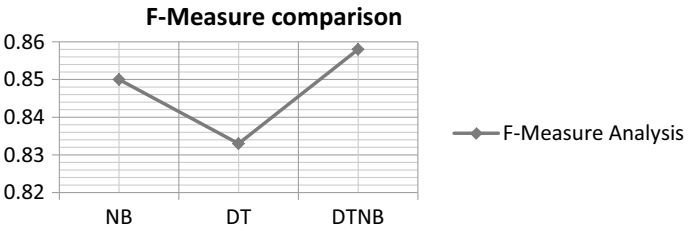

Fig. 8 F-measure analysis without SMOTE technique

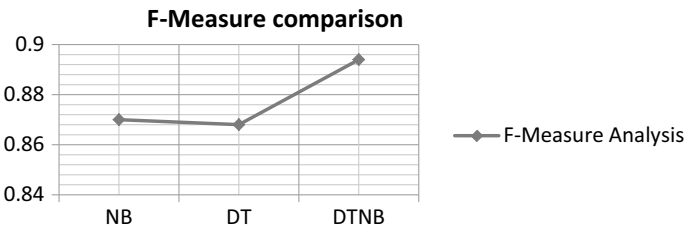

Fig. 9 F-measure analysis with SMOTE technique

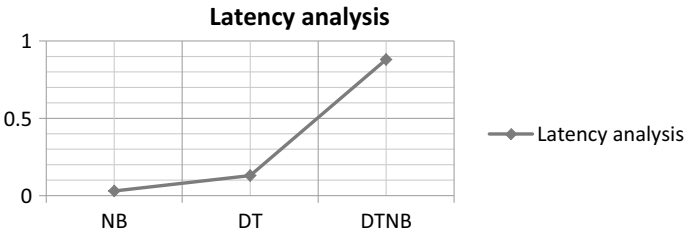

Fig. 10 Latency analysis without SMOTE technique

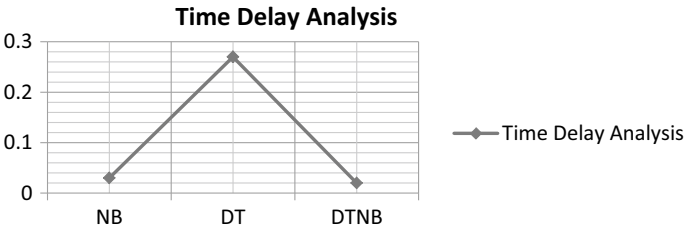

Fig. 11 Latency analysis with SMOTE technique

5 Conclusion

Heart sickness is the majority and widespread donor of transience in India. Recognition of chief hazard factor, increase of decision support systems, effectual control events, and clinical teaching program may turn down the heart diseases mortality. Classification plays a vital role in the fast rising area of information mining. Different issues addressed in various fields like industry, science, and health may be considered as categorization problems. In this work, we have developed and implemented a hybrid data mining model which is a grouping of both Naïve Bayes and decision tree called DTNB model. It is observed that this new classification model works effectively in determining the heart risk factors; thus, it can assist the medical experts in efficient diagnosis of heart patients.

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Comparative Study of AHP and Fuzzy AHP for Ranking of Medicinal Drugs

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Abstract Evaluation of healthcare policies and taking decisions with regard to complex problems require assessments at many levels and by a group of experts. This paper studies the selection criteria and their weights for the five drugs for metastatic colorectal cancer treatment. A comparative value assessment of the drugs was conducted with the analytic hierarchy process (AHP) and the fuzzy analytic hierarchy process (Fuzzy AHP) techniques of multi-criteria decision making. The ranking scores of all the alternative drugs have been examined and the implications of the vagueness in the decision making have been scrutinized for both the AHP and Fuzzy AHP.

Keywords Fuzzy set theory · Healthcare management · Multi-criteria decision making

1 Introduction

Public healthcare facilities are a determining factor in the overall development of the country [1]. Providing in-time healthcare services based on the peculiarity of admissible diseases and demographic information increases the extent of the impact. Human bias, error, and behavioural uncertainty in the decision making have led to irreversible damage in the past [2]. Implementation of an expert opinion-based

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mathematical model for taking the decision related to healthcare policies provides an optimized practical system for solving real-life problems. The rightful assessment of the impact of all the contributing factors helps is weighing the alternatives available. In the view of drug procurement, formulation of healthcare policies and inventory management at hospitals, this paper studies extent of impact of the selection criteria of drugs for metastatic colorectal cancer from five alternatives: "Bevacizumab", "Cetuximab", "Panitumumab", "Aflibercept", "Regorafenib" as taken up by Jason Chia-Hsun Hsieh et al. [3] in their study and this paper considers the same weights. The reviews of the first expert from the National Health Insurance Administration (NHIA) and the sub-criteria weights allotted by the first subject have been considered for simpler reasoning. This paper illustrates the comparison between AHP [4] and Fuzzy AHP [5] for decision making where each medicine has been studied on the basis of clinical, economic, and societal dimensions. Learning the process of hierarchical structuring through the decomposition of the problem into goals, criteria, sub-factors, and alternatives for selecting the most suitable alternative for the treatment.

As per the UN report [6], nearly half of the globe fails to receive essential medical facilities. Thus, efficient management of funds in health care, especially for the procurement of essential medicines is necessary. The effectiveness of subjective bias and varying opinion in healthcare decision making has been studied which results in the introduction of fuzziness in the problem. A comparative analysis between AHP and fuzzy AHP techniques has been performed and its implications on the selection procedure for all the alternative medicines have been examined.

2 Review of Related Work

The study conducted for selection of drugs for hypnotics by the System of Objectified Judgement Analysis(SOJA) method by Rob Janknegt et al. [7]. For the rational reasoning of the drug formularies with eight criteria for three countries that are Netherland, France, and the UK. Clinical efficacy set to be the most important criteria with 300 points. SOJA does not support decision making of individual patients as other prevailing factors like concurrent diseases are not accounted for. The scoring of the drugs was different for different countries where the cost of procurement and sleep architecture played a major role.

Evaluation of the alternatives for the treatment of healthcare waste in Istanbul was conducted. Controlled combustion, autoclaving, microwave disinfection, and landfill were considered as the alternatives for the study performed by Mehtap Dursun [8]. Fuzzy MCDM equipped authors with hierarchical classification of all the attributes. The authors used a nominal group technique for reducing the attributes of the performance. For the aggregation of the subjective opinions of all the decision-makers, this study incorporated ordered weighted averaging. The paper concluded steam sterilization as the best technique because of having minimal impact on the environment.

Selection of hospital sites in rural India using fuzzy AHP was analysed Debmallya Chatterjee et al. [9]. The authors conducted decision-making analysis for the establishment of a healthcare facility using three major and eleven sub-factors. The cost of the site along with the density of the population and availability of the transport services were taken as the most important factors. A team of twelve medical experts provided subjective inputs to the questionnaire. The study selected alternative sites for the construction in Burdwan, West Bengal, India. The defuzzified weights assigned to the sub-factors guided in the decision-making process where cost was given 46% importance, population characteristics and location were given 27% importance each. The hierarchical analysis performed by the authors can be extended for the selection of future healthcare sites in both metropolitan and rural areas.

Fuzzy AHP approach for decision making of the maintenance strategy for the medical devices was studied by Zeineb Ben Houria [10]. The strategies were designed based on time, condition, and corrective maintenance requirements. Increasing the longevity of medical devices by efficient maintenance management reduces the overall cost. The authors constructed the maintenance strategy aimed at reducing the downtime and risks associated with the device. The ranking using fuzzy AHP provided an appropriate assessment of the criticality for each device.

3 Methodology

Analytical Hierarchy Process (AHP) [11, 12] is a structured technique for organizing and analysing complex and crucial decision problems based on mathematics and psychology. This technique carries out a pairwise comparative analysis between the alternatives and some criteria to achieve a specified goal. AHP induces the selection of the most suitable alternative by ranking the alternatives with respect to each of the criteria and then finally aggregating the separate ranking results into a final result. The problem is decomposed into a hierarchical structure of goals, decision criteria, sub-factors, and alternative. Pairwise comparison is performed for all the elements of a layer starting from the bottom of the structure and a numerical value is computed for the degree of preference on a preference/ratio scale and not at 0 and 1. As shown in Fig. 1. Methodology of AHP and fuzzy AHP where the first step to identify the problem and the final goal to achieve this step also involves the selection of alternatives that are going to compete for the ranking.

In the second step, modelling of the problem is conducted into a hierarchy structure. The hierarchy is constructed while the decision-makers increase the understanding of the problem, of its context and most importantly the feelings and thoughts of other decision-makers in the panel. This step determines which level of detail is there in the ranking process. Decision-makers break down a single criterion into multiple criteria to achieve more accurate results. This breaking down surely adds up to the accuracy of the result but it also adds up to increase in the complexity of the problem and the underlying calculations in the subsequent steps. The third step is the

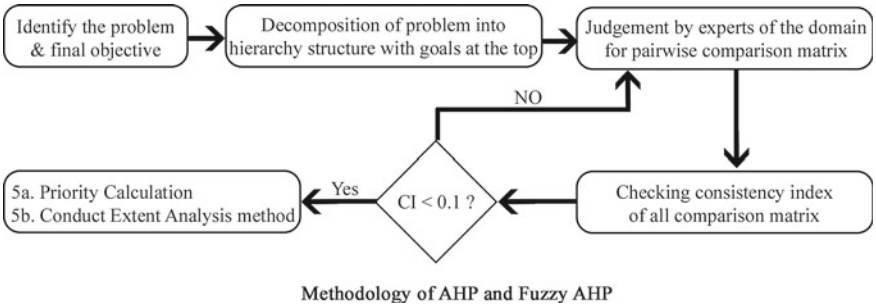

Fig. 1 Flowchart for AHP and fuzzy AHP methodology

laborious step of all. This step involves filling up the pairwise comparison matrix for each alternative for each criterion and sub-criteria, also the criteria and sub-criteria need to be compared among themselves too. The reason why this step needs so much time as the decision-makers need to debate for each pair being compared and then choose the best value. This is followed by the fourth step where the consistency ratio of each pairwise comparison matrix is analysed. If the consistency index comes out to be less than 10%, the pairwise comparison matrix can be used for further calculations, else decision-makers need to reconsider the comparison, these four steps are same for both AHP and fuzzy AHP. The difference originates from the fifth step, priority calculation is done in case of AHP and extent analysis is done in fuzzy AHP this difference then broadens because of the mathematics that follows behind further calculations.

Quantitative scrutiny of many real-life problems may not be predicted precisely by humans. Experts often make imprecise judgements leading to inconsistencies. This imperfection also reflects during the ranking procedure. To combat such a scenario, fuzzy AHP was introduced over the classical AHP model for ensuring the quantitative and qualitative factors of MCDM. Fuzzy AHP [13–15] interprets the linguistic and vague phenomenons using fuzzy set theory. Analysis of every criterion as the degree of possibility is conducted. This provides decision-makers the scope to incorporate the fuzzy nature of the problem which is very common in the real practical world. Extent analysis method results in incorporating the fuzziness of the problem and because of this, slightly different weights of the criteria are obtained due to which different scores for both AHP and fuzzy AHP are observed.

4 Simulation Results and Analysis

The comparative matrices are shown in Tables 1 and 2 for all the levels of the hierarchical structure shown in Fig. 2. AHP and then Fuzzy AHP have been deployed and the difference in the scores of both the ranking techniques has been investigated. Ranking of the cancer treatment colorectal cancer drugs are examined on the basis

Table 1 Pairwise weight assignment for criteria

Weights	Criteria								
Type of stakeholder	1.1/1.2	1.1/1.3	1.2/1.3	2.1/2.2	2.1/2.3	2.2/2.3	3.1/3.2	3.1/3.3	3.2/3.3
NHIA	3	3	2	2	3	2	1/2	1/2	2

Table 2 Criteria wise weight assignment for alternatives

Alternatives	Criteria								
	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3
Bevacizumab	2	3	2	4	5	5	4	5	4
Cetuximab	3	2	2	3	3	4	3	3	4
Panitumumab	3	2	2	4	2	3	2	2	4
Aflibercept	2	2	2	3	2	1	2	1	3
Regorafenib	1	1	3	2	3	2	2	3	4

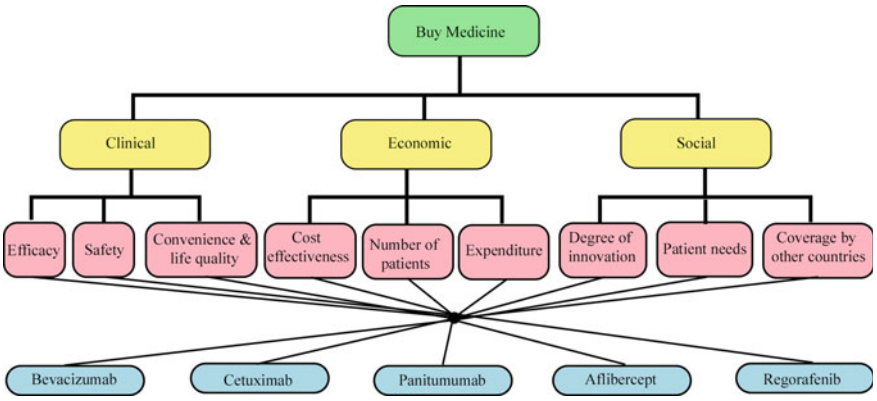

Fig. 2 Structural hierarchy for buying medicine

of three criteria that are Clinical (1), Economic (2), and Social (2) having 30%, 60%, and 10% weight respective.

The clinical criterion has further three sub-criteria namely: Efficacy (1.1), Safety (1.2) & Convenience and life quality (1.3). The economic criterion has further three sub-criteria namely: Cost-effectiveness (2.1), Number of patients (2.2) & Expenditure (2.3). The social criterion has further three sub-criteria, namely: Degree of innovation (3.1), Patient needs (3.2) & Coverage by other countries (3.3). The pairwise comparison for the comparison matrix of the criteria as set by expert is shown in Table 1 and sub-criteria weight have been represented in Table 2. AHP and fuzzy AHP provide ranks to the alternatives namely: "Bevacizumab", "Cetuximab", "Panitumumab", "Aflibercept", "Regorafenib".

For sample illustration, the clinical comparative matrix weights have been shown in Tables 3 and 4. The result was in favour of "Bevacizumab" which had an AHP score of 3.800363 and a defuzzified fuzzy AHP score of 3.857013. This was the spotlight of our experiment as both the scores were different although the same data was fed to both the models shown in Table 5.

As we derive from Table 5, the scores of each alternative/drug is different for the case of AHP and fuzzy AHP. This is because of the underlying mathematics of the fuzzy numbers which is different from simple crisp numbers. Tables 3 and 4 showcase that the inverse of 2 is 1/2 in the case for fuzzy inverse 1 2 3 is 1/3,1/2,1/1. Fuzzy numbers are associated with fuzzy AHP which is determined by a triangular membership function with a width of 2. The consistency ratio of the comparison matrix is checked and that summed to be 0.05155921 for clinical sub-criteria, 0.008848762 for economic sub-criteria and 0.05155921 for social sub-criteria comparison. That is considered well enough to go as the AHP model works fine up to a consistency ratio of 10%. After that, we need to reconsider the matrix to produce trustable results.

So, in fuzzy numbers, decision-makers gets a bit of flexibility in determining comparison matrix which is similar to real-world problems. An interesting feature of fuzzy AHP is that the criteria which are very less important as compared to other criteria are given weights of 0 that is very logical. This is not possible in the case of normal AHP technique due to pairwise comparison using crisp numbers.

Table 3 Comparison matrix for sub-criteria of clinical criteria (CRISP NUMBERS)

Subcriteria versus sub-criteria	Efficacy	Safety	Convenience and life quality
Efficacy	1	3	3
Safety	1/3	1	2
Convenience and life quality	1/3	1/2	1

Table 4 Comparison matrix for sub-criteria of clinical criteria (FUZZIFIED)

Subcriteria versus sub-criteria	Efficacy	Safety	Convenience and life quality
Efficacy	(1; 1; 1)	(2; 3; 4)	(2; 3; 4)
Safety	(1/4; 1/3; 1/2)	(1; 1; 1)	(1; 2; 3)
Convenience and life quality	(1/4; 1/3; 1/2)	(1/3; 1/2; 1)	1; 1; 1)

Table 5 Scores of all the alternatives

Alternatives	AHP SCORE	Fuzzy AHP score
Bevacizumab	3.800363	3.857013
Cetuximab	3.007226	3.045464
Panitumumab	2.985845	2.993812
Aflibercept	2.287877	2.291056
Regorafenib	2.083912	2.121714

Running the AHP model in R studio using a standard package of fuzzy AHP gave the advantage of comparing a large number of alternatives without filling large pairwise comparison matrix for each criterion for all five alternatives. As we observe Table 5, depicting the final scores of alternatives exhibits a difference in scores of alternative 1 and alternative 2. In the case of fuzzy AHP is 3.800363-3.007226 = 0.793137 and for the case of AHP, it is 3.857013-3.045464 = 0.811549. So we see that according to fuzzy AHP, alternative 1 is much better than alternative 2.

Although the difference is small, in a strong competitive environment, it can solve major conflicts as in practical world certain cases may arise where due to the fuzzy nature of the environment, some of the ranking orders get changed. This can result in drastic losses to organizations that do not consider fuzziness which should always be taken care of.

5 Conclusion

In this study, we have ranked five medicines for the treatment of colorectal cancer using a famous multi-criteria decision-making technique known as AHP and fuzzy AHP. The results clearly sketch out "Bevacizumab" with the highest AHP score of 3.800363 and a defuzzified Fuzzy AHP score of 3.857013. Different scores for AHP and Fuzzy AHP are observed for the same data, and the relative difference between the scores also vary in both famous techniques. Although this is due to slightly different mathematics in the case of fuzzy AHP because of involvement of fuzzy numbers which increases complexity in computation but gives trustable results in fuzzy environment. The study shows that the fuzzy AHP incorporates the fuzziness in comparing two alternatives. Therefore, in a competitive environment, the ranking may be changed due to the involvement of fuzzy numbers and give different results from that of Normal AHP.

So we may conclude that AHP is optimal when we compare alternatives using crisp numbers but despite the computation complexity, in real life, it is better to incorporate the uncertainties and fuzzy nature of comparison using fuzzy AHP in those cases. So it all depends on the decision-maker whether to use AHP or fuzzy AHP as a decision-making technique based on the dominance of the fuzzy nature of the environment.

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A Novel Privacy Preservation Mechanism for Wireless Medical Sensor Networks

Ashish Singh, Ravi Raushan Kumar Chaudhary, and Kakali Chatterjee

Abstract Wireless Medical Sensors Networks (WMSNs) are mainly used to track and collect health data from patients using body sensors which are implanted on the patient body. This helps to reduce the cost of treatment, provide reliable resources and services, provide accurate diagnostic results, and quicker diagnosis. Security and privacy are the most significant challenges in such networks while the healthcare information is transferred via wireless communication to the medical server. Security requirements such as confidentiality, honesty, and authenticity should be maintained throughout the entire process. This paper proposes a robust privacy preservation framework based on homomorphic encryption. The randomness in encrypted data provides different ciphertexts which enhances the privacy of the processed data. The network and encryption performance of the proposed monitoring system are evaluated using an OPNET-based simulation model. It demonstrated that the proposed framework achieves better throughput and less delay as compared to previous works.

Keywords WMSN · OPNET · Homomorphism · Information gain · Clustering · Entropy · Security and privacy

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1 Introduction

Remote health care is a popular application of Wireless Medical Sensor Networks (WMSNs) which consists of many-body sensors for collecting and monitoring data remotely [1–5]. The sensor nodes are mounted either externally on a person's body or under his skin to collect some parameters data in the body such as blood glucose, electrocardiogram (ECG), electroencephalogram (EEG), body movement, temperature, heart rate, blood pressure, and many more. These collected data are transferred to a medical server through which a medical practitioner can access those data from anywhere and anytime. Mainly the medical sensors nodes are implanted in three ways for the collection of data from the human body. Firstly, the sensor nodes are inside the patient body/tissue/skin. The second way is the nodes are placed on the body surface or two centimeters from the patient body. The third way is the sensor node are implanted a few centimeters to 5 m away from the human body.

Real-time monitoring could be implemented remotely through these sensors. A body sensor-based healthcare application can provide many benefits in the health sectors. These types of applications can provide a conducive environment for monitoring those vital parameters. These parameters check daily life activity and medical conditions for long-term critically ill (paralyzed patient, cancer patient) persons. These approaches may reduce huge hospitalization costs. The collected sensitive clinical data are used for further patient treatment. To provide the security of these sensitive data, some cryptographic methods have been proposed [6–13]. With the security of these data, privacy is also a major issue as these biomedical data are highly confidential. Mainly, privacy preservation techniques of such health data streams follow an accumulation-based method [14]. In accumulation-based techniques, the data is accumulated and clustered until certain privacy conditions such that k-anonymity [15–17] and l-diversity [18] are satisfied. These methods have certain demerits like information loss and computational delay is very high. In such cases, information gain must be computed, and attributes must be prioritized before assigning input tuples to a different clusters. To solve such problems, we have proposed a privacy preservation framework, which is mainly based on homomorphism techniques [19, 20]. The primary contribution of our research is:

- The proposed structure is based on the homomorphic scheme that preserves the privacy of the data while the data is processed without being seen by third parties. This is important for WMSNs.
- Proposed work also provides randomity in encrypted data so that the same plain text generates different cipher texts after several encryptions.
- The encryption performance and comparison show that it has less delay with considerably high throughput.

The rest part of the paper is arranged as follows in the following way: Sect. 2 presents security requirements in WMSN. In Sect. 3, the proposed work has been described. Section 4 represents the implementation and result analysis of the proposed work. Section 5 deals with the conclusion of the work.

2 Security Requirements in WMSN

In the WMSN environment, mainly resource-conscious security requirements are extremely needed [21, 22]. Some of the security requirements that are important in healthcare applications are addressed using WMSNs.

- Data confidentiality: In data confidentiality, data can be accessed by only authorized users. It should prevent data access from unauthorized persons. It could create several consequences in medical condition if the data is opened in front of any unauthorized person.
- Data Integrity: In data integrity, data should be accurate and reliable. However, data should be safeguarded by unauthorized modification. Integrity has preserved by using an authentication protocol.
- Anonymity: Anonymity is a significant requirement as no one should be aware of the identity of the communicating node.
- Availability: Network availability is one of the most significant variables as delicate information in tiny cases of time can be very crucial.
- Data authentication: Authentication of data is the source of data and confirmation of integrity. Generally, communication, messaging, and convergence are connected with the term. The authentication of data has two modules: authentication and validation of the correct entity's data integrity.
- Data freshness: It is a technique of maintaining integrity and confidentiality by defending information against the WBSN coordinator being replayed and recorded and confused.
- Perfect forward secrecy: It tells us that the session keys will not be compromised even if the secret key is compromised.
- Secure localization: WMSN application should have applications that convey the correct location when necessary.
- Error correction: Every healthcare application must have efficient, durable, and robust. It is also important the applications must contain error detection and correction techniques.
- Verification table: To update joining and removing a node, it should be ensured that there is no need for a verification table.

3 Proposed Work

The components of our proposed WMSNs are divided into the front end and back end, as shown in Fig. 1. The front component consists of body sensors, mini gateway, network coordinator, and base station. The back-end component consists of cloud data storage which is used for storing the medical data. The working of the proposed model is explained in the following steps

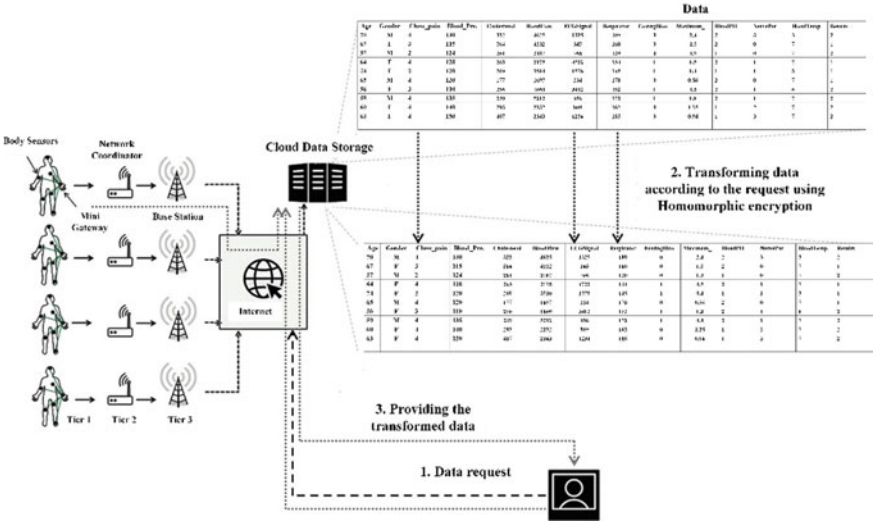

Fig. 1 Proposed privacy preservation framework for WMSN

Step 1: Data gathering and storage

In this step, we discuss how the data is gathered from the source to the destination and finally getting stored at the destination.

This is the initial step of our proposed work. The raw data generated from individual sensors or a group of sensors travels through a mini gateway, network coordinator, and base station finally reaches its destination cloud data storage through the Internet.

Accumulation of data at a regular interval of time leads to the creation of a large data set. It comprises of parameters such as fasting blood sugar, blood flow, nerve potentials, maximum heart rate, ECG signal, respiratory rate, blood pressure, blood pH, body temperature, gender, chest pain type, age, and cholesterol. This creation happens at the cloud data storage which maintains the complete database and is of any arbitrary size. Also, continuous accumulation makes the data set humongous and performing any manipulation on such a scale is an arduous task. Now, we have divided the data set into the block of 270 rows 14 column data sets (including the output yielding attribute). This makes the computation job easy and efficient because small blocks work well in a working framework.

Step 2: Calculation of information gain

In this step, we calculate the information yielding ability of an attribute in a data set block.

Each divided block has 270 instances with 14 attributes. We separate the output yielding attribute and find the most information yielding attribute among 14 attributes with respect to the output attribute. For achieving the desired result, we use one of the decision tree algorithms known as ID3. This algorithm calculates the information

gain of every attribute using its entropy. The computation of information gain and entropy is described by Eqs. 1 and 2, respectively.

$$E(u) = -\Sigma u_i \log_2 u_i \tag{1}$$

$$\text{Gain}\,(Z, R) = E\,(Z) - \sum_{r \in v(R)} \frac{|Zr|}{|Z|} E(Zr) \tag{2}$$

Entropy is defined by $E(u_i)$ where u_i is the set of probabilities. And information gain is defined by gain (Z, R) where Z is a set of features, and R is the possible feature out of complete set Z.

Step 3: Prioritization and grouping

In this step, we have discussed how to prioritize the attributes and group them accordingly.

After calculation of individual information gains, we prioritize the attributes with higher information gains (also known as most sensitive attributes) as it holds the key to give away privacy the most. This process is called prioritization. Prioritization is done because any modifications necessary will require those attributes to be modified first, which are the most sensitive and reduce the risk of privacy the most. So, this process becomes an integral part involved in our proposed method and thus acts as a pre-requisite for further processing also.

After prioritizing, we group the few top prioritized attributes within a block. It may vary from one to many in numbers depending on the sensitivity of the attributes and varying levels of privacy.

Step 4: Clustering of data:
In this step, we see the accumulation-based method applied to our data set.

Now, we cluster the entire blocks according to the AC- accumulation-based method. Accumulation-based method, as suggested by the author [14], is about delaying the tuples of a data set until they satisfy a given privacy condition. But in this proposed work, we do not use tuples scenario. We implement the same scenario within our blocks of data. We accumulate the blocks in clusters and delay the block until it meets the corresponding block of its cluster. This process induces more randomness and generalization to the data, hence reducing the chance of getting identified.

Step 5: Release of encrypted data

In this step, we see the homomorphic scheme applied to our data set after the accumulation method is used.

Now, we apply our homomorphic encryption scheme on our blocks within clusters one by one. The homomorphic scheme includes algorithms namely: Key generation, encryption, and decryption. Key generation algorithm is used to generate public key since it is an asymmetric key algorithm and is mentioned in Algorithm 1. The

prioritized group within blocks is encrypted using Algorithm 2 with the help of the public key. After encryption, the prioritized group is replaced with the new values and is used as and when fetched along with other attributes. Transformed data is used in different evaluations and when it is received back, it can also be decrypted with the help of the decryption algorithm mentioned in Algorithm 3. There is a unique property that the homomorphic scheme holds. Evaluations on transformed data in a homomorphic scheme hold the property of malleability which provides us the facility of doing any manipulation also in an encrypted way without letting the third person know the secret key.

Algorithm 1 Key generation

procedure KEYGEN $(p,\ q)$
  Select two prime numbers p and q.
  if $GCD\ (\ pq\ ,\ (p-1)(q-1)\ ) == 1$ **then**
    $n_1 = p \times q$
    Store multiplicative inverse values of n_1 in $list_1$ as $Z^*_{n_1}$
    Compute the squared value of n_1 in n_2
    Store multiplicative inverse values of n_2 in $list_2$ as $Z^*_{n_2}$
    $\lambda = LCM\ (p-1,\ q-1)$
    for $i \leftarrow 1$ to $len\ (\ list_2\ )$ **do**
      if $(\ (\ list_2[i]^{\lambda}\ \ mod\ n_2\ )\ \ mod\ p == 0\ ||\ (\ list_2[i]^{\lambda}\ \ mod\ n_2\ )\ \ mod\ q == 0\ )$ **then**
        $delete\ (\ list_2[i]\ )$
        end if
        end for
    Choose a random value g from $list_2$, such that $GCD\ (\ L(\ g^{\lambda}\ \ mod\ n_2),\ n_1) == 1$ where $L(u) = \frac{u-1}{n}$
    Choose $(n_1,\ g)$ as public key.
  else
    return $error$
  return 0

Algorithm 2 Encryption algorithm

procedure ENC$(pk,\ m)$
  Using the public key, select a message $m\ \epsilon\ Z_{n_1}$
  Randomly select a number $rr_1\ \epsilon\ Z^*_{n_1}$ from $list_1$
  Encrypt the message m using
  $c = g^m\ .\ rr_1^{n_1}\ \ mod\ n_2$
  return c

Algorithm 3 Decryption algorithm

procedure DEC$(sk,\ c)$
  Calculating multiplicative inverse $\mu = L\ (g^{\lambda}\ mod\ n_2)^{-1}\ mod\ n_2$
  Compute $c' = L\ (c^{\lambda}\ mod\ n_2\ )^{-1}\ mod\ n_2$
  Now decrypt the message as $p = \mu\ .\ c'\ mod\ n_1$
  return p

4 Implementation and Result Analysis

In this section, we have presented the implementation scenario, results, and comparison of the proposed work.

4.1 Implementation Scenario

For the network implementation part, we have used RIVERBED OPNET simulator (version 17.5A PL7) and for the homomorphic scheme, we have used PYTHON as a high-level language but any preferred high-level languages can be used. OPNET simulation tool is used to create and configure topologies, create traffic, choose statistics, run simulation, view, and publish results [23]. These things make OPNET simulator more powerful than other simulators. For our proposed work, we have

created our own data set. For ease of use 270 rows 14 columns block size data set is designed to the implementation proposed model. Finally, the homomorphic scheme is applied at the time of the release of data.

4.2 Result Analysis

Now, we have to evaluate the encryption performance of the proposed work. After the evaluation, we will compare our proposed scheme with the other existing schemes [24, 25] in terms of communication cost, delay, computation cost, and storage cost.

Encryption performance evaluation: We have used three algorithms in the homomorphic scheme used at the time of the release of data. They are key generation, encryption, and decryption. From the implementation of the scheme in high-level languages such as PYTHON, we see that all three algorithms in the encryption scheme run in a polynomial-time of security parameter λ which is quite efficient and suitable enough. Key generation uses λ, to generate two keys—a public encryption key and a secret decryption key. Separately, we have also formed a Table 1 which shows the relation in size of the key, the total number of cycles and throughput while using the homomorphic scheme (Table 2).

Author [24] proposed two scheme: preliminary scheme and security-enhanced scheme. The communication cost of preliminary scheme given in paper [24] is 160 + 1024 + 64 + 512 + 1024 + 32 + 1024 = 3840 bits. Whereas communication cost of security-enhanced scheme given in paper [24] is calculated as 160 + 1024 + 32 +

Table 1 Performance of homomorphic scheme

Modulo size n (in bits)	Modulo size n^2 (in bits)	Total number of cycles	Throughput (Kbits/s)
15	225	370,123	787
35	1225	2,456,245	175
77	5929	3,546,124	80

Table 2 Comparison of the proposed scheme with other existing models

Parameters	Preliminary scheme [24]	Security-enhanced scheme [24]	Scheme in paper [25]	Proposed scheme
Communication cost	3840 bits	3264 bits	3360 bits	3184 bits
Delay	2300 s	2264 s	2165 s	2100 s
Computation cost	4 SM + 1 HF + 1 AD +1 ME + 3 GHF = 11.95 s	4 SM +1 HF + 2 AD +1 ME + 3 GHF = 11.95 s	4 SM + 1 HF + 1 AD + 4 GHF = 10.69 s	4 SM + 1 HF + 1 AD + 1 GHF = 10.06 s
Storage cost	(160 + 512 n) bits	(160 + 1536 n) bits	160 bits	158 bits

1024 + 1024 = 3264 bits. Paper [25] communication cost is calculated as 32 + 64 + 1024 + 1024 + 32 + 1024 + 160 = 3360 bits. Our proposed scheme communication cost is calculated as 32 + 32 + 1024 + 1024 + 32 + 16 + 1024 = 3184 bits. This communication cost shows that our proposed scheme has less communication cost over the existing scheme.

The delay of the preliminary scheme given in paper [24], security-enhanced scheme given in paper [24], and paper [25] scheme is 2300, 2264, and 2165 s. In our framework, the delay is 2100 s. These results demonstrated that the proposed framework has less delay.

Computation cost is the summation of the execution time of scalar multiplication (SM), a map-to-point hash function (HF), addition operation (AD), modular exponentiation (ME), and a general hash function (SHF). The numerical cost of preliminary scheme, security-enhanced scheme given in paper [24], and in paper [25] scheme is 11.95 s, 11.95 s, and 10.69 s. But, our proposed framework computation cost is 10.06 s, which is less as compared to other existing frameworks.

Finally, the storage cost of preliminary scheme, security-enhanced scheme given in paper [24], and in paper [25] scheme is (160 + 512 n), (160 + 1536 n), 160 bits. Our proposed framework storage cost is 158 bits, which is comparatively less.

5 Conclusion

In this work, we have discussed a new method for privacy preservation in WMSN and calculated its delay and throughput. To preserve privacy and security in WMSN, we have proposed a scheme which is an amalgamation of processes such as prioritization, grouping, clustering, and homomorphic scheme. Later, we have implemented our proposed scheme on a created data set and tried to achieve minimized delay and maximized throughput through network and encryption performance analysis. The comparative results demonstrated that the proposed framework is better in terms of delay, throughput, storage, and computation. Now, we can say from the above discussion that our technique is efficient enough in securing privacy in WMSNs.

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IOT-Based Visitor Sensing Doormat: Future Generation

Anunay Kumar, Aman Pandey, Anukriti, Megha Singh, Shivam Kumar, and Subhashree Mishra

Abstract In current scenario, security is one of the major factors. People wants to be more secured by applying the current technology in the day-to-day appliances. In this paper, we are proposing an improvised IOT-based doormat which senses when anybody comes at our doorsteps, and it sends a notification in our mobile. With the built-in force sensing resistor, the doormat is able to monitor changes in pressure whenever someone steps over it. Smart mat is capable of providing a wide range of applications by sensing a user's identity and activity in the house. This paper shows the various advantages of Arduino Uno and the various fields it can be applied.

Keywords IOT · Smart home · Piezosensor · Arduino Uno

1 Introduction

Today, automation is one of the main concerns either in the case of home appliances or vehicles or industries and this can be made possible using the concepts like IoT [1, 2]. This proposal contains a model which notifies the user whenever someone steps on the doormat, for this force sensing resistor is placed in the doormat which

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converts pressure into electrical signal transfers it to the Arduino camera clicks the photo of the visitor and compares it with the faces of the family members if found different the buzzer starts making noise which warns the owner, for this we used SQL database. With the force sensing resistor in the mat, it actively senses pressure and gets active [3, 4]. PHPoC module is used to transmit the output directly to any online platform such as Google Drive (in this project) and text message I sent by the GSM module to the owner that someone has arrived and the owner then can open his Google Drive to see the picture of the visitor; the components applied in the project lead to the proper completion of the project.

The organization of the contents is as follows: Section 2 contains the basic components used for designing of this product. The discussion of the architecture of the mat is in Section 3. Section 4 contains the experimental detail of the proposed model. Conclusion and future research direction are presented in Section 5.

2 Preliminaries of SmartMart

The SmartMart is designed by taking the following components in to consideration.

Arduino Uno: It is a microcontroller used to implement IoT. It consists of a USB interfacing, six analog I/O pins, 14 input digital ports using which external electronic circuits are connected (Fig. 1).

Force sensing resistors: It acts as a pressure sensor; when the pressure is applied, resistance decreases and it becomes active (Fig. 2).

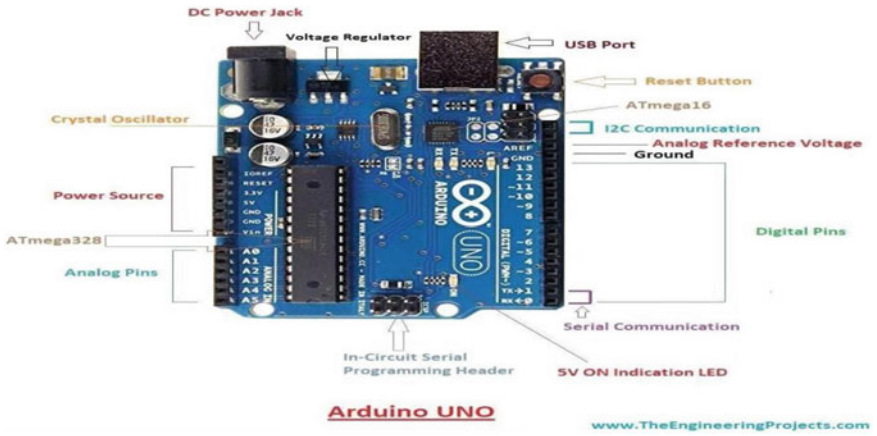


Fig 1 Arduino UNO

Fig 2 Force sensing resistor

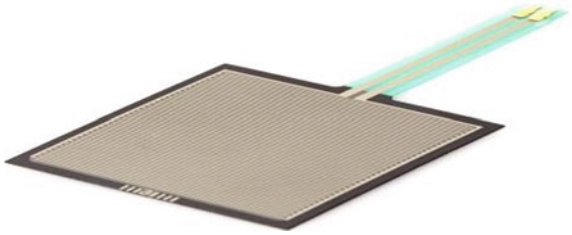


Fig 3 PHPoC shield

PHPoCShield: PHPoC module connects Arduino to Internet providing many features to it; in this project, we are using it to send picture of the visitor to the owner's device (Fig. 3).

Buzzer: A buzzer is an output device commonly used with Arduino; the connection of negative pin is done to the ground and positive pin is connected to supply usually +5 V or +6 V DC voltage. It can be used as alarms or timers (Fig. 4).

Breadboard: A breadboard finds it application in circuit designing, the terminals of the wires are into the holes, it is generally used to connect components in serial or parallel (Fig. 5).

GSMmodule: It is used to enable communication between a microprocessor and microcontroller and GSM/GPSRnetwork (Fig. 6).

System Software

Arduino IDE: The fullform of IDE is integrated development environment; it is used write and upload programs to component used with Arduino. Arduino IDE works in Windows, macOS and LINUX (Fig. 7).

Fig 4 Buzzer

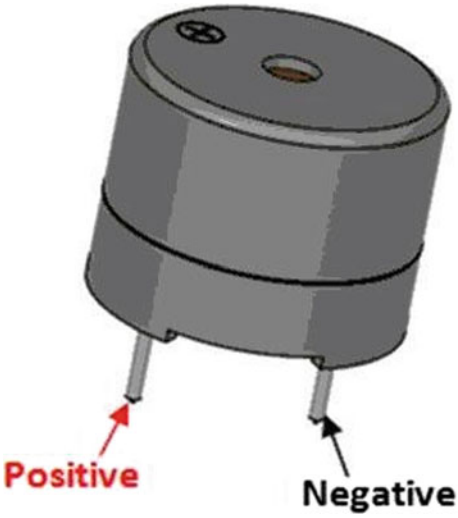


Fig 5 Breadboard

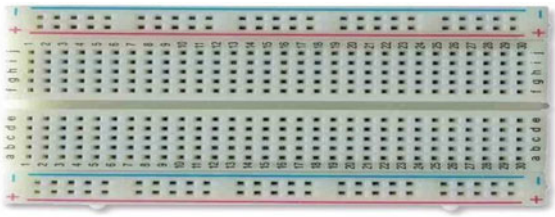


Fig 6 GSM module

3 Proposed Architecture

The working procedure of the proposed IoT-based visitor sensing doormat is based on five stages which is clearly explained as follows (Fig. 8).

Fig 7 Arduino IDE interface

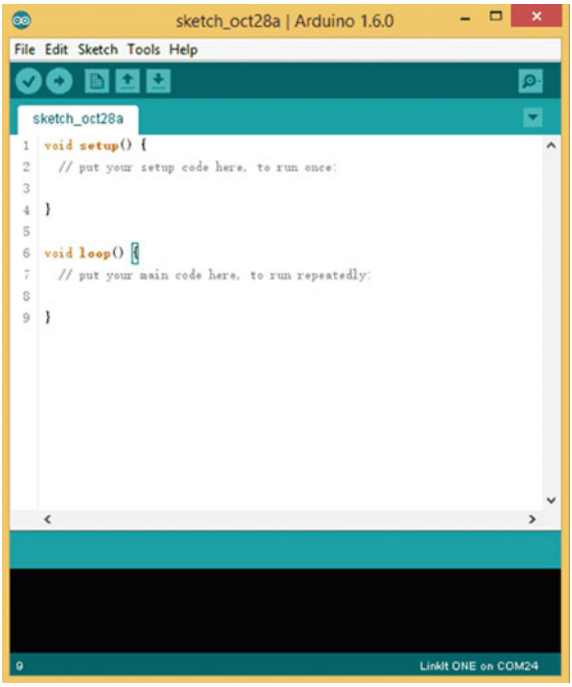


Fig 8 Basic flow diagram of the process

Step 1:Installation of Doormat with force sensing resistor (pressure sensing) so whenever

Anybody steps on it, it produces a signal which is sent to the Arduino.

Step 2: Signal sensed and captured by the Arduino considered as Input signal.

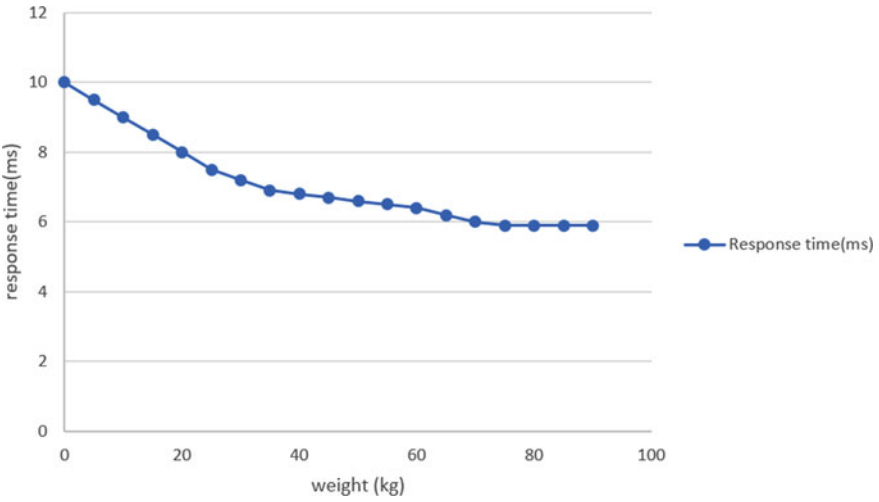
Step 3: Input data is analyzed to verify the authenticity of the object on the doormat, once it is verified and found as an intrusion the camera connected to the device captures the image of it and then buzzer starts making noise.

Step 4: The captured image is sent to the device using PHPoC module and the notification is sent to the device as sms using GSMmodule.

4 Experimental Analysis

This section presents a comparative analysis on the existing technique and our proposed methodology based on parameters like delay time, response time of the event.

Existing doormat (digital doormat)	Proposed door mat (smart doormat IOT-based visitor sensing doormat)
Delay 3–5 s as doormat reconnect to WiFi network	Delays of 1–2 s as the mat reconnect to WiFi network
When someone stepped on, it only activates buzzer	It not only activates the buzzer but it also sends a notification in user mobile
It is only for notification purpose	It is used for notification as well as security purpose as it clicks the picture of guest and sends it to the owner
Due to less amount of weight on doormat, sometimes its response time become slow	Its response time is same and faster in less amount of weight also
It is digital doormat	It is visitor-based smart doormat as it is IoT enabled



Simulation and sample code

Here, first you discuss on the experimental setup. And also give some sample code not detail (Fig. 9).

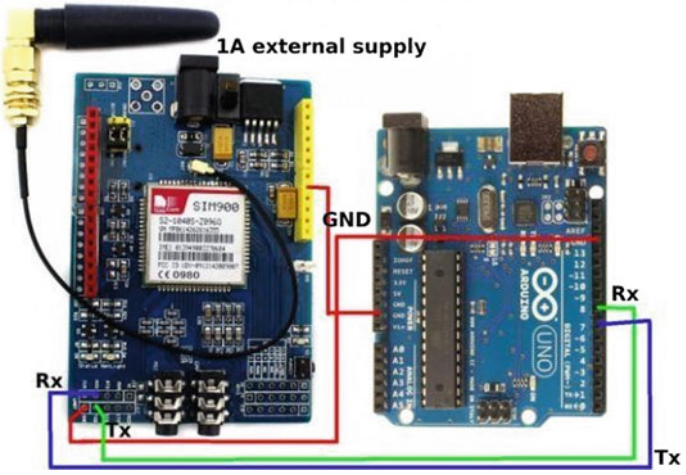


Fig 9 Experimental setup

CODE

```
#include<SoftwareSerial.h>
SoftwareSerial_mySerial(10,11);
Void setup()
{
   myserial.begin(9600);//setting baud rate
}
Void_loop()
{
   If(serialavailable()>0)
sendMessage();
   If(myserial.available()>0)
      Serial.write(myserial.read());
}
Void SendMessage()
{
   myserial.print_ln("AT+CMGF=1");
   myserial.print_ln("AT+CMGS=\"+xxxxxxxxxx;");
   myserial.print_ln((chr)26);
}
```

Future modification

Smart doormat can be proved applicable to various scenarios and activity in the house (Fig. 10).

Smart mat can be used for providing personalized services for different family members like when mother come back from the work, the doormat senses it and turns on the lights. Moreover, our system can provide small health assistance by measuring the weight of person. When they are on the smart mat, it converts the pressure data to weight and sends it to the server. Smart mat can also be used to provide safety in some ways as, for example, if the doormat is placed near kitchen, it can turn off appliances if a child steps on it or notifies the server. With our smart mat, the smart home system can detect user's presence, so that the light will be turned off as soon as users leave the room and reduce energy consumption.

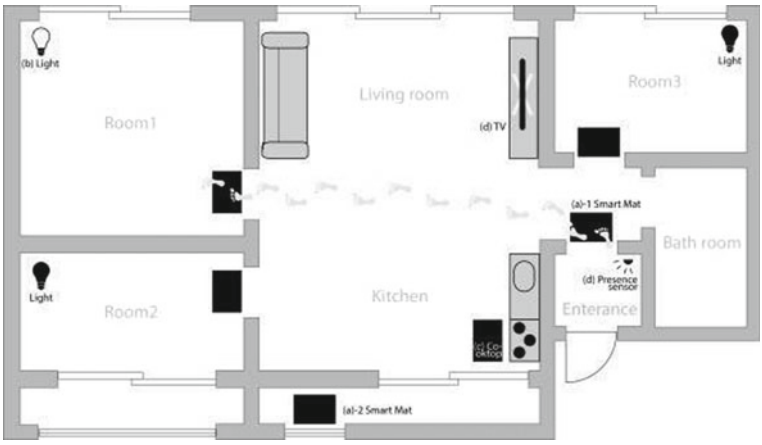


Fig 10 Smart mats installation scenarios. Laid at entrance (a)-1, each room and a place with flaw in security (a)-2.

5 Conclusion

In last couple of decades, the technology has revolutionized the human society. People are nowadays completely dependent on the one of the greatest inventions of human life, i.e., the Internet. In this network, most of the informative buzz is been generated through email, the Web and many other user services. In this era of artificial intelligence and complete home automation, we are making things fully automated around us to build the world known as "smart world."

Today, smart world is dependent upon various factors to make task easy and simple for the user and provide other tasks, such as to look out at different phenomena surrounding u which can be made possible using IoT. In this project, we have proposed an IoT-based visitor sensing doormat for home, to detect a visitor, guest or an intruder, when someone stepped in your home through door and nobody is available there. In order to address this, a low cost IoT-based visitor sensing doormat is introduced using Arduino Uno, GSM module and PHPoC module. Talking about the functioning of the project which is pretty simple, when someone steps on, it sends one notification and an image of the visitor to the owner's device and makes noise only when a stranger steps on it. It can be concluded that this project is one step forward toward a smart home.

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Heart Disease Prediction Using Machine Learning Technique

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Abstract The most commonly used platform in technical field is artificial intelligence, and machine learning is a subset of it. It is very well known about its model training and testing. Nowadays, it is used in every platform, and surprisingly, it is giving unexpected result. Like in recent studies, it is found that in mall the most buying product with beer is diaper, but as a person, we never even thought of this combination. The most cautious part of human life is heart. The moment it will stop working, we will be dead. So by looking at this concern, we have done our survey in the Internet, and all the sites says that after retirement, 90% people are being affected by heart. The cause of its affected may be directly or by any other disease affecting it. We have shown our concerned toward the heart disease and chose the machine learning platform for the analysis. In this paper, we are going to predict the heart disease by providing a brief introduction about all the machine learning algorithms their advantages and disadvantages.

Keywords Machine learning · Unsupervised learning · SVM · MLP

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1 Introduction

In our planet, we have jillion types of living creatures, and all the creatures are living because their lives totally depend on the heart. We need to take good care of heart to live long and healthy. In the field of medical science, the medical examination on heart problems is the biggest challenging test. It depends on an accurate investigation on a lot of pathological along with clinical data of patients by medical professionals, whichever is puzzling technique. Because of betterment of information technology along with machine learning, the medical researchers and practitioners in large amount are absorbed in advancement of automatic system on forecast of heart problem, i.e., highly authentic, helpful along with effective in new finding. Data mining is that technique where finding formerly unknown patterns as well as trends of databases and using the data to build anticipating models. Heart disease advances to claim an dangerous number of locate across the planet. Heart disease is the most immense scourge poignant the industrialized countries. Heart diseases not only crashes down a compelling fraction of population without cautioning but also matter prolonged suffering along with disability in the more larger number. In USA alone, heart disease is responsible for almost one million fatalities each year and more than half of all deaths [1]. Almost five million persons affiliated with heart disease are hospitalized each year. The price of those illness in terms of people suffering and material riches is almost enormous. The endemic of cardiovascular disease is an international phenomenon and in this type of environment, significance of the boost of incidence. Over past decade, heart disease was grown as the single most crucial cause of death worldwide. In this paper, we are presenting a brief comparative analysis of the popular machine learning algorithms. Machine learning is the most commonly used platform nowadays because it provides the result quickly by training the model. The models are trained by using the data's, and then, they are tested. So we have taken our dataset from Kaggle heart disease UCI.

2 Methodology

A large section of machine learning is distribution we try to know which class (group) a conclusion belongs. The capability to precisely distinguish observations is acutely valuable for different business applications alike predicting in case a particular patient will get the disease or not or concluding whether a given lend will bilk or not [2]. Data science gives a plethora of division algorithms being logistic regression, backing vector machine, naive Bayes classifier, and decision trees, and many more are there. In this part, we will describe each of them briefly, and we will study a comparative analysis in between them (Fig. 1).

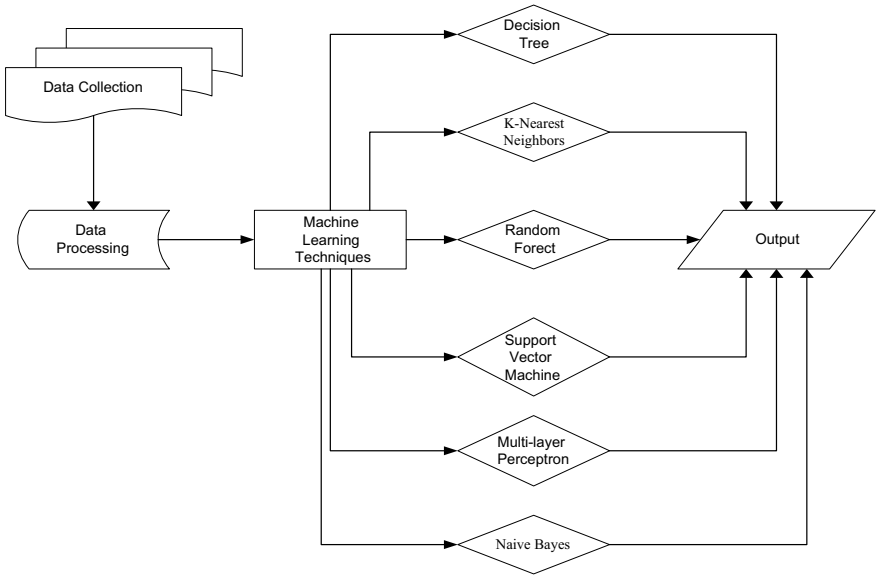

Fig. 1 Analysis model

2.1 Decision Tree

The decision tree is like a flowchart arrangement where every internal node tells about a "test" on an characteristics like a coin spin turns up tails or heads, every branch means result of the tests, along with each leaf node says about single class label which is agreement taken after calculating all aspects. The ways from root toward the leaf mean distribution rules [3]. Inside decision analysis, the decision tree along with the nearly associated influence diagram was used just as the visual and discrete decision support machine, where usual values of challenging options are measured.

Decision tree made of three types of nodes:

- Decision nodes are usually described by squares
- Chance nodes are usually described by circles
- End nodes are usually described by triangles.

In decision tree, the major problems are to apperception of the aspect for the root node in every level. This particular process is acknowledged as attribute collection. We have two popular aspects selection measures that are Gini index, information gain.

To predict the heart disease, we have used the information gain approach.

- Take one attribute (A) for which you want to calculate the information gain.

$$\text{Inf}(A) = -\sum_{i=1}^{a} x_i \log_2(x_i) \tag{1}$$

A attribute
a total no. of classes
x the probability that the attribute A belongs to that class.

$$\text{Gain}(A) = \inf(Y) - \inf(A) \tag{2}$$

Y target class information.

2.2 *Random Forest*

Random forest, as its name entail, consists of an enormous number of single decision trees that achieve as an altogether. Every individual tree in that random forest announces a class forecast, and the collection along with the most votes develops our models forecast. Random forest, as per its name entails, consists of piles of individual decision trees which do as a group [4]. Every single tree in that particular random forest splutter one class prediction as well as the class with the largest votes develops into our models forecast. As in random forest algorithm, if there is enough trees in that particular forest, then the distinguisher can't fit the model. The third edge is a distinguisher of random forest which can deal with lost data; the concluding asset is a random forest distinguisher which may be sculptured for absolute data.

- Promptly choose K faces from all m-features where $k < m$.
- Amid K-features measure the d-node taking the finest split point.
- Break that node in daughter nodes putting a best split, replicate the a to c steps till l node has been extended.
- Make forest by replicating steps a to d for n-times to make n-number of trees.

2.3 K *Nearest Neighbors Algorithm*

The K Nearest Neighbors (KNN) algorithm is the convenient, simple controlled machine learning algorithm which can be availed for solving all two regression and classification problems.

- Stack the data
- Load K to your picked number of acquaintances.
- For each example in the data.
- Measure the distance amid the current example and the query example from the data.

- Count the index of the example and the distance together to an organized collection.
- Sort the organized collection of indices and length or distances in ascending order by the distances or lengths (taken Euclidean distance for calculation)

$$\text{Distance}\ (P1,\ P2)\ = \sqrt{\sum (p_{1i} - P_{2i})^2} \tag{3}$$

- Take the first K entries from the arranged collection
- Get the tags of the chosen K entries
- If relapse, return the median of the K labels
- If classification, send the mode of those K labels.

2.4 Naive Bayes Algorithm

It is a distribution technique based on the Bayes theorem which includes an expectation of predictors and independence [5]. One could say that the naive Bayes classifier predicts the existence of a particular feature in a class cannot be related to existence of any other aspect. In case, a particular fruit can be treated as an apple only if it is round, reddish, or approximately three inches in diameter. Even though those features be dependent on the presence of the different other features or on each other, all of these details independently put up to the likelihood that the fruit is an apple. That is why this is familiar. You can use this algorithm if you have very long dataset which provides all the information's like the past examples with the proof how it was happened. The Bayes theorem is

$$\text{Posterior} = \frac{\text{Likelihood} \times \text{Prior}}{\text{Evidence}} \tag{4}$$

The posterior probability is the probability that will give the probability after looking into the evidence, and the evidence information should be related to the prior probability.

2.5 Support Vector Machine

The Support Vector Machine (SVM) actually is a discerning classifier formally explained by a splitting up the hyper plane. In simple words, it helps the dataset to separate by using a simple hyper plane so the new data which will come can be classified according to the hyperplane [6].

- Get the dataset into n points.
- The points that are help to draw a hyper planes which are known as the vectors.

- Draw a hyper plane to isolate the classes.
- That hyper plane should be drawn in as the new data point can easily classified.

2.6 Multi-layer Perceptron

An MLP may be considered as a logistic retrogression classifier where that input is 1st transformed making use of a erudite non-linear modification. This alteration projects the feed in data into a room where it suits linearly divisible. This halfway layer is referred to a secret layer. A single concealed layer is enough to make MLPs a common approximator. All we have used arched function as the accurate function.

$$Y_i = wX_i + b \tag{5}$$

Y Observed output
w Weight
b Bias
X Inputs.

3 Analysis and Result

Our dataset contains 14 attributes. The attributes contain.

- Age-Age-in years continuous.
- Sex—Male or Female-1 = male,0 = female.
- CP-chest pain—type 1 = typical type 1 2 = typical type angina 3 = non angina pain 4 = asymptomatic.
- Thestbps—Resting blood pressure continuous value in mm/hg.
- Cholesterol—Serum cholesterol continuous value in mm/dl.
- RestECG—Resting electrographic results 0 = normal 1 = having ST-T wave abnormal 2 = left ventricular hypertrophy.
- Fbs—Fasting blood sugar 1¿ = 120 mg/dl 0¡ = 120 mg/dl.
- Thalach—Maximum heart rate achieved continuous value.
- Exchange Exercise Induced Angina 0 = no 1 = yes.
- Oldpeak ST depression induced by exercise relative to rest continuous.
- Slope—Slope of the peak exercise ST segment 1 = unsloping 2 = flat 3 = downsloping.
- Ca—Number of major vessels colored by floursopy 0–3 value.
- Thal—Defect type 3 = normal 6 = fixed 7 = reversible defect.
- Target.

We divided our dataset in two parts, i.e., for testing, we take 40% dat, and for training, we have taken 60%. We have studied the algorithms and have implement

it. So in this dataset, we used decision tree, KNN, SVM, naive Bayes, multi-layer perceptron, random forest and get the accuracy as 68.032%, 88.524%, 95.392%, 82.786%, and 97.5%, respectively.

4 Comparison Analysis

We have implemented decision tree, notable lead of a decision tree is which it intensify the deliberation of all possible results of a conclusion and traces each way to a ending. It generates a comprehensive examination of the consequences with each arm and identifies decision nodes that need farther study. Decision trees are simple to explain and use with easy math, no compound formulas. They show optically all of the results options for quick collation in a configurations that are simple to understand along with only hasty explanations. Those are instinctive along with follow the identical pattern of intelligence that humans utilize when making resolutions. A group of business difficulties can be examined and answered by decision trees. That algorithm of that particular decision tree may be desegregated with all other management survey tools like Project Evaluation Review Technique (PERT) and net present value. Easy decision trees are physically constructed or can be used with computer programs for many sophisticated diagrams. KNN is also called lazy learner (as like Instance-based learning). It cannot learn anything in the time of training. This doesn't obtain any discriminative task from training data. Namely, there is no training time for this [7]. This supplies the training dataset as well as studies from this only at particular time of generating real-time forecasts. This gives the idea to the KNN algorithm to speed up among the algorithms those need training, e.g., SVM, linear regression, etc. (Table 1).

There is only need of two variables required to execute KNN that is value of K as well as the distance function (example: Euclidean or Manhattan, etc.).

SVMs are better when we do not have any idea about that data. It works very well with unstructured as well as semi-structured dataset as images, text, and trees. That trick of kernel is the real power of SVM. Accompanied by a suitable kernel function, we can resolve any compound problem. Unalike in the neural networks, SVM cannot be solved local optima. It measures relatively well toward high-dimensional dataset [8]. SVM replica have ending in application, the problem of overfitting is smaller in SVM. SVM which is always collated with ANN. While compared to ANN models, the SVMs allow better conclusion. Naive Bayes is simple to execute.

It works more effectively than other algorithms, if the independence supposition holds. The number of training data is decreased significantly. It is more measurable. It generates various probabilistic assumptions. It can hold both continuous and discrete data. Heartless toward the irrelevant details. It works simply along with the missing values. The arrival of new data is simple to update. It is mostly suited for classification of text problems. Multi-layer perceptron single layer can be used only for simple problems. However, its computation time is very fast. Multi-layer is most of the neural networks expect deep learning. One or two hidden layers are usually used

Table 1 Comparison between machine learning models

Algorithm name	Discovered by	Advantages	Disadvantages	Accuracy (%)
Decision tree	J. Ross Quinlan	Not require normalization of data	Higher time to compile	68.032
Random forest	Leo Breiman	Handle missing values	More complexity	97.5
KNN	Ockham	Lazy learner	Sensitive to noisy data, missing values, and outliers	88.524
SVM	Isabelle Guyon	Works well when margin of separation is clear	Sensitive to noisy dataset and does not perform well	95.392
Naive Bayes	Reverend Thomas Bayes	Take less training period	Assumption of independent predictors	82.786
Multi-layer perception	Frank Rosenblatt	They classify an unknown pattern with other known patterns	Convergence can be slow	97.540

[9]. They can be used to solve more complex problems. However, they need long training time sometimes random forest. The anticipating performance take part with best superintended learning techniques those provide a dependable feature important predictions; they offer well-organized predictions of the trial error without suffering the cost of replicated model training related with cross-validation. We found that the machine learning algorithms are giving accuracy according to the data. So, the main analysis we should do is the data analysis. The data are trained according to its problem. We also studied and analyzed that all the machine learning algorithms are made to trained differently and work differently. But the common in all the algorithms are that they are taking the characters from the data either in supervise way or in unsupervised way. So, it is important to give the correct data to the model [10].

5 Conclusion

Diseases diagnosis and prediction is one of the most crucial tasks in healthcare field. Early diagnosis can save many lives. Various machine learning techniques could significantly affect the medical science by increasing accuracy and delivering proper diagnostics of the diseases. Hence, reducing effort and saving more time for the doctors. Heart diseases are one most prominent cause of distress and death in the world today [11]. It is very difficult to diagnose and even more difficult to predict. All the machine learning algorithms are powerful when we gave them the right amount

of data for training and testing based on their behavior. They have disadvantages of their own but the advantages of their work is appreciated for all. In our work, we did a comparison and found random forest, SVM, and multi-layer perceptron giving us more accuracy and still the model needs more data and can be made more optimized. We are concluding here that machine learning algorithms can be enhanced by using optimization algorithms in it. For the heart dataset, the disease predictor still not giving us a 100% accuracy as a result. We are further try to optimize the neural network for better result.

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A Smart Energy Meter-Based Home Recommender System

T. Jain, S. Pradhan, and S. Mishra

Abstract In the current scenario, energy conservation is the need of the hour. Conserving energy not only includes making limited resources last for long but also reducing demand on a limited supply. People need far greater and more detailed feedback regarding energy use. The proposed model is an improvised IOT-based smart energy meter which can record the power consumption and then deliver the same data to the concerned user for tracking the daily power usage and accordingly switch off appliances to keep the energy usage under control. Smart energy meters can be used for a variety of applications by identifying the energy consumption of individual devices.

Keywords IOT · Smart home · Dual channel relay · WiFi module · Arduino Uno

1 Introduction

The Internet Of things (IOT) is a budding topic which holds importance socially, economically, and technically. It incorporates the use of the Internet to facilitate communication between products, goods, automobiles, sensors, and objects in everyday life. Thus, manual influence and intervention are highly reduced.

In this paper, we are proposing an IOT-based smart energy meter which provides a two way communication. Hall effect is the governing principle of the proposed model. According to the principle, if a conductor having current flowing through it is placed inside a magnetic field, then a voltage is induced. The induced voltage is perpendicular to both the fields, i.e., electric and magnetic fields. The hall sensor

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measures the hall-voltage which basically is the strength of magnetic field around the conductor. The hall-voltage increases with the increase in current through the conductor. The main objective of the project is to develop a smart wireless energy meter resulting in reduced human interference which in return provides reduced human error and added mobility [1]. The secondary objective is to limit the daily usage of power up to a certain threshold in order to save energy. Thus, whenever the consumer detects extra usage of energy, he/she may pass on an order to switch off a particular device. The analog inputs from ACS712 and ZMPT101B sensors are then multiplied to produce the a single number which corresponds to the power consumption of the devices connected to it. This data provided by the sensors is sent to the cloud using WiFi module and Arduino Uno, where it is stored.

The remaining part is presented as follows: Sect. 2 involves the basic components and equipment required for designing this product. The architecture and the proposed method of the advanced meter are discussed in the next section. Block diagram of this suggested methodology is contained in the fourth section.

2 Preliminaries of Smart Meter

The smart meter is designed by taking the following components and equipment into consideration:

2.1. WiFi module: In order to make the Arduino device WiFi enabled, a ESP8266 WiFi module is incorporated. ESP8266 is a SoC [2].
2.2. Arduino Uno: It is a ATmesga328-based microcontroller board which consists of resonator, a USB port, reset button, ICSP header, power jack, and 20 I/O pins [3].
2.3. Dual channel relay: This module consists of two relays which are electrically isolated from the controlling input. Unlike traditionally used microcontrollers, the relays can be used to switch higher voltage and current loads [3].
2.4. ACS712 current sensor: In order to calculate the current flowing through the conductor, a ACS712 current sensor is being used. Unlike other current sensors, ACS712 does interfere with the working of the system and hence maintains the optimum performance [4].
2.5. ZMPT101B voltage sensor: AC mains voltage up to 250 V can be measures using this high precision ZMPT101B voltage transformer [5].

3 Proposed Methodology and Experimental Analysis

The basic purpose of the circuit is to upload our data regarding the power consumption onto the Internet for review and display and then accordingly make changes in the devices active in the household. For demonstration purposes, we are using two

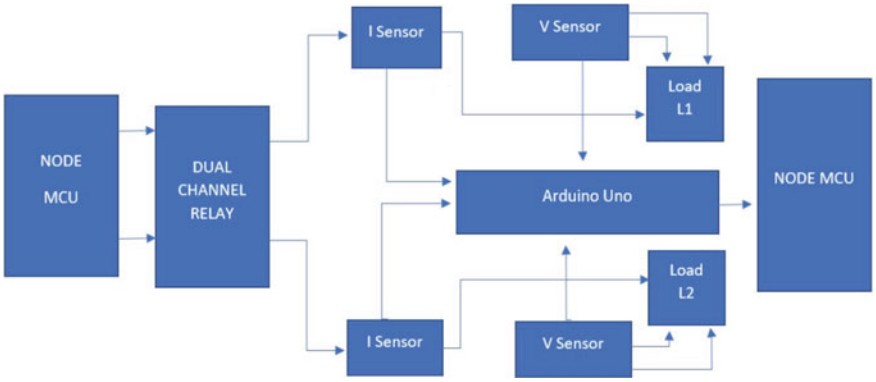

Fig. 1 Basic architecture of the proposed model

devices; however, the meter can be used for multiple devices. The basic architecture of the proposed model is described in Fig. 1.

The basic steps to be followed are presented below:

Step 1: Connection of voltage sensor in parallel mode and current sensor in serial mode.
Step 2: Calculation of power consumption using the formula $P = V * I$.
Step 3: Control parameters of the relay are controlled through ESP8266 Wi-Fi SoC.
Step 4: The calculated power (P_c) is uploaded to cloud for analysis.
Step 5: If $P_c > P_t$, then the device is switched off.

The process started off with the basic connection of the voltage sensor and the current sensor. Since $P = VXI$, the reading of the sensor when multiplied would yield the power consumption. The voltage sensor-ZMPT101B was parallelly connected whereas the current sensor-ACS712 was connected in series.

A 5V two channel relay was needed to switch between the channels containing the loads/appliances. The control parameter of the relay is controlled by the user through node MCU. The corresponding live wires from the relay were connected through the loads and the common port was shorted. The common port was then connected to the plug for the power supply. The neutral wires from both the loads were also shorted and connected to the plug.

The main purpose of the project is however not solved yet. To calculate the power, the data corresponding to the current and voltage sensors is transmitted and then stored in cloud for further usage. Due to the absence of multiple analog pins on the Node MCU, Arduino Uno was used which can take multiple analog inputs and then pass through the information to the Node MCU. The power was then calculated using the formula: $P = V * I$.

After obtaining the power consumption figures, each data was compared with the threshold power usage value. If the power consumption exceeds the threshold value, then the dual channel relay was triggered accordingly. The priority of the devices is pre-set which is referred to while shutting the devices down.

4 Simulation and Sample Code

code | Arduino 1.8.10

File Edit Sketch Tools Help

code §

```
void loop
{
int V1=analogRead(A0); //Voltage value from the sensor1
int V2=analogRead(A1); //Voltage value from the sensor2
int I1=analogRead(A2); //Current value from the sensor1
int I2=analogRead(A3); //Current value from the sensor1
int P1=V1*I1; //Power calculation
int P2=V2*I2; // Power calculation
    int P=P1+P2; // Total power calculation
    int threshold=analoagRead(A4); // Taking user input as threshold
    if(P>=threshold) // Turning on/off the loads based upon the priority
    {
    digitalWrite(13,1);
    digitalWrite(14,0);
    }
    else
    {
    digitalWrite(13,1);
    digitalWrite(14,1);
    }
```

5 Result Analysis

The basic model of the conventional energy meter does not recognize the involvement of any appliance. It depends upon the load present on the cable passing through it. As a result, it becomes difficult to track and limit the energy consumption of individual appliances. Whereas the proposed model monitors the power usage of each and every appliance and then combines it to produce a single number. The independent control over appliances further leads way to the ability of being able to control each and every device individually.

5.1 Rate Chart of Energy Units (Domestic) [6]

Unit[a] range	Tariff rates
0–150 units	₹2.75
150–400 units	₹4.80
400 units and above	₹5.20

[a]1 unit = 1 kWh

5.2 Rate Chart of Energy Units (Non-residential Supply) [6]

Unit[a] range	Tariff rates
0–150 units	₹5.00
150–400 units	₹5.30
400 units and above	₹5.60

[a]1 unit = 1 kWh

5.3 Appliance Power Usage [7]

Appliance	Minimum (W)	Maximum (W)	Standby (W)
LED light bulb	7	10	0
100 W light bulb	100	100	0
32 in. LED TV	20	60	1
Fridge	100	220	N/A

Considering 2 LED bulbs LED1 and LED2 of 7 W and 10 W respectively are used for 16 h a day for 1 month:

LED1 uses 7 W * 16 h = 0.112 kWh
LED2 uses 10 W * 16 h = 0.160 kWh
Total power usage = 0.272 kWh.

For 1 month, i.e., 30 days

Month power usage = 0.272 kWh * 30 = 8.16 units ≈ 9 units

Unit[a] range	Number of units consumed in the range	Tariff rates	Amount
0–150 units	9	₹2.75	₹24.75
150–400 units	0	₹4.80	₹0
400 units and above	0	₹5.20	₹0

6 Conclusion

This paper presents an IOT-enabled system by using which we can optimize the use of power consumption. The collected data gets stored in cloud which can be further used in the future or for data analytics. In this paper, Arduino platform is used for designing the code. Also, Arduino Uno was used to make use of multiple analog inputs which was absent in Node MCU. The power is calculated from the voltage and current sensors, and is compared with a reference voltage level, upon crossing which, the dual channel gets triggered.

This device can be further implemented into other application oriented projects, which would monitor the power consumption for a given duration of time.

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Performance of Solar PV Panel Under Higher Concentration of Carbon Dioxide

Bhabani Patnaik, Sarat Chandra Swain, and Ullash Kumar Rout

Abstract For a growing population, an innovation of the hybrid system is there to produce demandable electric energy. At the same time, the environmental condition is also changing rigorously and concentration of GHG also increasing due to burning fossil fuels for heavy energy demand. And the effect of climate change directly depends on renewable energy sources which are now the fastest-growing sources in the world as solar PV technology is one of the demandable renewable energy sources so in this paper, some experimental analysis has done on solar PV panel. But this system is affected by so many environmental factors by which the efficiency of the PV system is disturbed. The module efficiency is mainly affected by ambient temperature, module temperature, incoming solar irradiation, and photovoltaic module material composition. In this paper, an experimental result has carried out, which shows the effect of an increase in greenhouse gas on solar photovoltaic performance.

Keywords GHG · OTC · CO_2 concentration · Solar PV cell · Maximum power

1 Introduction

Nowadays, growth of population is there. And accordingly, energy demand is also there. So more fossil fuels are burning to fulfill the energy demand of consumers. And this is the leading region for the increase of greenhouse gas concentration in the atmosphere [1]. These gases are capable of absorbing infrared radiation and holding

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heat in the atmosphere. So the earth surface is getting warmer; this effect is also known as global warming. Everywhere the world is facing severe droughts, storms, and flooding. Especially in India, the atmospheric condition is changing very firstly and temperature also increasing gradually [2]. So it is the time to produce electrical energy from clean sources by which global warming can minimize.

For this point of view, renewable energy is the best source for the production of electricity [3]. Now, solar PV technology is the most demandable energy source from all other renewable energy sources because it has many advantages over all other sources [4]. It is a clean source of energy, and it is reliable in nature [5]. But this system is entirely dependent on different environmental factors like temperature, dust, humidity, color spectrum, water, etc. [6]. Whereas climate change is a common thing all over the world as it is a part of human experience and it will change day by day. With that climate, population and energy demand are also increasing. We can assume that energy demand will be doubled within next ten years. So it is the time to reduce greenhouse gas emission or to produce desired output power from renewable energy source at any climatic condition [7].we have to analyze the effect of greenhouse gas on solar PV system because increase of greenhouse gas (GHG) is the main factors of climate-changing. So this paper has categorized with six sections. Section 2 is about the concentration of GHG. In Sect. 3, the experimental methodology has described. In Sect. 4, experimental result has shown. Discussion and conclusion are in Sects. 5 and 6 of this paper, respectively.

2 GHG and Its Concentration

Day to day, the temperature of the earth gradually increases. The reason behind of this is, increase of GHG concentration. Because by this effect, there is increase of carbon dioxide and methane concentration in the atmosphere and these gases trap the heat from infrared radiation of the sun. From this effect, the atmospheric temperature rises gradually. This gas is combination of different gases which includes methane (16%), carbon dioxide (76%), nitrous oxide (6%), ozone, and chlorofluorocarbon (2%).

From Fig. 1, it is clear that the concentration of carbon dioxide is much more than other gases that is 76% of total GHG as per 2019 International Energy Agency (IEA) data.

2.1 Effect of Carbon Dioxide

The atmospheric concentrations of CO_2 since last few decades did not exceed 300 parts per million (ppm). But due to change in technology, industrial development, emission of CO_2 from human beings as well as burning of fossil fuels made a rapid

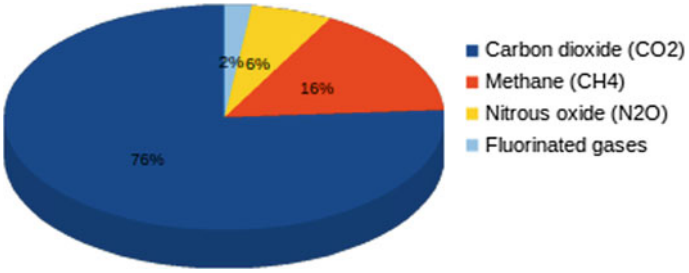

Fig. 1 Concentration of each gas of GHG

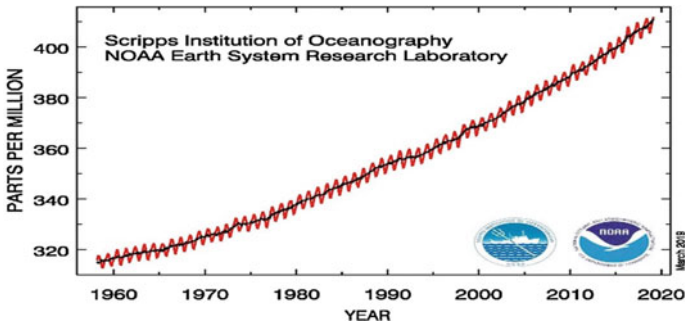

Fig. 2 Increasing rate of carbon dioxide concentration

change in global concentration in recent decades [8]. So due to this, the level of carbon dioxide exceeds above 400 ppm, which has shown in Fig. 2.

With this increase of CO_2 label, global temperature also increases gradually, and a small rise in global temperature can destroy the whole world by many natural calamities [9].

From the above graph, we can imagine the concentration of carbon dioxide after 10–20 years. So as mentioned above, an experimental analysis has done to estimate the output power of solar PV panel under the higher concentration of carbon dioxide.

3 Experimental Set-Up

The experiment has done at NRRI, Cuttack, Odisha, because they have Open Top Chamber (OTC) facility their institution. In that OTC, they supply the required concentration of carbon dioxide as per their requirements which is higher than the ambient concentration of CO_2. And the upper part of that chamber is fully opened so that the solar irradiation can enter directly to that chamber. A sensor system is there to maintain the proper concentration of CO_2 as per their requirement.

So I have take permission from this institution to do my experiment accurately. They had given permission for a single day (October 14, 2020) to do experiment with solar PV module in 550 ppm OTC which maintain 150 ppm more than an ambient concentration of CO_2. With this concentration, temperature and humidity also recorded by a computer system. The figure of both OTC and the system where the level of CO_2, temperature and humidity are recorded has given in Fig. 3.

The required instrument for solar PV experiment has given in Table 1, which is used at NRRI.

Two set-ups had arranged to analyze the performance of solar PV module under two different concentrations of carbon dioxide. One is the ambient concentration (398–410 ppm). Another setup has in 550 ppm OTC chamber. Experimental setup of two different concentrations has shown in Figs. 4 and 5.

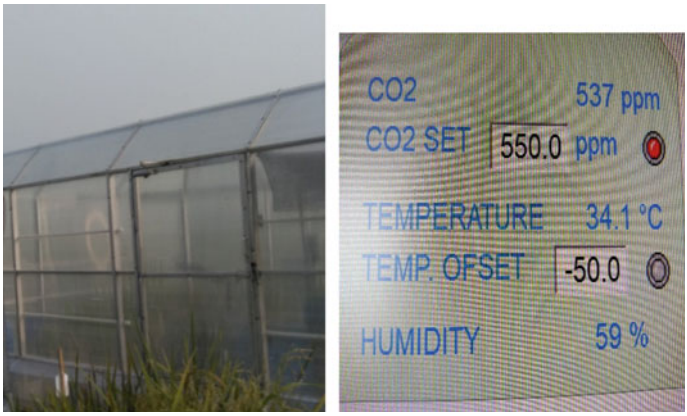

Fig. 3 OTC with 550 ppm and the recorded system

Table 1 Required instruments for experiment and their rating

Instruments required	Range	Unit
Solar panel	20 W	2
Ammeter	0–1 A (DC)	2
Voltmeter (multimeter)	0–100 V (DC)	2
Rheostat	0–145 Ω	2
Solari meter	Measuring irradiation	1
Solar PV stand	Tilt angle-22°	2
Thermometer	0–500 °C	2

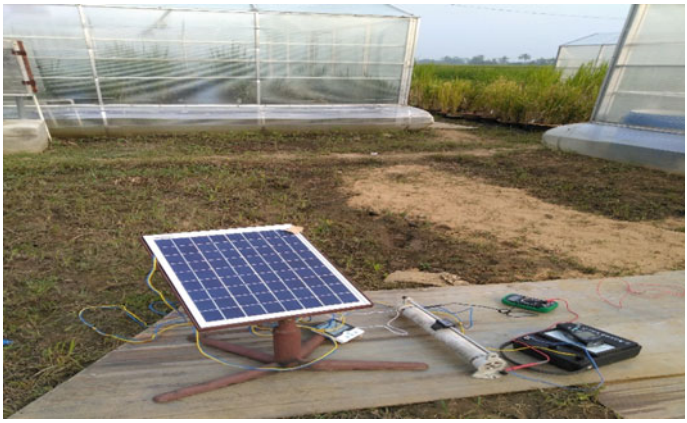

Fig. 4 Performance of solar PV module at ambient CO_2 concentration

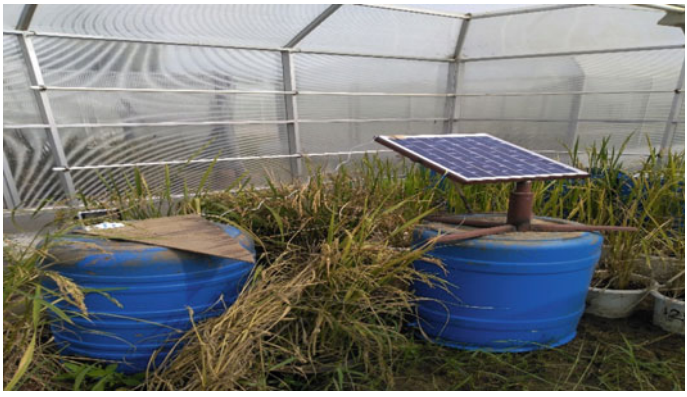

Fig. 5 Performance of solar PV module at 550 ppm OTC

4 Result

All the data has taken simultaneously for both the system. I had taken the reading of solar irradiation, open-circuit voltage, short-circuit current, maximum power, ambient temperature, and module temperature at every one-hour interval. But I have shown here three significant data of that day in Table 2.

Using the above data, *P*–*V* curve has characterized for both the solar PV system. which has shown in Figs. 6, 7 and 8.

Table 2 Required data for both PV module at same time

Time	CO_2 concentration	Irradiance (W/m^2)	T_{amb} (°C)	T_{PV} (°C)	P_m (W)
11:00 A.M.	400 ppm	840	33	42.7	4.082
12:00 P.M.	400 ppm	900	35.5	44	4.68
1.00 P.M.	400 ppm	760	36.3	47.5	3.84
11:00 A.M.	550 ppm	860	34.4	44.7	4.074
12:00 P.M.	550 ppm	915	36.8	45.6	4.585
1.00 P.M.	550 ppm	750	36.8	51.2	3.68

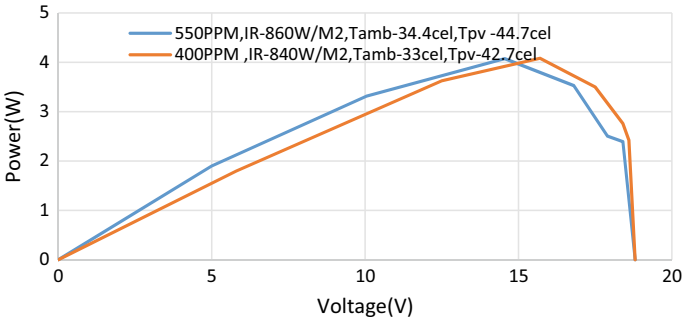

Fig. 6 *P–V* characteristics of PV module under 550 and 400 ppm CO_2 at 11 A.M.

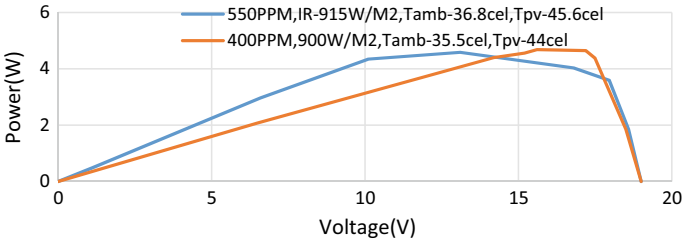

Fig. 7 *P–V* characteristics of PV module under 550 and 400 ppm CO_2 at 12 P.M.

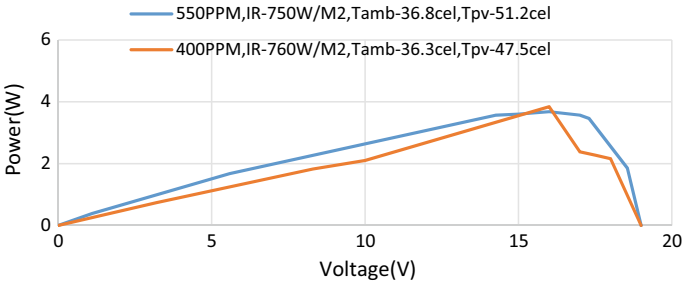

Fig. 8 *P–V* characteristics of PV module under 550 and 400 ppm CO_2 at 1 P.M.

5 Discussion

From the above experimental result, we confirm that the concentration of CO_2 is directly proportional to the atmospheric temperature. In the above experimental analysis, the same irradiance is absorbed by both the panel and each data of both panel has a taken at the same time. But due to a higher concentration of CO_2, the ambient temperature of 550 ppm OTC is higher than the ambient temperature of 400 ppm CO_2. Due to an increase in the ambient temperature of OTC, the PV module temperature, which is placed in that OTC has increased. So from the above graph, it shows the output power of the solar PV module in 550 ppm OTC is less than the output power of the PV module in 400 ppm (ambient).

6 Conclusion

In 2000, the concentration of CO_2 was 366 ppm, and now (2020) the concentration of CO_2 is (400–405) ppm. At the meantime, the demand for solar photovoltaic energy is there so, many researches are going on to get maximum efficiency from the solar PV panel. There are many factors present in the atmosphere by which the efficiency of solar PV can be effected. So from this experimental analysis, we observe that due to higher concentration of CO_2, the temperature of the atmosphere also increases. A small increase in ambient temperature is very much effect on panel efficiency because the panel temperature increases with an increase in ambient temperature. And temperature is inversely proportional to the module efficiency. So at standard test condition, the solar panel gives maximum efficiency where the temperature should be 25 °C. So it is necessary to maintain the module temperature 25–30 °C.

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Speech Enhancement Using a Novel Spectral Subtraction Method for Seashore Noise

Rashmirekha Ram, Saumendra Kumar Mohapatra, and Mihir Narayan Mohanty

Abstract Many factors including noise are there for degradation of the voice signal that needs to be enhanced. In this paper, we have taken an attempt to improve the speech quality. The averaging spectral subtraction (SS) method is modified with the Welch method. In first phase, the Bartlett method is used and in the second phase, the Welch method is used as the novelty of the work. The method is based on the spectrum dependent gain function and the noise is estimated using Welch method. The overlapping windowed frames and the adaptive averaging of the gain function result better enhancement. The results obtained using the proposed method are shown in the result section. The comparison results prove the proposed algorithm is better for tidy noisy signals. For quality measure of the signals, signal-to-noise ratio (SNR), segmental SNR (SegSNR), and mean opinion score (MOS) are evaluated.

Keywords Spectral subtraction · Bartlett estimation · Welch estimation · Segmental SNR · Mean opinion score

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1 Introduction

The task of speech enhancement is an emerging area of research in current decade. Many techniques have been applied in this field since a long. The enhancement methods are used for speech recognition, mobile communication, hearing aids design, teleconferencing systems, etc. Speech enhancement algorithms are mainly based on filtering, decomposition methods, and subspace methods [1–3]. Without loss of information to obtain a clean speech is still a challenge in this part of research. The appropriate estimation of signal has a major role on speech quality improvement.

Boll proposed spectral subtraction (SS) method to estimate the noise spectrum during the silence segments of the speech. An estimate of the noise was subtracted from the noisy speech spectrum to obtain the clean signal [4]. Voice activity detection (VAD) algorithm was used to identify the silent region of the speech signal. This performed well in the stationary noise environments. However, in non-stationary noise environment, it was not well suited. The MMSE approach for noise estimation was used that was continuously track the change of the noise spectrum and the short-time spectral amplitude of the signal was used for perception [5].

For noise cancellation in speech enhancement, different adaptive algorithms are proposed and designed by authors. The fast affine projection was used for attenuating the noise with the combination of Euclidean direction search algorithm [6]. A better enhanced signal was achieved by the combination of these two algorithms by attenuating the noise. To improve the performance of the adaptive filter, the convex combination of WSLMS algorithm was used as component filter. The performance of speech enhancement systems was improved in terms of mean-squares-error (MSE). State-space recursive least square algorithm based on time-varying filter and least square method was developed for enhancement of the noisy speech signals. The quality of signals was compared with LMS and recursive least square (RLS). The SS algorithm and the standard adaptive algorithms were tested for different signals. For noise reduction and speech enhancement, kalman filter, minimum variance distortion less response (MVDR) were used. The beamformer was designed by optimizing the worst-case performance and formulated by second-order kalman filter [7–9]. To cancel the echo and the external noise present in the speech signal, the adaptive LMS filter was used to eliminate the noise [10, 11].

Different forms of spectral subtraction methods are presented in [12]. The spectral subtraction using over subtraction factor, multiband spectral components, iterative subtraction technique and perceptual properties were used to eliminate the half wave rectification. Different objective measures such as, SNR, perceptual evaluation of speech quality (PESQ), and the subjective measure such as, spectrograms, listening rests were evaluated to measure the noise and speech quality for both stationary as well as non-stationary signals. It was marked from the results that the minimal speech distortion was in the enhanced speech. However, the musical noise was not significantly removed. The author used a self-adaptive averaging factor to estimate the a priori SNR that used the low-frequency sections of noisy speech. The method was capable of tracking the noise time variation with low computational complexity [13,

14]. Still the noise was not removed from the speech signals completely. The power spectral subtraction [15] and the magnitude spectral subtraction [16] estimated the noise from the initial frames and were subtracted from noisy spectral magnitude; the successive proposed steps were removed the residual noise and attenuated signal to improve the performance. Li et al., first analyzed the β-order generalized spectral subtraction (GSS) in respect of gain function [17]. A data-driven optimization technique was quantitatively determined the β changes with the input SNR changes. The spectral order parameter updated the SNR adaptively in each band frame to frame. The performance of the proposed method was evaluated in various noise conditions by SegSNR and log-spectral distance (LSD).

As mentioned in the literature, musical noise present in the signal through subtraction reduces the quality of the speech signal. The large variance in the spectral estimation and the large variance in the gain function create the musical noise. To overcome these issues, Gustafson et al. [18] divided the frame into subframes and averaged to find a lower variance spectrum. In this work, the noise estimation was calculated by Welch method instead of Bartlett method. The overlapping windowed frames are considered to estimate the noise in the speech absence region. The proposed method is described in the next section.

2 Proposed Method

In this work, the basic method is chosen as power spectral estimation method. Out of many methods modified, Welch method is utilized as the novelty of this work. In standard Welch method, the signal usually divides into non-overlapping frames and is similar to Bartlett method where the frequency resolution is considered to be reduced. For the sake of comparison, initially, Bartlett window is used in spectral subtraction method. In this proposed method, the signal is divided with overlapping frames. Further to evaluate the frame of the signal, Hamming window is used for each frame so that the spectrum of the signal is estimated and updated where the signal is not present. The initial segment is considered as the silent region and the noise is estimated during this period. Figure 1 represents the block diagram of the proposed method used for speech enhancement.

Consider $y(t)$ is the noisy signal and is represented as,

$$y(t) = s(t) + n(t) \tag{1}$$

where $s(t)$, $n(t)$ are the clean and noise signals, respectively. Assuming the noise is adaptive and stationary. Additionally, the noise has zero mean and is uncorrelated with the clean signal. The signal is processed frame wise and the Fourier transform is represented as

$$Y(f, k) = S(s, k) + N(f, k) \tag{2}$$

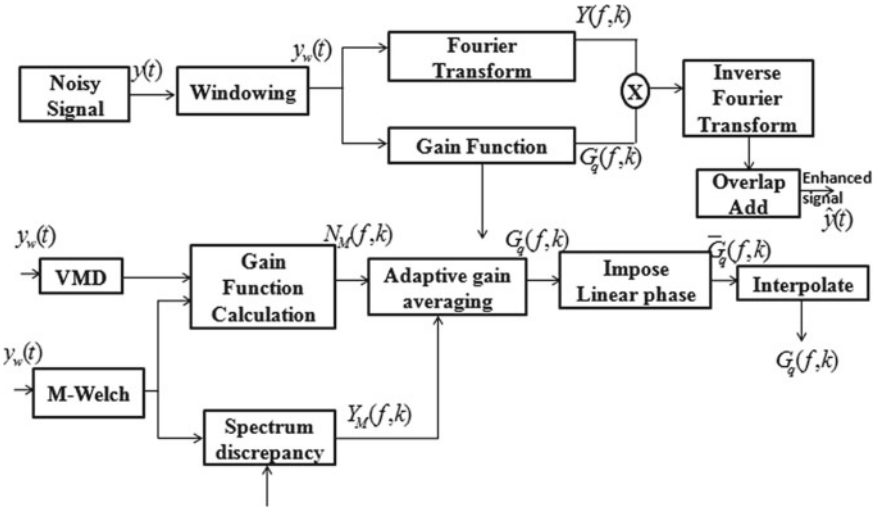

Fig. 1 Proposed method for speech enhancement

where k represents the frame number. The power spectrum of the framed signal $y(t)$ has no cross-terms as the signal is uncorrelated with the noise and is represented as,

$$|Y(f,k)|^2 = |S(f,k)|^2 + |N(f,k)|^2 \tag{3}$$

By subtracting an estimate of noise from the noisy signal, the enhanced signal is estimated and can be written as,

$$\left|\widehat{S}(f,k)\right|^2 = |Y(f,k)|^2 - \left|\widehat{N}(f,k)\right|^2 \tag{4}$$

The noise spectrum $\left|\widehat{N}(f,k)\right|^2$ is estimated by averaging the silent regions of the overlapping frames. The input signal $y(t)$ is divided into L sample frames and again subdivided into M number of subframes. The overlapping segments are represented by

$$y_m(t) = w(n)y(t+mk) \tag{5}$$

with, $t = 0, 1, 2, \ldots, M-1$ and $m = 0, 1, 2, \ldots, L-1$. k is the window size and $w(n)$ is the window function. Then, the periodograms of the mth block is given by

$$P_{y_m M}(f,k) = \frac{1}{M}|Y(f,k)|^2 \tag{6}$$

The noise estimation through the Welch can be written as,

$$\left|\widehat{N}(f,k)\right|^2 = \frac{1}{L}\sum_{m=0}^{L-1} P_{y_{m,m}}(f,k) \tag{7}$$

The computed spectrum in each subframe is averaged to a low-variance magnitude spectrum estimate as $\overline{Y}_q^M(f,k)$, where q denotes the frame number and M is the size of FFT. From $\overline{Y}_q^M(f,k)$, the gain function is written as,

$$G_q^M(f,k) = 1 - a\frac{\left|\widehat{N}(f,k)\right|}{\overline{Y}^M(f,k)} \tag{8}$$

where a is the subtraction factor. The gain function is averaged over time to reduce the variability and becomes

$$\overline{G}_q^M(f,k) = \alpha\overline{G}_q^M(f,k) + (1-\alpha)G_q^M(f,k) \tag{9}$$

where $\overline{G}_q^M(f,k)$ is the smoothed gain function and α is the adaptive smoothing parameter. It is derived from a spectral discrepancy measure [18]. The enhanced signal is obtained by computing the inverse FFT as,

$$\widehat{S}(f,k) = \overline{G}_q^M(k).Y(f,k) \tag{10}$$

This method is applied on different noisy signals to measure the quality of the signals and the results are presented in the next section.

3 Results and Discussion

To test the results, seashore noise is considered. Different signals are recorded from both male and female speakers in a classroom. The signals are recorded using Philips sound recorder in a closed room. The seashore noise is recorded near the beach and added to the signal to make them noisy. All experiments are executed in MATLAB environment. Figure 2 shows the clean signal '*He wrote down a long list of item*' and Fig. 3 represents the noisy signal of seashore noise.

All the recorded signals are in.wav format and originally the sentences are sampled at 44 kHz and down sampled to 8 kHz. The duration of signals is 2–4 s. First, the signals are divided into 20 ms of speech with 50% of overlap. The length of the frame is 160 with hamming window is multiplied to the overlapped frame. The length of the periodograms must be the power of 2 and chosen as 32. This provides a total length $L + M = 192$. This should be less than the size of FFT and the size of the FFT is 256. The smaller value of the periodograms provides the small variance whereas the larger value does not remove the musical noise. The subtraction factor (a) is chosen

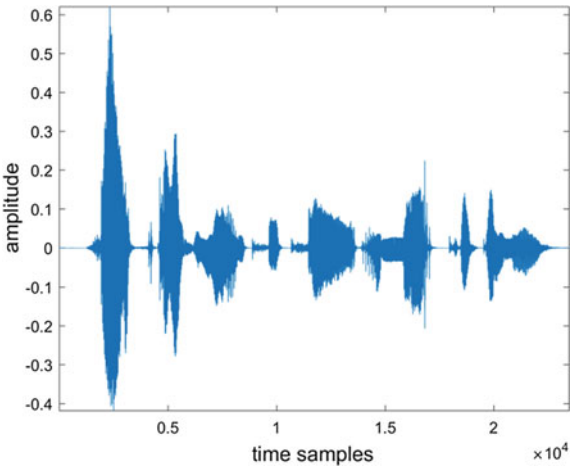

Fig. 2 Clean signal '*He wrote down a long list of item*'

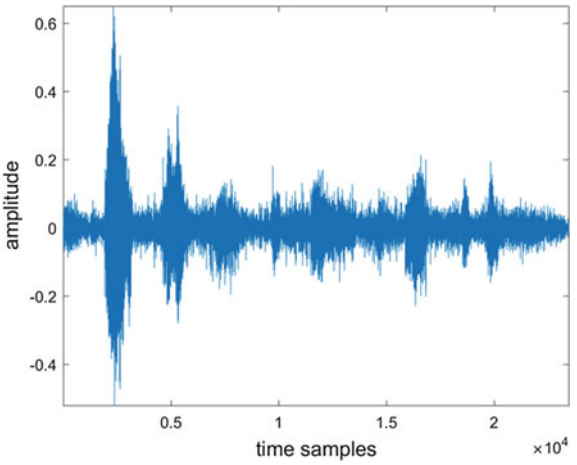

Fig. 3 Noisy speech with tide noise

iteratively and set at 0.8. The time constant controls the average spectral discrepancy and chosen as 0.7.

Figures 4 and 6 show the enhanced signal and convergence curve using spectral subtraction of Bartlett adaptive averaging method respectively. Figure 5 shows the enhanced signal obtained from the proposed method. Figure 7 shows the convergence rate of the proposed method. The MSE converges after 20,000 iterations in both the methods; however, the convergence rate is linear as shown in Fig. 7.

To measure the performance, SNR is calculated frame wise and is represented as,

$$\begin{aligned}\Delta\mathrm{SNR}(q) &= \mathrm{SNR}_{\mathrm{out}}(q)(\mathrm{dB}) - \mathrm{SNR}_{\mathrm{in}}(q)(\mathrm{dB}) \\ &= \frac{\mathrm{SNR}_{\mathrm{out}}(q)}{\mathrm{SNR}_{\mathrm{in}}(q)}\end{aligned}$$

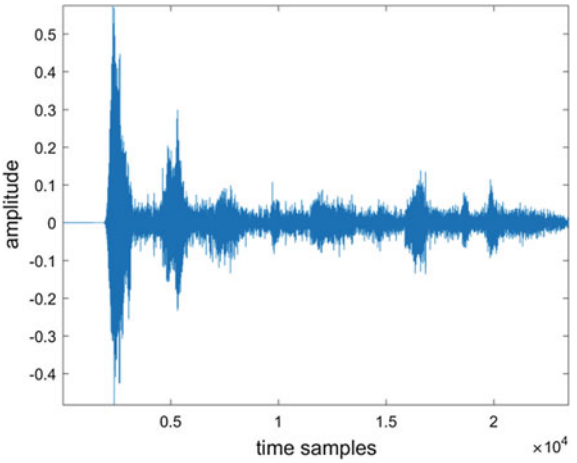

Fig. 4 Enhanced signal using SS with Bartlett adaptive averaging method

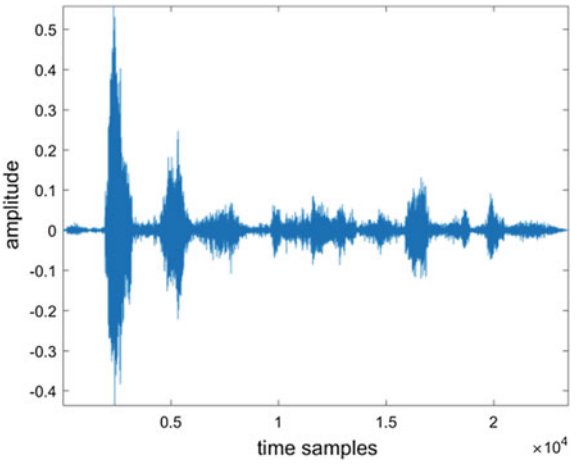

Fig. 5 Enhanced signal using proposed method

$$= \frac{P_{\mathrm{n}}(q)}{P_{\mathrm{nw}}(q)} \cdot \frac{P_{\mathrm{sw}}(q)}{P_{\mathrm{s}}(q)} \tag{11}$$

where $P_{\mathrm{n}}(q)$ is the power spectral density (PSD) of noise signal, $P_{\mathrm{sw}}(q)$ is the processed background noise signal, and $P_{\mathrm{s}}(q)$ is the input speech signal. The $\mathrm{SNR}_{\mathrm{out}}$ and $\mathrm{SNR}_{\mathrm{in}}$ are represented as,

$$\mathrm{SNR}_{\mathrm{out}}(q) = \frac{P_{\mathrm{s}}(q)}{P_{\mathrm{n}}(q)}$$

$$\mathrm{SNR}_{\mathrm{in}}(q) = \frac{P_{\mathrm{sw}}(q)}{P_{\mathrm{nw}}(q)}$$

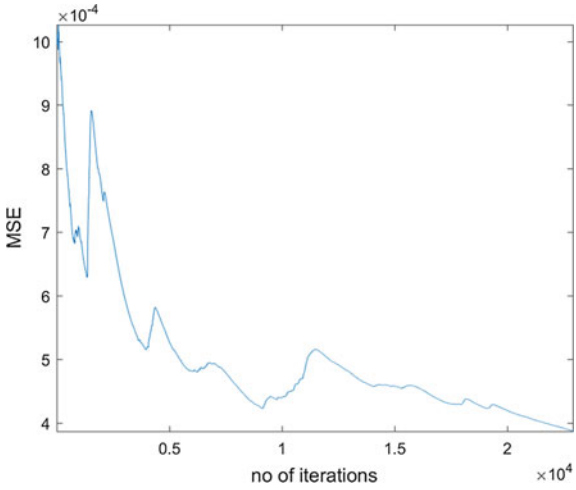

Fig. 6 Convergence rate using SS with Bartlett adaptive averaging method

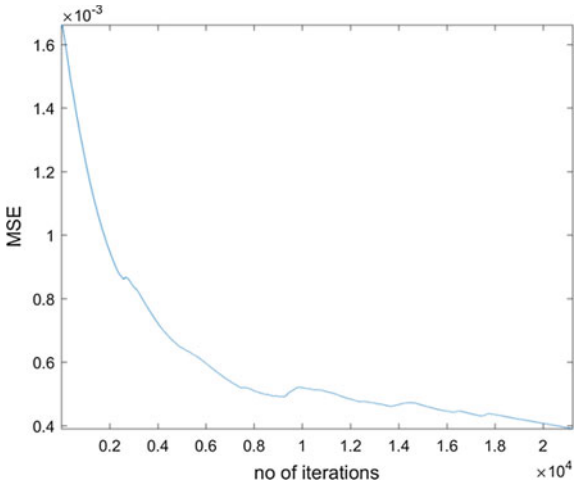

Fig. 7 Convergence rate using proposed method

The noise reduction during the speech periods can be calculated as,

$$\text{Noise Reduction} = \frac{P_{\text{n}}(q)}{P_{\text{nw}}(q)} \tag{12}$$

Table 1 shows the quality measure of different methods in terms of SNR, SegSNR [3], and MOS [2].

In the proposed method, the SNR before enhancement is 6.34 dB and after enhancement, it is 8.21 dB. The SegSNR of noisy speech is 0.11 dB. After enhancement, it is 2.95 dB. In addition to this, MOS is more preferable for quality measure of the speech signal. From the proposed method, the MOS is obtained 2.82.

Table 1 Comparison using different objective measures

Method	Quality measures		
	SNR (dB)	SegSNR (dB)	MOS
Noisy signal	6.34	0.11	1.64
SS using Bartlett adaptive averaging	7.10	1.65	2.46
Proposed method	8.21	2.95	2.82

4 Conclusion

In this work, spectral subtraction with adaptive averaging is implemented for speech enhancement. The Welch method is used for estimating the noise spectrum. The overlapping window frames used to estimate the periodograms provide better noise estimation. Consequently, the subtraction of proper noise estimates results the better enhancement of the noisy signals. The adaptive averaging of the gain function provides the lower variance and reduces the noise. The additive seashore noisy signal is considered to evaluate the performance of the proposed method. Different quality measures prove the efficacy of the proposed method.

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Optical Wave Guide: Fast and Secure Communication for Next-Generation Technology

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Abstract Optical communication is an indispensable technology for current society requirements. It satisfies the short-distance and long-distance communication with the help of different mode analysis of variety type of fibers. In this paper, an analytical study has been presented that can help the next-generation high-speed secure communication. The advantage is that, it can act as the filter in terms of signal processing and channel in terms of communication. The waveguide can satisfy in both the way. For revolutionary communication and signal processing, it is found that optical waveguide research can satisfy future generation communication. The suitable design can be used for all optical signal processing. This article can provide insight to the researchers working in this direction.

Keywords Optical fiber · Optical communication · Waveguide · Optical waveguide · Optical signal processing

1 Introduction

Over the past decades, optical communication has established itself as the indispensable network technology for societal IP-driven traffic, resulting in a dependence of our society on this network technology. Optical waveguide is a guiding structure that guides light with the scale of optical wavelength. Many waveguide structures such as longitudinally uniform, angularly uniform, and longitudinally periodic are possible. Researchers modified different optical waveguide concepts some extent

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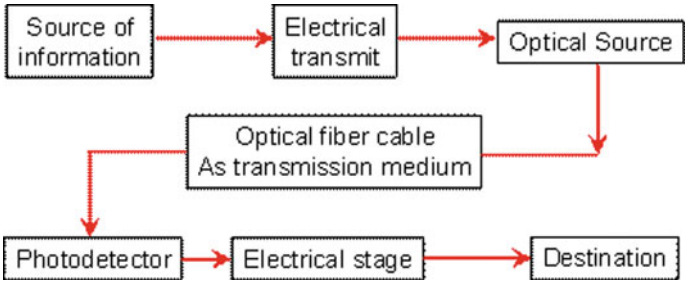

Fig. 1 Generalized optical communication system

based on geometry, refractive index, and materials used. It may photonic crystal waveguides, slotted photonic crystal waveguide (SPCW), Silicon-on-insulator-based strip and slot waveguides, silicon nanophotonic waveguides, gallium-nitride ridge waveguides, polymer optical waveguides, chalcogenide waveguides, nanoplasmoic waveguide [1–4]. For high-speed signal processing application with the development of silicon-based photonic technology optical waveguide occupied a special position in this technical era. To derive optimum performance from optical fiber glass, it is a crucial task. By adopting different techniques with an optical waveguide, many nonlinear optical effect such as phase modulation, four wave mixing, and Raman scattering can be achieved [5].

The types of optical detectors may be of photodiodes, phototransistors, and photoconductors. The electrical stage receives the information and provides it to the destination as shown in Fig. 1 for the basic optical communication system.

In case of digital optical fiber communication system, information is encoded prior to drive circuit of optical source and at the receiver end, a decoder is used after amplification and equalization.

Optical fiber is simply one type of dielectric waveguide through which information is transmitted in the form of light. It consists of a transparent core with certain refractive index surrounded by cladding which is of less refractive index. The cladding supports the waveguide and protects the core from contaminated absorbing surface. Due to its thickness, substantially, it reduces the radiation loss. A set of guided electromagnetic waves can define the propagation of light along the waveguide is called as modes of waveguide [6].

In high-speed communication network system, data signals, in the form of optical pulses, are traveling at the speed of light in fibers. While signal processing is still performed in electrical domain. It requires optical-electrical-optical conversion, which imposes a bandwidth limit for each transmission channel. Optical signal processing can be applied to break such a bottleneck as it relies on nonlinear optical effects that have nearly instantaneous response. The following subsection describes regarding the earlier work performed in this context.

2 Related Literature

Due to two key developments in the optical domain, the 1960s mark the introduction of the optical transmission systems which now form the backbone of the worldwide communication network. One of these developments was the development of the laser in 1960 [2]. This achievement was quickly followed by the demonstration of the first Gallium Arsenide (GaAs) semiconductor laser in 1962 [3], and was particularly important, as it was the first coherent optical frequency oscillator. Accordingly, this demonstration showed the optical equivalent of the electrical oscillator. The second key development was the fiber medium, which has a long history of achievements. A key moment was 1966, when C. K. Kao and G. A. Hockham posed the idea that the optical fiber attenuation could be reduced <20 dB km^{-1}, the ocular attenuation figure, by reducing impurities [4]. At that time, the attenuation figure of optical fibers was >1000 dB km^{-1}, which were used for medical applications [5]. Among other contributions, the proposal of using optical fibers for telecommunications resulted in C. K. Kao receiving the Nobel Prize in Physics in 2009. In 1970, engineers at the Corning Glass Works (now Corning Inc.) developed the first single mode fiber (SMF) with an attenuation figure <20 dB km^{-1}. The theoretical model of the SMF was first described by E. Snitzer in 1961 [6], which could minimize the attenuation figure. Over the following years, the SMF drawing and purity were optimized to decrease the medium's attenuation. Currently, commercial SMFs approach the fundamental attenuation figure of ~0.148 dB km^{-1} at 1550 nm [7], where the measured attenuation is ~0.2 dB km^{-1}. This attenuation was reached in 1980 [8].

The wavelength region is subdivided into transmission windows. Since, the lasers are optical oscillators, they allow for the subdivision of the wavelength region for FDM in the optical domain termed wavelength division multiplexing (WDM). WDM was first demonstrated in the laboratory in 1978 [9], and is currently standardized in the ITU G.694.1 standard to account for a channel spacing of 12.5, 25, 50, and 100 GHz [10]. As WDM is the optical equivalent of FDM, optical TDM (OTDM) was also proposed for optical transmission systems. However, it was never widely adopted. Due to its implementation simplicity, WDM transmission became the standard for optical transmission systems. However, the transmission distance remained short before optical-electrical-optical conversion repeaters were required. Nevertheless, this transmission distance was substantially longer than copper-based solutions could achieve. Coherent transmission and detection were proposed to extend the transmission distance [11]. However, the solution for increasing the transmission distance without requiring OEOC repeaters came with the invention of the low-noise erbium doped fiber amplifier (EDFA) by R. J. Mears et al. in 1986 [12], and the EDFA demonstration in 1987 by R. J. Mears et al. and E. Desurvire et al. [13]. This demonstration caused the development of coherent transmission to be halted as the EDFA allows low-noise optical amplification of the transmitted signal in the wavelength region. The development of the EDFA is the reason the conventional band is designated as such. By changing the wavelength of the pump laser, the long band can be amplified instead of the conventional band.

As the ITU specifications denote standardized channel spacings, the serial rate cannot increase indefinitely as two neighboring channels start overlapping in the frequency domain. In the late 1990s, all transmission systems were direct-detection, i.e., the received power denotes the binary values being transmitted. To increase the SE, coherent receivers were reintroduced in 2004 [14], and were combined with powerful digital signal processing (DSP) techniques to compensate for linear transmission impairments. Coherent transmission exploits the amplitude and phase dimensions, and can, therefore, increase the SE over direct-detection transmission systems. This was a common transmission technique for radio communications, denoted as quadrature amplitude modulation (QAM). Soon after the reintroduction of coherent receivers, it was proposed to exploit the two linear polarization dimensions of the SSMF [15], which is denoted as polarization division multiplexing (PDM). The two modulated channels are mixed during transmission, and were unraveled at the receiver side using 2×2 multiple-input multiple-output (MIMO) equalization. Note that both polarization channels use the same frequency spectrum. Accordingly, the SE is doubled with respect to single polarization transmission. In 2010, the first real-time $\geq$100 Gbit s^{-1} $carrier^{-1}$ employing two information channels using PDM was demonstrated using prototype equipment. Information theory and DSP became popular topics in optical transmission systems to maximize the throughput in SSMFs by compensating linear and nonlinear transmission impairments. GVD compensation in coherent transmission systems was performed in the digital domain using DSP without a penalty with respect to dispersion shifted SMFs. Therefore, DS SMFs were no longer commonly used in long-haul transmission systems. By using WDM and direct-detection receivers, a throughput of 10 Tbit s^{-1} was achieved [16].

Using coherent transmission with higher order modulation formats and simultaneously exploiting the two available polarizations in an SSMF, a throughput of ~100 Tbit s^{-1} was achieved [17]. All possible orthogonal dimensions were exploited simultaneously, corresponding to a theoretical throughput limit of the SSMF. To further increase the throughput of a single fiber, only one option was left unexploited: space. Therefore, the optical transmission systems exploiting the spatial dimension are termed SDM [16]. Earlier SDM work using direct-detection referred used the terminology mode group diversity multiplexing (MGDM) due to the usage of multimode fibers (MMFs). Through the aforementioned technologies, the SSMF throughput has increased substantially for research systems over the recent decades. However, since the mid-1980s, rapid growth in capacity demand has also been observed from the commercialization of optical telecommunication networks and IP-driven traffic, where modern commercial products already exploit PDM and WDM transmission. It was observed that the throughput in commercial products closely follows the throughput increase achieved in research systems. However, it was previously noted that ~100 Tbit s^{-1} was the theoretical limit of SSMFs [17].

For high-speed signal processing application, the silica-based waveguide coherent optical transversal filter with a tapped delay-line structure was described [18]. It was experimentally confirmed that these filters could process broad-band signals over 4 THz. At the same time, the future computer architecture the ultra fast data transfer

can be achieved by using optical switches made from optical waveguide. So a temperature stable optical waveguide had been realized and integrated into PCB [19]. GaN is having properties of low thermo-optical co-efficient, weak material dispersion, high optical damage threshold and chemical stability; hence, it was promising material for operation at high temp and for hybrid integration on silicon. Thus, suitable for making optical waveguide with low loss [20]. Ridge waveguides in GaN with propagation losses as low as 1 dB/cm at 1550 nm have been reported [21–23]. Large information capacity of an optical waveguide such as it must be capable of serving very hares environment condition. It exhibited a very rapid response to ultraviolet radiation at 6 mW cm^{-2} [24]. Silicon-on insulator (SOI) was considered a well-suited system of making compact/miniaturized optical linear as well as nonlinear devices. It has a great attraction due to compatibility with the existing CMOS technology [25]. SMF was used for broad-band signal processing around 10 GHz of bandwidth due to the good property of propagation and delay.

It is difficult to construct and reproduce effective delay-line filter using SMF until verification of the related important parameters. The dominant dispersive mechanism depends on the waveguide properties of the fiber and the spectrum of the optical source. Whereas multimode fiber can maintain the group velocity and can guide many modes at time that results the fidelity with high-frequency components but in limited range. Digital signal processing comes to rescue and is a critical technology underpinning the next-generation advanced fiber-optic systems. Literally, it contributes two principal enforcements with respect to information communication. One is the implementation of spectrally-efficient modulation schemes, and the other is the guarantee of the recovery of information from the spectrally-efficient optical signals after channel transmission. However fails to satisfy long-haul communication. Guided wave optics covers both fiber and integrated optics technology. Hence, photonics technology improves optical communication and minimizes the optical components used for communication as well as measurement applications. It has following advantages.

1. It can allow even the sharp bends.
2. It can provide large-scale photonics component circuits and its integrated devices.

The waveguide can support a large number of modes and therefore, any changes of the waveguide geometry must be made with great care bearing in mind mode conversion and reconversion phenomena. This requires a detailed study of wave transmission in multimode waveguides and the coupling effects due to irregularities; a field relatively unexploited in its analytical and experimental aspects. Despite all the planning difficulties, a waveguide when properly designed will give satisfactory service and will handle successfully a bandwidth well in excess.

All-optical signal processing is an essential feature for next-generation communication. As a result, it can reduce the complexity, probability of wavelength blocking to increase the capacity. All-optical switches, logical gates, parametric amplifiers, format converters, and wavelength converters have been realized earlier, where silicon waveguides shown better performance. FWM has the ability to preserve the amplitude and phase information simultaneously. All-optical signal processing based

on FWM in silicon waveguides, including wavelength conversion, wavelength multicasting, and logic gates have been proposed. Spectral filtering is a critical operation. In optical signal processing applications, like arbitrary waveform generation and RF signal channelization, spectral filtering found critical [26, 27].

3 Analytical Characteristics of Optical Waveguide

Optical waveguides are used as components in integrated optical circuits or as the transmission medium in local and long-haul optical communication systems. These are classified according to their geometry mode structure, refractive index distribution, and material. Passive waveguides, electrooptic components, transmitters, receivers, and driving electronics can be integrated into one chip using planar technology, similar to microelectronics. These parameters must be optimized before fabricating a device. With large-scale optoelectronic circuits, accurate modeling is predominant because of the numerous resources required to fabricate a chip. Optical waveguide design relies on simulating the propagation of light signals, waveguide modes, mode coupling, and loss and gain. Waveguides are the building blocks of photonic circuits. The width of a waveguide (constant or variable) is defined as perpendicular to the path along the waveguide center.

Any wave characterized by,

$$E(r, t) = A(r, t)\exp(\varnothing(r, t)) \tag{1}$$

$A(r, t)$ is the amplitude and $\varnothing(r, t)$ is the phase component of the signal.

A pulse propagating in any three-dimensional medium can have three components varying with the respective direction as

$$E(x, y, z, t) = \hat{i}E_x(x, y, z, t) + \hat{j}E_y(x, y, z.t) + \hat{k}E_z(x, y, z, t) \tag{2}$$

Similarly,

$$H(x, y, z, t) = \hat{i}H_x(x, y, z, t) + \hat{j}H_y(x, y, z, t) + \hat{k}H_z(x, y, z, t) \tag{3}$$

$\hat{i}$, $\hat{j}$, and $\hat{k}$ is the direction vector for X, Y and Z direction.

In planner optical waveguide, TE and TM modes with none vanishing $E_y H_x H_z$ and $H_y E_x E_z$ modes exists, respectively. So it can always form wave equation H_z and get transverse components E_y and H_x and E_z(longitudinal component) $= 0$, i.e., TE and similarly to form wave equation E_z and get the transverse component sH_y and E_x, i.e., TM mode.

In circular waveguide, the plane of polarization is not stable due to geometry. In optical fiber, the refractive index variation in r and $\varnothing$ direction as $n^2(r, \varnothing)$.

The $\vec{E}$ and $\vec{H}$ fields are

$$\overrightarrow{E}(r, \varphi, z, t) = \overrightarrow{E}(r, \varphi)\mathrm{e}^{i(\omega t - \beta z)} \tag{4}$$

$$\overrightarrow{H}(r, \varphi, z, t) = \overrightarrow{H}(r, \varphi)\mathrm{e}^{i(\omega t - \beta z)} \tag{5}$$

The transverse components $\overrightarrow{E_r}$ and $\overrightarrow{E_\varnothing}$ in terms of longitudinal component $\overrightarrow{E_z}$ and $\overrightarrow{H_z}$ by substituting Eqs. (1) and (2) in the Maxwell's equations

$$\nabla \times \overrightarrow{E} = -\mu_0 \frac{\partial \overrightarrow{H}}{\partial t} \tag{6}$$

$$\nabla \times \overrightarrow{H} = \varepsilon \frac{\partial \overrightarrow{E}}{\partial t} \tag{7}$$

And by doing some mathematical manipulations, it will have the form of

$$\frac{\partial^2 \overrightarrow{E_z}}{\partial r^2} + \frac{1}{r}\frac{\overrightarrow{E}_z}{\partial r} + \frac{1}{r^2}\frac{\partial^2 \overrightarrow{E_z}}{\partial \varnothing^2} + \left[K_0^2 n^2(r) - \beta^2\right]E_z = 0 \tag{8}$$

$$\frac{\partial^2 \overrightarrow{H_z}}{\partial r^2} + \frac{1}{r}\frac{\overrightarrow{H}_z}{\partial r} + \frac{1}{r^2}\frac{\partial^2 \overrightarrow{H_z}}{\partial \varnothing^2} + \left[K_0^2 n^2(r) - \beta^2\right]H_z = 0 \tag{9}$$

By solving Eqs. (8) and (9), we can get E_z and H_z. But the modes cannot be distinguished. But in case of $\varnothing$ independent the E_z and H_z can be separated. So, in general, these are hybrid modes (HE and EH). So any optical waveguide obeys these set of equations.

Showing the dispersion characteristic, a single pulse can be analyzed propagating with Z-direction which is direction of propagation through the optical fiber (It has only one component arbitrarily) as,

$$E(z, t) = \hat{i}E_x(z, t)$$

It will obey the wave equation

$$\nabla^2 E(z, t) = \frac{1}{C^2}\frac{\partial^2 E(z, t)}{\partial t^2} \tag{10}$$

$C \rightarrow$ speed of light.

Solution of this equation becomes

$$E(z, t) = S(z, t)\exp(j(kz - \omega_0 t)) \tag{11}$$

For Gaussian pulse, at $z = 0$.

The amplitude becomes,

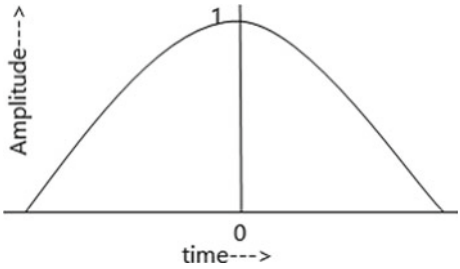

Fig. 2 Gaussian distribution sinc pulse

$$S(0.t) = A\exp\left(\frac{-t^2}{2T^2}\right) \tag{12}$$

Similarly, the EM field at $Z = 0$ from Eq. (11)

$$E(0,t) = A\exp\left(\frac{-t^2}{2T^2}\right)\exp(-j\omega_0 t) \tag{13}$$

As it is known that a *rect* pulse in time domain is always a *sinc* pulse in frequency domain. Here, sinc pulse is Gaussian distributed as depicted in Fig. 2.

The original propagation takes place in frequency domain, and so, the expression of pulse in frequency domain will be,

$$\widetilde{E}(0,\omega) = \frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} E(0,t)\exp(j\omega t)\mathrm{d}t \text{ at } z = 0 \tag{14}$$

After a distance 'z', the pulse becomes,

$$\widetilde{E}(0,\omega) = \frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} E(0,t)\exp(j\omega t)\exp(jkz)\mathrm{d}t \tag{15}$$

In time domain, the expression of pulse becomes

$$E(z,t) = \frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} \widetilde{E}(0,\omega)\exp(-j\omega t + jkz)\mathrm{d}\omega \tag{16}$$

Here, 'k' is the wave number which is function of angular frequency as

$$k = k(\omega)$$

and $k(\omega) = \frac{\omega_n(\omega)}{C}$.

The refractive index is the function of optical frequency using Lorentz formula,

$$n(\omega) = \sqrt{n_0^2 + \sum_i \frac{b_i}{\omega^2 + \omega_{0i} + 2j\delta_i\omega}} \tag{17}$$

$$k_n(\omega) = \sum_{n=0}^{\infty} \frac{1}{n!} k_n(\omega_0)(\omega - \omega_0)^2 \tag{18}$$

$$k_n(\omega_0) = \frac{\partial^n(k)}{\partial\omega^n} \text{ at } \omega = \omega_0 \tag{19}$$

By expanding up to ω^2 term and further simplifying the equation may be written as,

$$E(z,t) = S(z,t)\exp(j(k(\omega_0)z - \omega_0 t)) \tag{20}$$

The amplitude of Gaussian pulse is

$$S(z,t) = \frac{A}{\left(1 + \frac{k_2(\omega_0)z^2}{T^4}\right)^{1/4}} \exp\left(\frac{(k_1(\omega)z - t^2)}{2T^2(1 + k_2(\omega_0)z^2/T^4}\right) \tag{21}$$

From the above equation, we can observe the pulse remain Gaussian but the width of the pulse increases with the decreasing amplitude of the pulse. So intersymbol interference and absorption occur. So it is not sufficient for making a economical effective optical communication.

4 Remarks for Future Work

The use of optical fiber increases day-by-day in telecommunication sector, industries, and defense along with for storage and commercial applications. Due to extremely lower attenuation and interference, optical fiber has large for long-distance, high-demand applications. Simultaneously, the prices of fiber-optic communications have dropped considerably since 2000. Optical signal processing put together variety fields of optics and signal processing such as, nonlinear devices and processes, analog and digital signals. To achieve high-speed signal processing functions for line rate of fiber-optic communications, information can be encoded spatial features of an optical wave to achieve high-capacity transmission. It requires to revisit advances in the key enabling technologies that led to recent research in optical signal processing for digital signals that are encoded in one or more of these dimensions. Recent advances in high-speed optical signal processing applications in the areas of equalization, regeneration, flexible signal generation, and optical logic are to be analyzed in proper way. Similarly, the development of waveguides for different application based on digital signal processing can be the significant research in the future.

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Removal of Artifact from the Brain Signal Using Discrete Cosine Transform

Sandhyalati Behera and Mihir Narayan Mohanty

Abstract Electroencephalogram (EEG) signal processing is an emerging research area out of many biomedical applications. Brain waves study and characterization can be done for various faults. However, artifacts within the signal are like inherent property. The removal of artifacts is the major challenge that has been considered in this work by authors. The removal process is transformed based application within independent components. In first stage, the independent components are derived from the raw data. Further, the artifact channels are identified using statistical approach. Scaled entropy and kurtosis are used for it and fixed the threshold level. Finally, the application of discrete cosine transform (DCT) provides the clean signal that is used for analysis and diagnosis. The results are exhibited in the result section and compared with earlier methods.

Keywords Discrete cosine transform (DCT) · Electroencephalogram (EEG) · Electro-oculography (EOG)

1 Introduction

The record of the electrical activity introduced at the scalp by the flow ionic currents across and along the membranes of neurons of the brain is called electroencephalogram (EEG). During the time of recording, EEG signal undergoes different types of artifacts. The artifact in EEG may be either technical which is also known as external artifact or patient related which is the internal artifact. The patient-related artifacts

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significantly create disturbances in EEG and that to be removed from EEG for clear diagnosis.

There are many sources of EEG artifacts. Power line disturbance, fluctuation in impedance, cable movements, broken wire contacts, too much electrode paste, and low battery are some technical artifacts. The EMG (Electromyography), eye movements, and sweating are the patient-related artifacts [1]. Due to artifacts, the important information in EEG signal may lost and this becomes too difficult to analyze the EEG to obtain the clinical information. There is different methods of artifact removal which include filter method, manual method, and automatic artifact rejection method [2]. The adaptive time domain filter and empirical mode decomposition (EMD) are used to separate EOG artifact from the EEG signal. For the adaptive time domain filtering, fractional Gaussian noise (fGn) is used as a reference signal. The band pass Chebyshev filter is used to remove the artifact after transforming the EEG signal to the frequency domain with the help of fast Hartley transform. The detection of artifact is the first stage in artifact removal process. The regression method can be used for artifact removal if the reference signal is available. The generalized Eigen value decomposition method is used for separating the artifactual and non-artifactual subspaces [3, 4]. This method is based on identifying the number of ocular subspaces. The singular value decomposition (SVD) is used to remove unwanted component in EEG signal. For detection of high-dimensional signals in presence of white noise, simple Eigen value-based procedure is applied. The Eigen values are obtained from the population co variance matrix. The effective number of identifiable signals is obtained with the help of a threshold. The Eigen values greater than the threshold are the high-dimensional signals.

The detection of artifact can be done by using statistical approach and also done by machine learning approach. For the machine learning approach, both supervised and un supervised learning algorithms are used [5–12]. Artificial neural network (ANN) and support vector machine (SVM) are two most popular supervised learning algorithms. The basic approach using machine learning is to classify the artifact from EEG signal. In machine learning approach, the detection of artifact depends on the appropriate feature selection and choice of machine learning algorithms. In [7], both time and frequency domain features are used to detect the required the EEG signals.

For the statistical approach, the statistical parameters like kurtosis and multiscale entropy used to detect artifact with the help of a statistical threshold [9, 13]. With the help of EOG reference channel, the wavelet transform can also use to remove ocular artifact [14]. Wavelet transform is a powerful method to remove ocular artifact from single-channel EEG devices. Both stationary and discrete wavelet transforms (SWT and DWT) are used with various wavelet basis functions, such as harr, sym3, bior4.4, and coif3 using either universal threshold (UT) or statistical threshold (ST) [15]. The motion artifact from a single-channel EEG signal is removed by multiresolution total variation (MTV) and multiresolution weighted total variation (MWTV) filtering schemes [16]. For multiresolution analysis, the discrete wavelet transforms (DWT) help to segregate the EEG signal into various sub-band signals. The total variation and weighted total variation are applied to the approximation sub-bands. Two-stage variational mode decomposition VMD-I and VMD-II is used to remove ocular artifact

effectively [17, 18]. VMD-I and VMD-II decompose the EEG signal into different modes. For the proposed method, discrete cosine transform is used to remove ocular artifact.

In this paper, the brief idea about the EEG artifact and its removal techniques are given in Sect. 1, the methods used for identification and removal of artifact given in Sect. 2, results obtained are discussed in Sect. 3, and conclusion is given in final section.

2 Methodology

The block diagram for the method used in this paper is given in Fig. 1. The multi-channel EEG signals are given to ICA to get independent components (ICs). The ICs are independent from each other. For artifact identification, two statistical parameters such as kurtosis and scaled entropies are calculated from those ICs. With the help of thresholds which are applied on the statistical parameters to identify the artifactual channels. After identification, the artifacts are removed with the help of DCT from the detected channels. At the end, the inverse DCT gets the clean signal back.

2.1 Decomposition of EEG Signal

The EEG signal is decomposed into independent components with the help of independent component analysis (ICA). The ICA is used to separate multi-channel EEG signal $E = [e_1, e_2, e_3, \ldots, e_n]^{\mathrm{T}}$ into independent sources $S = [E_1, E_2, E_3, \ldots, E_n]^{\mathrm{T}}$. E is the source EEG signal and s is the observed signal. The main aim is to minimize the mutual information and maximize the non-Gaussianity between each EEG signals. Mathematically, ICA is given by

$$S = AE \tag{1}$$

From Eq. (1), A is the mixing matrix, E is the multichannel EEG signal otherwise known as source signal. The independent component is obtained by the following equation.

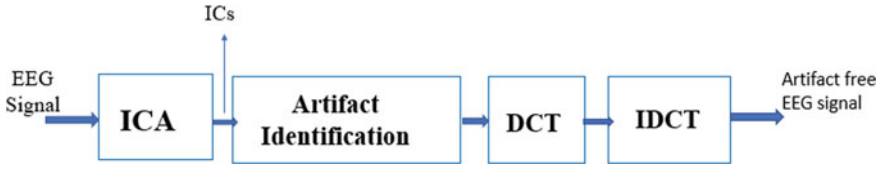

Fig. 1 Proposed method blocks

$$\text{IC} = WS \text{ and } W = A^{-1} \tag{2}$$

IC is the independent component. That means the source signals are uncorrelated with each other and non-Gaussianity is maximum among each signal.

2.2 Artifact Identification

The artifact identification is done by calculating two statistical parameters from the independent components. The statistical parameters are kurtosis and scaled entropy.

2.2.1 Scaled Entropy

The eye-blink-related artifacts are concentrated in small temporal interval with high probability and low entropy [19]. In other words, the expected value of scaled entropy is low for eye-blink artifact. So the scaled entropy is taken as a good statistical measure for identification of ocular artifact. In this paper, the scaled entropy is implemented by scaling each IC and computing the sample entropy for each scale. EEG recordings used in this paper have 2560 data points and scaling factor (τ) is 20. The average of each window is calculated by Eq. (3).

$$y_k^{\tau} = \sum_{j=(k-1)\tau+1}^{k\tau} \text{IC}_j; \quad 1 \le k \le \frac{N}{\tau} \tag{3}$$

where y_k^{τ} = average of each scaled series, IC = Independent components, N is the sample size, and $\frac{N}{\tau}$ is the number of samples in each scaled series.

The scaled entropy is calculated by using following equation

$$\text{scaled\_Entropy} = \text{SampEn}\left(y_j^{\tau}, m, \tau, r\right) \tag{4}$$

where m is the number of matching templates which is taken as 2 and r is the tolerance threshold which is taken as 20% of the standard deviation of ICs.

2.2.2 Kurtosis

At the time of occurrence of artifact, the EEG signal attains its peak value. Kurtosis is a measure of sharp peak in the dataset. For each independent component, kurtosis is calculated.

Mathematically, kurtosis is given by

$$\text{kurtosis} = m_4 - 3m_2^2 \tag{5}$$

$$m_n = E\{(\mathrm{IC} - m_1)^2\} \tag{6}$$

where m_4, m_2 and m_1 are 4th, 2nd, and 1st order moment, respectively. E is the expectation function.

2.2.3 Threshold for Identifying Artifact

The scaled entropy and kurtosis are two different parameters calculated from the ICs. As two different parameters having two different characteristics for the artifact so, two different thresholds are required for identifying the artifactual channels [9]. Two thresholds are L_Limit and U_Limit. The lower limit is based on scaled entropy and upper limit is based on kurtosis. On the use of these thresholding methods, the transients within the signal are artifacts are being identified.

The lower limit of threshold is given as

$$L\_\mathrm{Limit} = \overline{\mathrm{IC}} - \frac{\mathrm{sd}}{N} \times t_{N-1} \tag{7}$$

where $\overline{\mathrm{IC}}$ = mean of ICs, sd = standard deviation, $t_{N-1} = 2.201$ and $N = 2560$.

If scaled entropy of ICs falls below the L_Limit are consider as artifactual ICs.

The upper limit for the threshold is given as

$$U\_\mathrm{Limit} = \overline{\mathrm{IC}} + \frac{\mathrm{sd}}{N} \times t_{N-1} \tag{8}$$

If kurtosis of ICs falls above the threshold (i.e., U_Limit) is consider as artifactual ICs and need to be corrected.

3 Artifact Removal

Artifact identification is the first step in artifact removal process. The artifact removal technique is applicable to those EEG signals that have artifact. This saves the computational cost. The method for artifact removal includes the transformation of identified artifactual EEG signal into frequency domain then by applying the appropriate threshold, the artifacts are removed.

3.1 Frequency Domain Transformation

The artifactual EEG signal is transformed into its frequency domain with the help of DCT. The DCT coefficients obtained are nothing but its frequency components.

DCT represents the EEG signal into the sum of cosine functions. DCT is only the real part of fast Fourier transform (FFT) and is computationally simpler than FFT. Mathematically, DCT is given by Eq. (9).

$$D(f) = \sum_{n=0}^{N-1} \mathrm{IC}(n) \cos \frac{2\pi f n}{N} \quad 0 \leq f \leq N-1 \tag{9}$$

where $\mathrm{IC}(n)$ is the independent component. N is the number of samples and f is the frequency instant.

The inverse DCT is given by Eq. (10)

$$\mathrm{IC}(n) = \frac{1}{N} \sum_{f=0}^{N-1} D(f) \cos \frac{2\pi f n}{N} \quad 0 \leq f \leq N-1 \tag{10}$$

The IDCT is applied to get the original time domain signal.

3.2 Thresholding for Artifact Removal

After representing the artifactual EEG channels into its frequency domain by DCT, the threshold is applied to the DCT coefficients. The threshold T is given by Eq. (11)

$$T = \sqrt{2 \log N \, \mathrm{var}^2} \tag{11}$$

$$\mathrm{var}^2 = \mathrm{median}(|C(j,k)|/0.6745) \tag{12}$$

From Eq. (11) N is the number of DCT coefficients, $|C(j,k)|$ in Eq. (12) is the absolute value of DCT coefficients, and 0.6745 is a constant.

The DCT coefficients are greater than T are substituted with zero. After this replacement, the IDCT is taken to get the original signal back which is an artifact-free signal.

4 Results and Discussion

For the proposed work, the EEG signal is taken from CHB-MIT scalp EEG database have 23 used EEG channels. The signal plot of 23 EEG channels is shown in Fig. 2. The EEG signal of each channel has 2560 samples.

The amplitude of EEG signal is small and normally lies within 100 μV. The EEG signal having amplitude more than this range is said to have artifact and this artifact

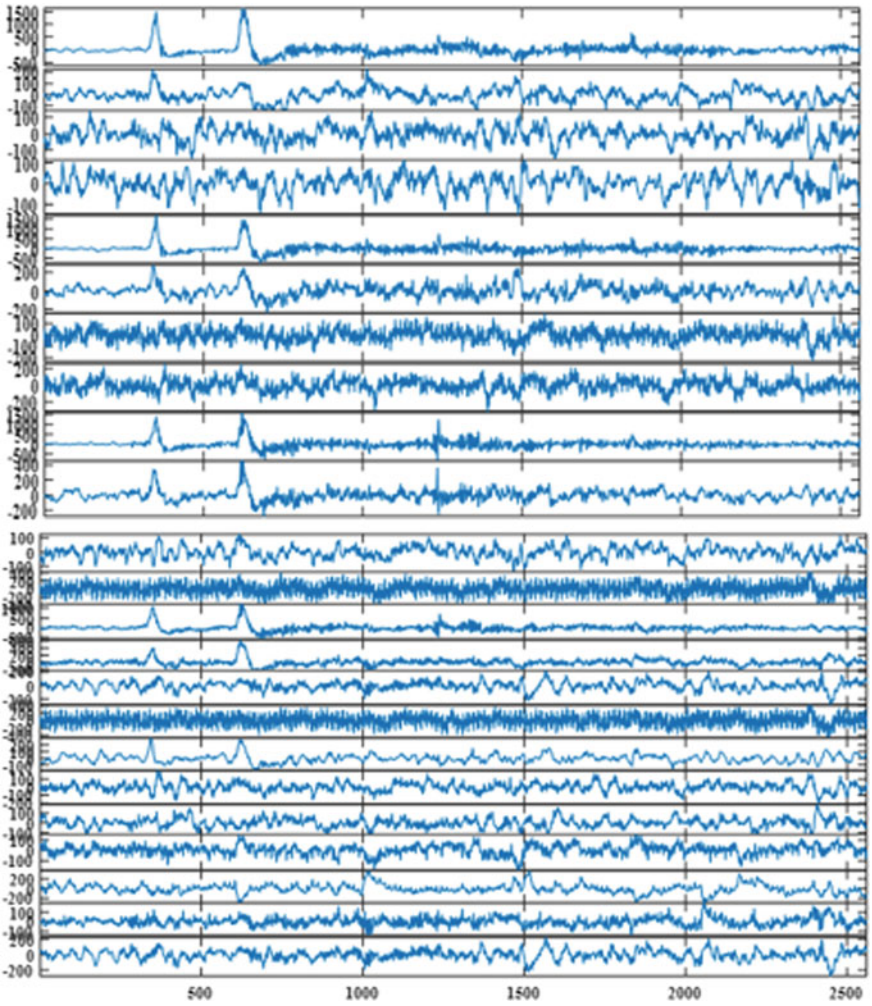

Fig. 2 23 channel EEG signal

has to be removed from it. From Fig. 3, it is clearly visible that the amplitude of EEG signal is more than 100 μV and said to have artifact.

For each channel, the scaled entropy is calculated and the plot of scaled entropy is shown in Fig. 4. The threshold for scaled entropy is shown by a straight line. It is clearly visible that the scaled entropy for channel 1, 5, 9, 12, 13, and 16 are lesser than the threshold and these channels are said to have artifact.

The kurtosis for the artifactual signals is high. The kurtosis for each channel is shown in Fig. 5. From the figure, it is shown that for channels 1, 5, 9, 13, and 14, the kurtosis is higher than the threshold.

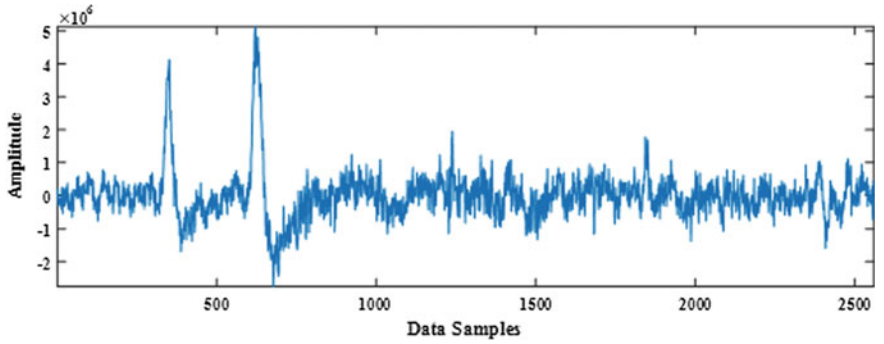

Fig. 3 Signal of channel 1

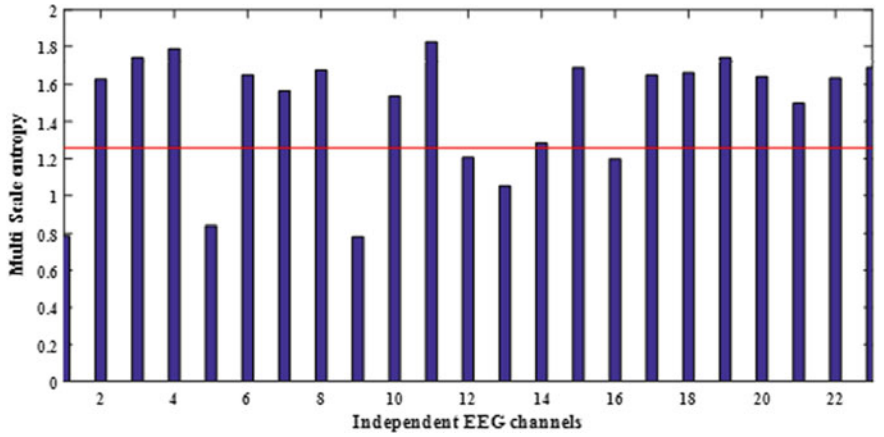

Fig. 4 Multiscale entropy of 23 independent channels. Threshold is indicated by the straight line

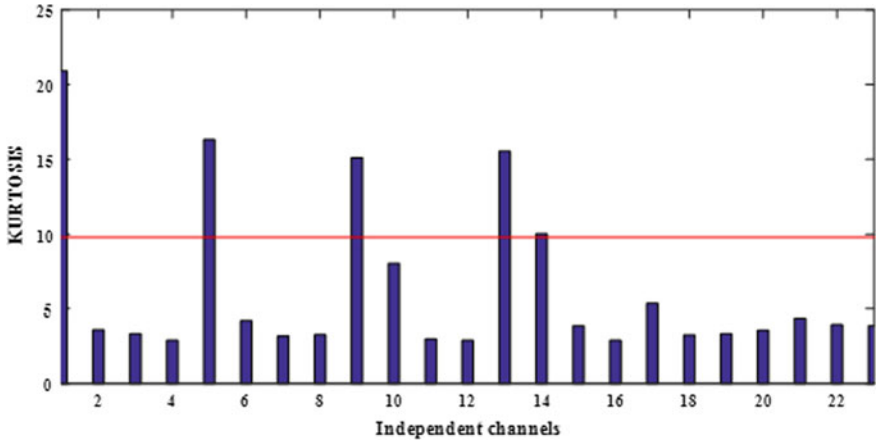

Fig. 5 Kurtosis plot of 23 independent channels. The horizontal line indicates the threshold

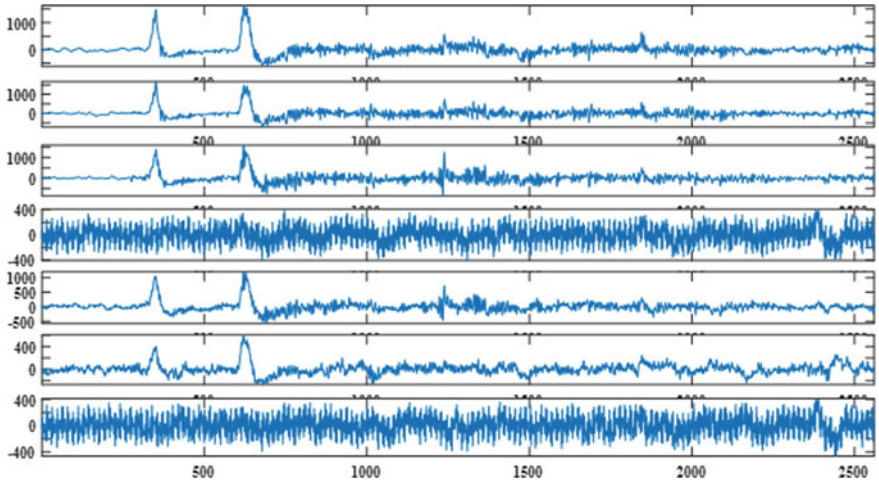

Fig. 6 Out of 23 channels, Ch 1, 5, 9, 12, 13, 14, and 16 are the identified artifactual channels

The identified artifactual EEG channels are shown in Fig. 6. The channels 1, 5, 9, 12, 13, 14, and 16 are having amplitude more than 100 μV and are said to have artifact. After identification of artifactual channels, the main aim is to use suitable algorithm to remove those artifacts. As discussed above in Sect. 2, the discrete cosine transform (DCT) is used to remove artifact from the identified channels.

Figure 7 shows the EEG signals after removal of artifact. It is seen from Figs. 8 and 9 that the artifacts are removed from channel 1.

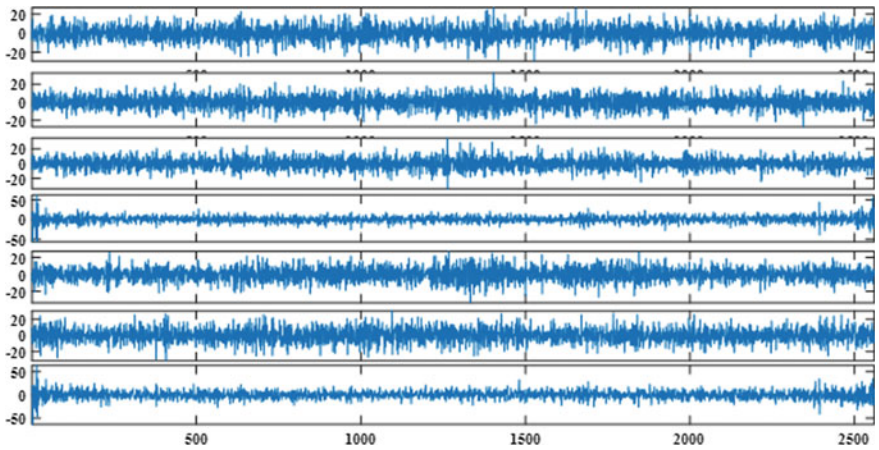

Fig. 7 Artifact removed from the identified artifactual channels

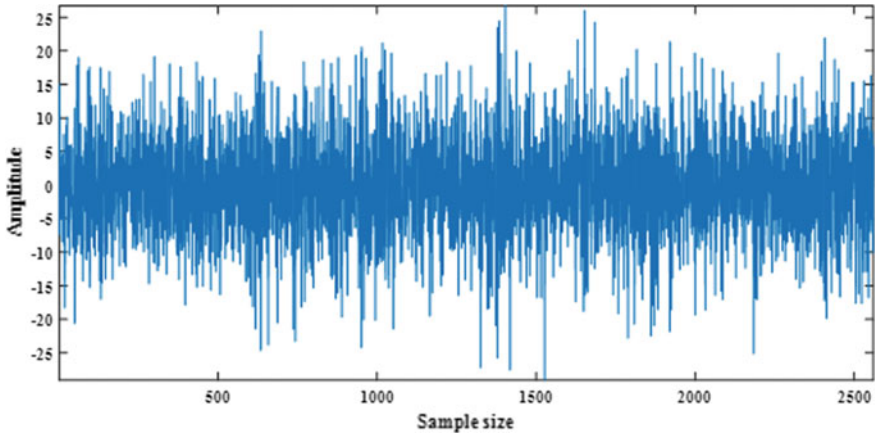

Fig. 8 Artifact removed from channel 1

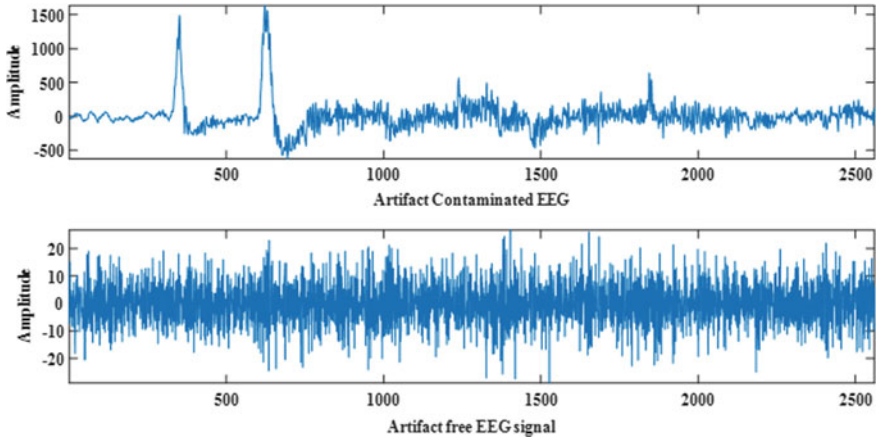

Fig. 9 EEG signal before and after removal of artifact from channel 1

5 Conclusion

The approach taken for artifact identification and removal shows good results. The statistical threshold applied to the kurtosis and scaled entropy gives excellent artifact identification and removal of artifact. The discrete cosine transforms-based artifact removal method used in this paper is computationally efficient. For the future work, the method may be optimized and will be used for different types of artifacts.

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A Comparison Study of Recurrent Neural Networks in Recognition of Handwritten Odia Numerals

Abhishek Das, Gyana Ranjan Patra, and Mihir Narayan Mohanty

Abstract Character recognition in handwritten data is a challenging work as the writing style varies from person to person. Choosing a method for handwritten numeral recognition is also having importance as the result depends on the method used in the recognition model. Deep learning-based recurrent neural network (RNN) is being used for prediction in time series data, generation of text lines, and other sequential data processing. But in this work, the pixel values of image are used as time stamp dependent input to the recurrent networks. We have applied simple RNN, long short term memory (LSTM), and gated recurrent Unit (GRU) for recognizing Odia handwritten numerals. A comparison study is also provided to understand the effect of vanishing gradient in RNN and how this drawback of RNN has been overcome by LSTM and GRU cells. The Adam optimizer is used in each proposed method. The accuracy values obtained in RNN, LSTM, and GRU are 50.04%, 88.81%, and 86.24%, respectively.

Keywords Character recognition · Odia handwritten numerals · Deep learning · RNN · LSTM · GRU · Adam optimization

1 Introduction

Development in digital electronics makes the works easier. Still a few documents are there which are physically filled for well being reasons. In bank cheque, the signature matching is a process to conform that the money is transferred with the permission of

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the account holder. The handwritten documents like letters or any other documents can be read digitally to help blind people. To improve the accuracy in character recognition, different methods have been developed. Application of deep learning is an emerging technique in this criterion. Deep learning is a part of machine learning which is developed on the basis of artificial neural networks. In artificial neural networks, different nodes are used which are trained by different algorithms like a human brain but there are many differences among the artificial neural networks and biological brain. In deep learning, large number of layers are used which are used for better accuracy value. Deep learning is used in different fields like automatic speech recognition, natural language processing, medical image analysis, natural language processing, visual art processing, image processing, and in many other areas of research. Convolutional neural networks (CNN) and recurrent neural networks are the two main categories of deep learning. To classify or recognize the image-based dataset, most of the researchers have used convolutional neural networks as it has the feature extraction capability from image pixels. Recurrent neural networks are basically used for time series data for prediction. The text lines are also generated when the RNN model is trained with paragraphs of a story. In these examples of RNN, the input to the networks is time dependent which makes it different from CNN which is pixel dependent.

Odia (Previously known as Oriya) is the official language of the Odisha which is a state of India. This language is spoken in almost all districts of Odisha as well as in some places of nearby states. Different documents, like old manuscripts, official files, are written in Odia. So, Odia character recognition is to be considered for different computer applications.

The main attributes of the paper are arranged in the following manner. The first section provides the information about the deep learning and its different categories in brief and its application in image processing for character recognition; the second section provides the related works done in the field of character recognition as well as numeral recognition; the third section provides the basics of different recurrent networks like simple_RNN, LSTM, and GRU; the fourth section provides the information regarding the proposed method in details; in fifth section, the results obtained from the proposed methods are given. In the sixth section, the conclusion is drawn from this research work.

2 Related Works

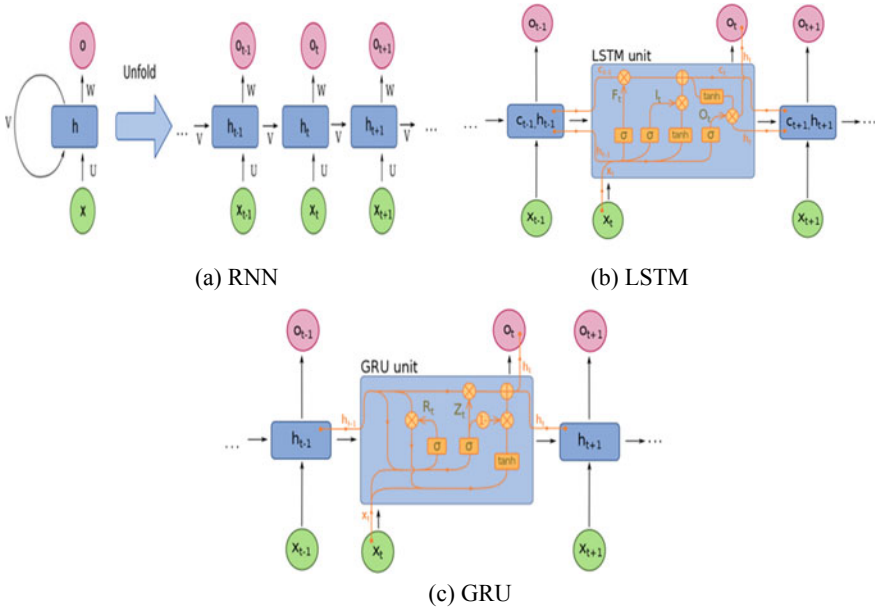
Image classification is a part of optical character recognition if the image consists of different characters in it. Convolutional neural network (CNN) has been used for image classification [1] and it have shown better performance. In this work, the authors have used MNIST dataset for numeral classification and CIFAR-10 dataset for classification of airplane, automobile, bird, cat, deer, dog, frog, horse, ship, truck. Medicine prescription recognition [2] is another form of hand written character recognition. In this work, Peilun Wu et al. have integrated three different classifiers. The

three classifiers are CNN, PCA, and KNN. A voting method has been used to select the best features extractor from the different filters. For Chinese clinical data recognition from the report Jiahui Qiu et al. have proposed a method using convolutional neural network with conditional random field [3]. Different researches have been done on Bangla handwritten digit recognition. In [4], the authors have used an improved version of CNN architecture which consists of 7 layers including convolutional layer, max pooling layer, and fully connected layer. Handwritten Chinese character recognition and based on it different fonts are printed in [5]. For the recognition part, the authors have used convolutional neural network (CNN). Nowadays mobile phones are having online handwritten character input capability. To recognize the character, different algorithms are being used. Authors have used CNN model for online handwritten recognition [6]. Birhanu Hailu Belay et al. have utilized the beauty of CNN in recognizing Amharic characters [7]. The dataset used for this work is having 80,000 numbers of Amharic characters. The authors have generated the Amharic text lines, characters using OCRopus. The application of CNN has been found for number plate recognition [8–12] which is a part of intelligent transportation system. In the field of clinical named entity recognition [13], Guohua Wu et al. have used bidirectional LSTM network along with conditional random field to recognize the words related to health issues, i.e., body parts, different diseases, symptoms, etc. For Nastaliq text recognition [14], authors have used multi-dimensional long short term memory. By using MD-LSTM, the authors achieved an accuracy of 98%. A pixel-based MD-LSTM has been used for this purpose. For in-air Chinese handwritten recognition [15] Haiqing Ren et al. have used recurrent neural network as we know that sequence data can be processed easily using RNN. The X and Y coordinates of the dot locations are used as sequential data for RNN network. Two hidden layer-based LSTM network [16] have been used by Nogra et al. for Baybayin handwritten recognition. Kalyan S. Dash et al. have proposed a hybrid method of feature extraction [17] in which they have used Kirsch gradient operator and properties based on curvature of handwritten numerals, followed by a feature dimension reduction using principal component analysis (PCA). Om Prakash Jena et al. have implemented linear discriminant analysis [18] for Odia Numeral Recognition. Sanjibani Sudha Pattanayak have used Support vector machine to recognize Odia hand written recognition [19]. The characters are classified which gives accuracy up to 85%.

Most of the recent works for character recognition are developed using convolutional neural network. No work is found using recurrent neural networks, long short term memory or gated recurrent unit for Odia numeral recognition. We have developed a network using RNN, LSTM, and GRU for Odia numeral recognition with a comparison study among these methods.

3 Recurrent Networks (RNN, LSTM, and GRU)

RNNs are a type of artificial neural network designed to recognize patterns in sequences of data, such as text, genomes, handwritten digits, etc. RNN has an internal



(a) RNN (b) LSTM

(c) GRU

Fig. 1 Basic structure of **a** RNN, **b** LSTM, **c** GRU

MEMORY. RNNs use back propagation algorithm to train the network for each time stamp. It is commonly known as back propagation through Time (BTT). RNN can model sequence of data so that each sample can be assumed to be dependent on previous ones. Recurrent neural networks are basically used to predict the time series data as these data are time dependent. RNN is having vanishing gradient and exploding gradient problems. A very small change in weight results the vanishing gradient and the large change in weight results exploding gradient problem. The LSTM and GRU are special kind of recurrent networks which are having long term dependencies which is useful to reduce the drawbacks present in simple recurrent neural networks. The basic structures of RNN, LSTM, and GRU cells are shown in Fig. 1.

4 Proposed Method

In this work, we have designed RNN, LSTM, and GRU networks to extract, classify, and recognize Odia digits. Each network is designed with one input layer, two consecutive recurrent layers with sigmoid activation function, a fully connected layer which is activated with Softmax function and at the end a regression layer is used with Adam activation function to optimize the error. The proposed architecture of simple RNN is given in Fig. 2. Same structure is used for LSTM- and GRU-based

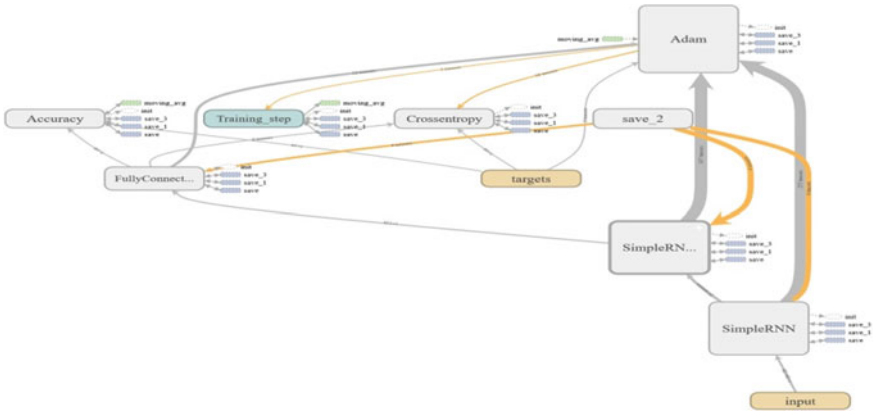


Fig. 2 Architecture of proposed simple_RNN

models. The images were resized to 28 × 28 pixels and read as binary images. The whole dataset was divided into two groups, one for training and another for testing. Then, the network modeling was done for RNN, LSTM, and GRU.

Due to the presence of cell_states (the top horizontal line in Fig. 1) in LSTM and GRU cells, the long term dependencies are maintained which is absent in case of simple RNN. This difference is verified by applying these three methods in recognizing the Odia handwritten numerals with same dataset for training and same set of testing dataset.

Each image is used as a sequence of pixels with the row pixels as time stamp and the column pixels as sequence numbers. Categorical cross entropy function is used to calculate the loss. To reduce the loss, Adam optimizer algorithm with learning rate of 0.001 is used in the regression layer which is used after the final fully connected layer.

Each hidden layer consists of 128 neurons of recurrent units with sigmoid activation function. After these hidden layers, a fully connected layer having 10 neurons with Softmax activation function(also named as Softmax Layer) which is having 10 neurons as we have 10 digits starting from 0 to 9 (in Odia, it is from Suna to Na).

The IIT Bhubaneswar Database for Odia numerals [4] is used to train the network which is shown in Fig. 3.

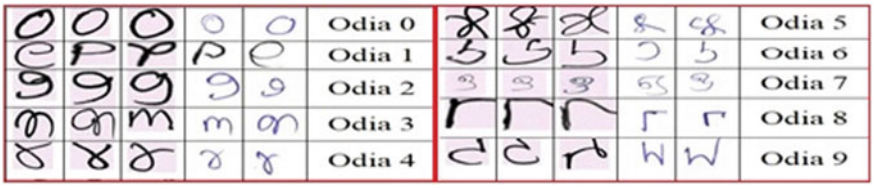


Fig. 3 Sample of IIT Bhubaneswar BATABASE for Odia numerals

The images are of different size and different formats. The IIT Bhubaneswar dataset consists of total 5164 numbers of images with jpg and tiff formats.

5 Results and Simulation

The proposed method is analyzed practically using Python 3.7 in Jupyter Notebook. The software was loaded in the operating system Microsoft Windows 10, i3 Generation with 8 Gb RAM capacity enabled laptop. The results are observed by running the program for different handwritten data as shown in Fig. 4.

As we know, no artificial neural network is 100% accurate, the proposed methods also show some error in recognition. The red colored square boxes in Fig. 4 indicate the numbers which are wrongly classified. The errors may be due to close approximation in writing with other numbers and may be due to some loss in the network. There is a huge difference in accuracy value of RNN in comparison to LSTM and GRU because of the vanishing gradient problem in RNN.

The accuracy calculated after 20 epocs in RNN, LSTM, and GRU networks are 50.04%, 88.81%, and 86.24%, respectively, which is shown in Fig. 5, which is a

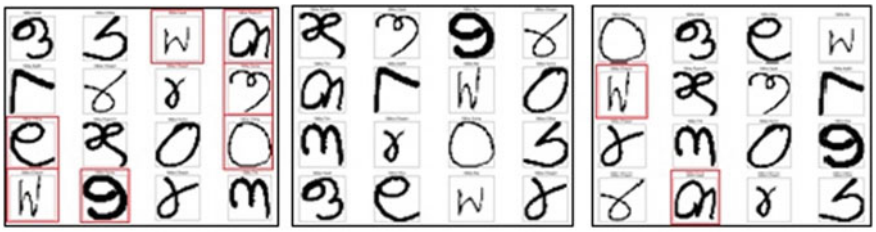


Fig. 4 Recognition results of **a** RNN, **b** LSTM, and **c** GRU after 20 epochs

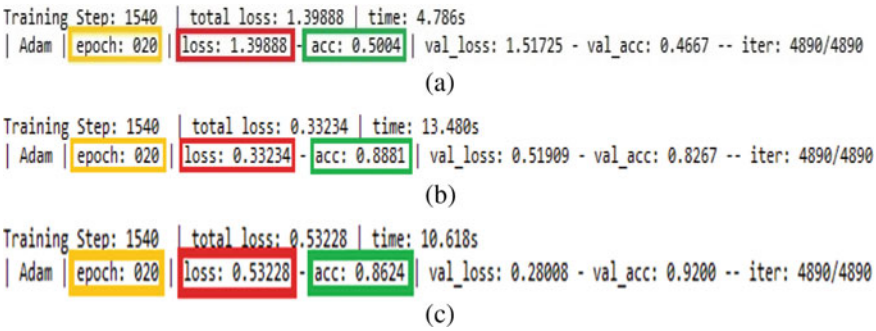


Fig. 5 Loss and accuracy after 20 epochs using **a** RNN **b** LSTM **c** GRU

screenshot taken from Jupyter Notebook. Accuracy plots for the proposed methods are given in Fig. 6.

6 Conclusion

Odia handwritten numerals recognition is a challenging work because of similarity among some of the digits and variation in writing styles which varies person to person. In this paper, we have developed three methods to recognize Odia hand written numerals and given a comparison study among these methods. The database with more number of handwritten numbers can be considered for more accuracy values. While developing the method, the accuracy and time factor were also considered for better performance. Accuracy values obtained in RNN, LSTM, and GRU are 50.04%, 88.81%, and 86.24%, respectively, which indicates the difference among the methods and the improvement obtained in LSTM and GRU cells in comparison to simple_recurrent cells which are having vanishing gradient problem. The steps followed in this method are described in details which provide the application and comparison of recurrent units using handwritten digits.

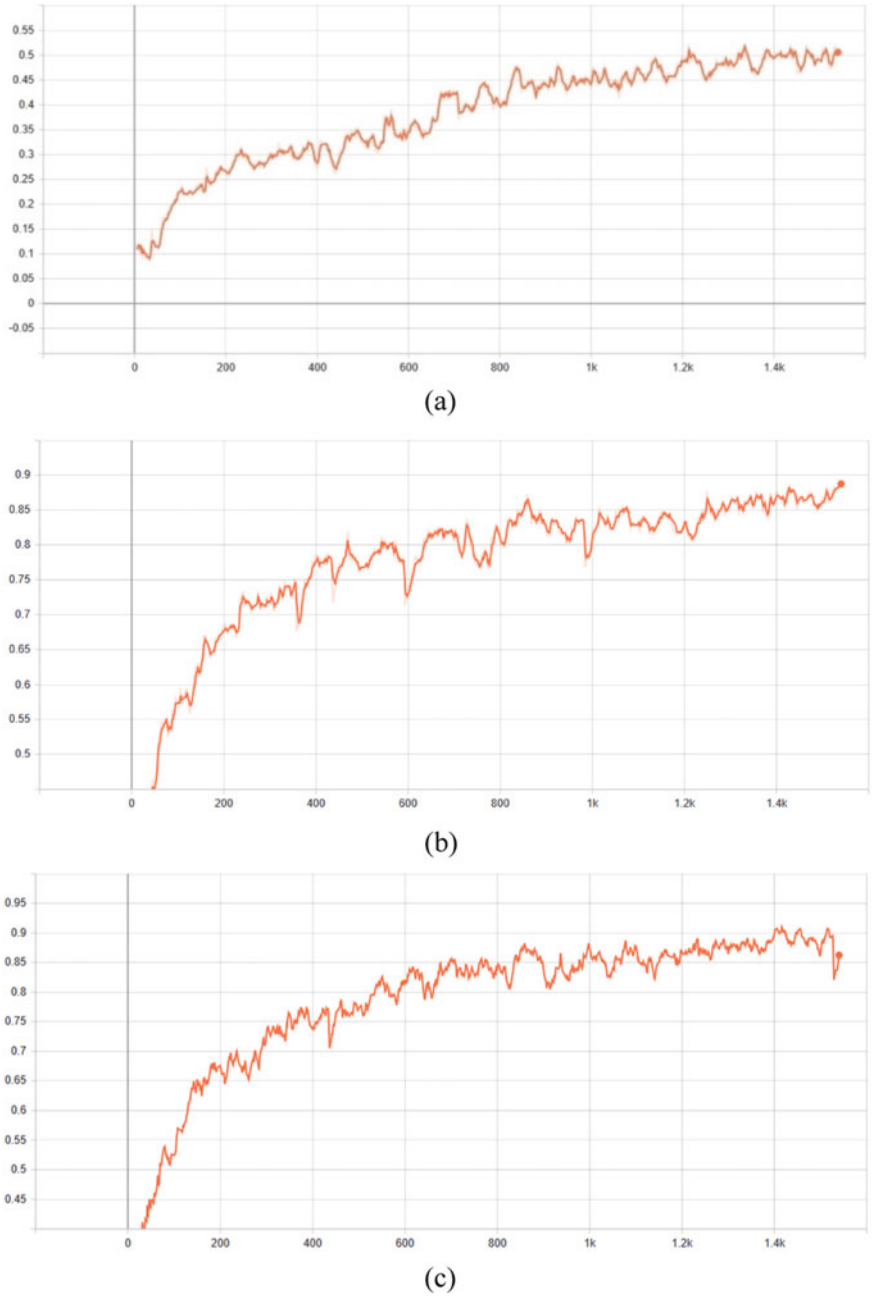


Fig. 6 Accuracy plot of **a** RNN **b** LSTM **c** GRU

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Noise Suppression in Non-stationary Signals Using Adaptive Techniques

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Abstract The physical signals are inherent in nature. The noise may be due to external environment or physiological change. These signals are non-stationary. Though it is a difficult task to suppress noise from non-stationary signals, enormous works have been done using different algorithms including LMS. In this work, consider two cases: (a) Speech signal (b) cardiac signal. In variant of least mean square is used for verification including LMS, NLMS, and DLMS. Gaussian noise is considered for speech signal due to environmental effect, whereas impulsive noise is taken for ECG signal, due to either artificial (cardiac) or spikes occurrence at the time of data acquisition. For current scenario of pipelining and parallel processing, authors have suggested delayed LMS for both the types of noises and found better performance in terms of SNR, stability, and convergence as compared to NLMS and LMS.

Keywords Adaptive filter · LMS · NLMS · DLMS · DNLMS

1 Introduction

Noise is spontaneous naturally and has more calamitous effects on application of communication and signal processing. The standard noise is evaluated with white Gaussian noise in each application, where as non-Gaussian noise also occurs (e.g., impulsive noise). Research method have been attempted since a long for noise suppression and also provide the idea about SNR computation [1–3]. The error is

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to be minimized to achieve the desired output. Generally, weights of the filter are to be varied by the help of adaptive algorithms like LMS, RLS to develop the adaptive system for minimizing the error [4, 5]. A major disadvantage of LMS algorithm is its fixed step size parameter, in each iteration that affects the performance. Similarly, it is inefficient for the pipelined structure. To eliminate these problemsn DLMS algorithm is used by interlining pipeline latches through the data path that reduces the critical path [6, 7]. For the contaminated signal recovery, DLMS algorithm provides low-latency design with the delayed element [8].

For active control, an alternative of LMS algorithm is filtered X-LMS algorithm [9, 10]. The spatial case of it is DLMS algorithm by introducing a delay element. To observe its properties of stability and convergence have been verified in [8] for Gaussian noise distribution.

For different applications, different types of filters are used. However, the adaptive filter is occupied a special position in research. It has the ability to remove noise in various circumstances b y minimizing this error. Filter is made adaptive through the application of different algorithms such as least mean square (LMS) and its variants, recursive least square (RLS), and its variants. In this work, the variants of LMS filter are considered for performance comparison [11, 12]. Again, the delayed LMS (DLMS) algorithm is utilized to design the filter and that has been applied for Gaussian and non-Gaussian noises in this work. The rest of the paper is in four subsections. Related literature is presented in Sect. 2. The basic methodologies are described in Sect. 3 and the proposed methodology is described in Sect. 4. Section 5 describes the results and Sect. 6 concludes the work.

2 Related Literature

Several techniques have been used by different researchers to remove the noise from speech. The techniques as spectral subtraction, statistical-model-based, and subspace algorithms are also utilized in literature [12, 13]. RLS and SSRLS algorithms were also used for speech enhancement in [14]. Impulsive noise was reduced from the signal by using a robust adaptive algorithm in [15]. They have considered three types of adaptive filters such as LMS, NLMS, and DLMS for impulsive noise cancellation purpose. From their result, DLMS algorithm was performing better as compared to other two. The same DLMS algorithm is again applied for noise elimination from the biomedical signal in [16, 17] and the result is measured in terms of SNR and MSE.

Similarly, minimum mean square error (MMSE) estimator with short-time spectral amplitude (MMSE-STSA), with log-spectral amplitude (MMSELSA) estimator, the optimally-modified log-spectral amplitude (OMLSA) estimator was described in [18]. NLMS is faster with more PSNR value as compared to LMS whereas quick convergence, robustness, and dynamic adaptive structure create RLS method more appropriate for the task of speech enhancement. The method is more consistent when

the signal is noisy with colored or white noise. Also the calculation is more complex for this algorithm [19].

Noise sources of ECG signal may be power line interference, electromagnetic fields, organ movement due to respiration. ECG signal has been filtered from impulsive noise by various algorithms. WLMS has been tested upon corruptive impulsive ECG signal [17]. NLMS, RCS, LMS, SSRLS algorithms used for noise cancelation from cardiac signal. RLS algorithm and SNR measurement was used to filter EMG signal [19, 20]. Recursive least square with state space technique (SSRLS) algorithm was applied on noisy ECG signal which had to be filtered and gave better result than NLMS and RLS techniques [21, 22]. Wavelet transform is one of the popular transforms used for noise removal [23]. Comparing on filtering techniques, Savitzky-Golay filter was also used for ECG denoising [24, 25].

To overcome the problems of standard algorithms, the application of DLMS algorithm is explained for speech and ECG signal in following section.

3 Methodology

Adaptive algorithm is considered for improving the parameter values of the system. Figure 1 shows the basic structure of the adaptive filter, where the error is minimized by updating the weight of the filter [24].

As shown in the figure, a sample signal as input signal $x(n)$ is supplied into a system that produces an output signal $y(n)$. As the principle of adaptive system, output is compared with the desired signal $d(n)$ to find the error and described as,

$$\text{err}(n) = d(n) - y(n) \tag{1}$$

3.1 LMS Algorithm

Least mean square (LMS) algorithm is a type of adaptive filter used to imitate the required filter by calculating the filter coefficients that relate to produce the least

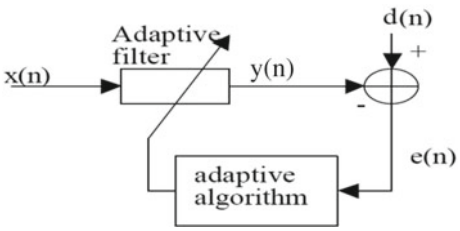

Fig. 1 Adaptive filtering technique

mean square of the error signal, i.e., the difference between the required signal and the input signal. In this approach, the optimum filter weights play the major role in this algorithm.

Given input signal $x(n)$ and a desired signal $d(n)$, output $o(n)$, and weights $w(n)$ can be updated as follows.

$$w(n+1) = w(n) + \mu x(n).\,\mathrm{err}(n) \tag{2}$$

3.2 NLMS Algorithm

Normalized LMS algorithm is exactly the same as the traditional LMS algorithm. Both adaptive filtering algorithms are built around a finite-duration impulse response (FIR) filter, but differ only in the way in which the weight controller is mechanized by using norm. It is described as,

$$w(n+1) = w(n) + \mu x(n).\,\mathrm{err}(n)/x^{\mathrm{T}}(n)x(n) \tag{3}$$

3.3 Proposed Methodology: Delayed LMS Algorithm (DLMS)

The error in the DLMS algorithm is calculated as the difference between computed and desired outputs. The weights of the filter are updated by this error in each cycle of nth iteration as described below,

$$\begin{aligned} \mathrm{err}(n) &= y(n) - y_{\mathrm{filt}}(n) \\ e(n) &= h^{\mathrm{T}}(n) * x(n) \\ y_{\mathrm{filt}}(n) &= w^{\mathrm{T}}(n) * x(n) \end{aligned} \tag{4}$$

where

$x(n)$	Input vector of basic FIR.
$h(n)$	Coefficient of LMS adaptive filter at nth iteration.
$w(n)$	Weight vector of LMS adaptive filter at nth iteration.
$o(n)$	Desired output.
$y_{\mathrm{filt}}(n)$	Output of adaptive filter at nth iteration.
$\mathrm{err}(n)$	Error in nth iteration is used for weight updation.
μ	Convergence-factor.

The algorithms and modified algorithms described are applied for two cases and described as follows.

Case-I: Noisy Speech Signal

In this case, the voice is recorded in the noise-free room. Further, the Gaussian noise is added with the signal.

It can be represented as

$$x_{\text{noisy}}(n) = x_{\text{clean}}(n) + u(n)$$

where

$x_{\text{noisy}}(n)$ Noisy speech signal.
$x_{\text{clean}}(n)$ Desired output signal.
$u(n)$ Random noise.

Further, the application of the developed algorithms provides the clean signal as described in the result section.

Case-II: Noisy cardiac Signal

Alike to speech signal, the cardiac signal is collected from physiobank [26]. Impulsive noise is added with it to verify the algorithm. All the time of recording the signal through the ECG machine, there is occurrence of electrical disturbances which result as impulsive noisy signal. Therefore, this variant of noise is also tested and verified through proposed techniques.

$$x_{\text{impulsive}}(n) = x_{\text{clean}}(n) + i(n)$$

$x_{\text{impulsive}}(n)$ Noisy cardiac signal.
$x_{\text{clean}}(n)$ Desired filtered signal.
$i(n)$ Impulsive noise.

Similarly, the utilization of algorithm outputs is shown in result section. Table 1 provides the parameters of adaptive algorithms used.

Table 1 Parameters used for adaptive algorithm

Parameters	Values
Mu	0.079
Delta	0.0011
Number of iteration	3500
Taps	16

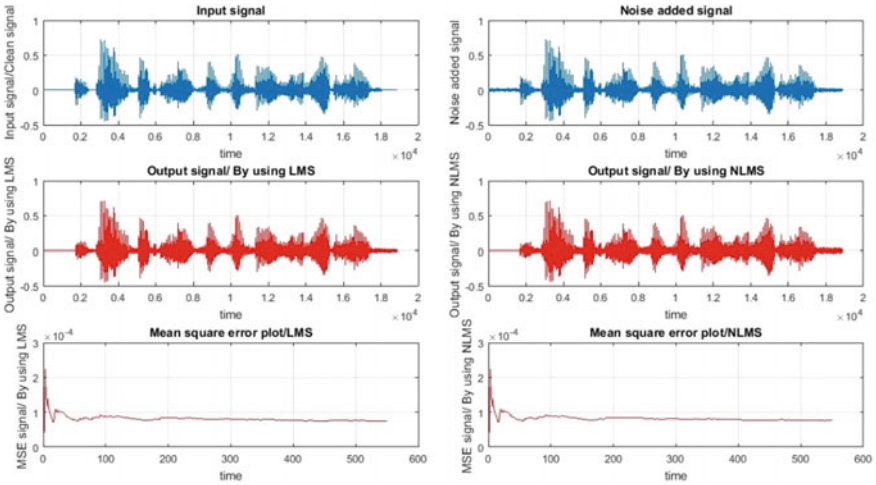

Fig. 2 Results of clean speech using LMS and NLMS algorithm

4 Results and Discussion

Voice is recorded in a closed noise-free room and added Gaussian noise for processing. A clean speech signal with 14.56 dB SNR is considered as input signal and after adding the Gaussian noise, the SNR is 12.30 dB. For the noise reduction purpose, three types of filters such as LMS, NLMS, and DLMS are used. Step size for these three types of filter is 0.8 is considered. From the result, it can be observed that DLMS algorithms are performing better as compared to LMS and NLMS. Obtained outputs are displayed in Figs. 2 and 3. In Table 2, the SNR values obtained from different algorithm is presented. The obtained output signal and the mean square error (MSE) performance of LMS, NLMS, and DLMS algorithms are shown in Figs. 2 and 3.

The ECG data is collected from Physio net database [26] and processed for impulsive noise with application of proposed algorithms. Obtained results for ECG signal are presented in Figs. 4, 5 and 6. SNR values are presented in Table 3.

5 Conclusion

Different adaptive algorithms are used in this proposed work to suppress both Gaussian and non-Gaussian noises. The delayed LMS algorithm use provides better results as compared to standard LMS algorithms. The beauty of this algorithm is, its performance obtained for both type of noise. Though the analysis of non-stationary signals is difficult task, we have taken these few examples. Other signals may be used with

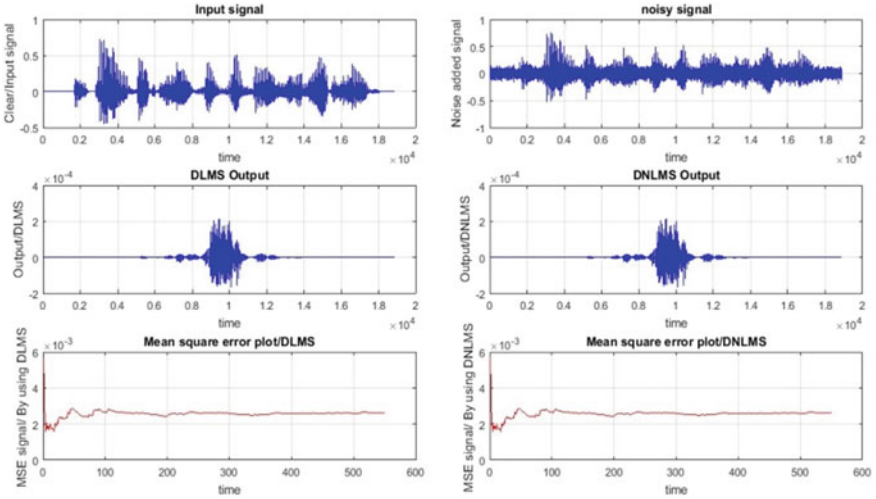

Fig. 3 Results of clean speech using DLMS algorithm

Table 2 SNR comparison between LMS, NLMS, and DLMS for speech signal

Algorithm used	SNR value
LMS output	12.96
NLMS output	14.97
DLMS output	15.76

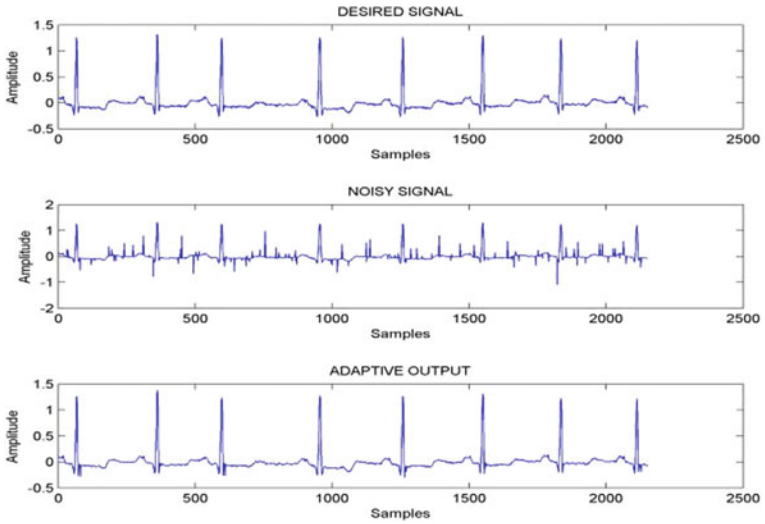

Fig. 4 Clean ECG result using LMS algorithm

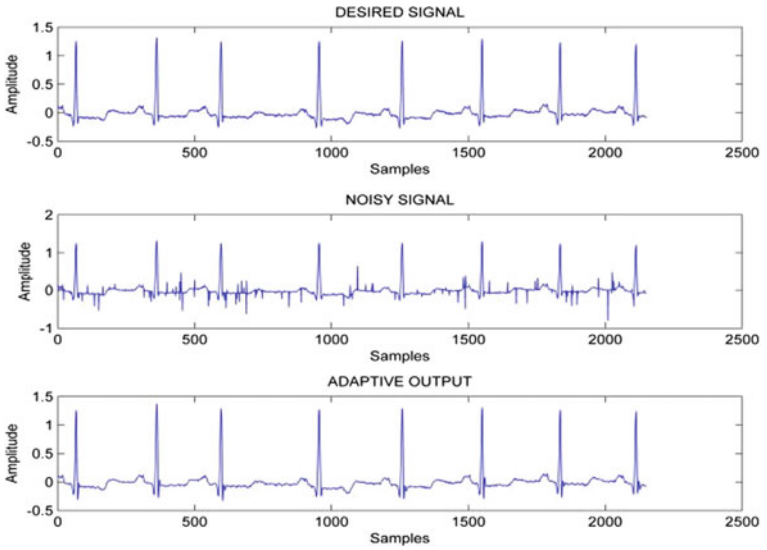

Fig. 5 Clean ECG result using NLMS algorithm

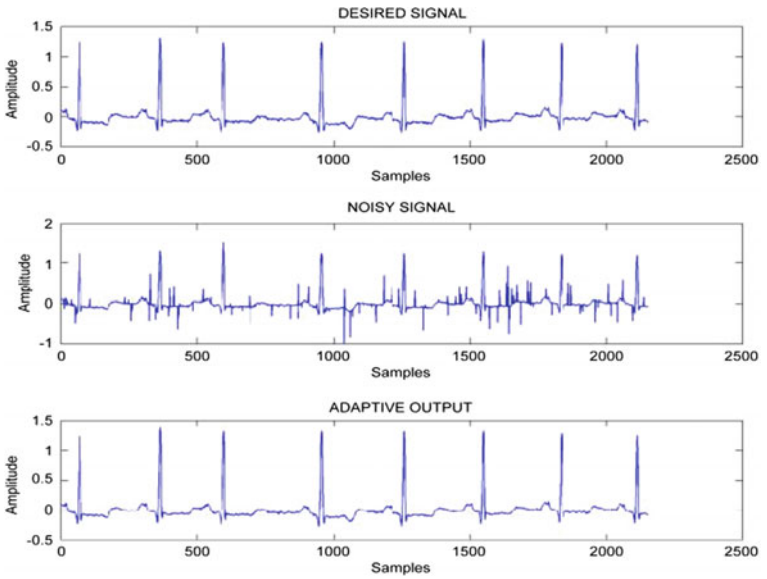

Fig. 6 Clean ECG result using DLMS algorithm

Table 3 SNR comparisons between LMS, NLMS, DLMS on application of ECG

Algorithms used	Noisy signal SNR (dB)	Clean signal SNR (dB)
LMS output	7.84	11.3659
NLMS output	7.84	12.5552
DLMS output	7.84	14.9473

other variants like FxLMS algorithms. Also the study can be done in the future for these along with real-time application.

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Design of Circular Patch Antenna for Wireless Communication in K-Band

Shaktijeet Mahapatra and Mihir Narayan Mohanty

Abstract In this paper, a novel circular patch antenna with annular rings fed by a microstrip line is proposed. The antenna has been designed for ultra-wideband applications. The proposed design exhibits an ultra-wideband response centered around 24 GHz. The antenna covers the entire K-band and may be used in satellite communications. The antenna occupies a very low volume of 1317.7 mm^3. FR4-epoxy is used as both substrate and superstrate in this design. The simulated performance of the antenna has also been presented.

Keywords Compact · Circular patch antenna · K-band · Planar · Ultra-wideband

1 Introduction

Wireless communication depends heavily upon antennas for sending and receiving signals. The presence of microstrip patch antennas has now become ubiquitous in many wireless devices owing to the fact that they can be easily integrated with ICs; thus, helping to decrease the size of the devices. But the microstrip antennas have a limitation of having an arrow bandwidth [1]. This limitation of microstrip patch antennas can be overcome by different bandwidth enhancing techniques. The techniques for enhancing the bandwidth include changing the substrate parameters, changing the feeding point parameters, slight changes in the shape of the patch, modifying the ground plane, addition of the superstrate, and addition of shorting pins and planes [1].

Researchers have explored many of the available techniques for bandwidth enhancement. Sze and Wong [2, 3] used loading slots for enhancing bandwidths. Jolani et al. [4] designed a small-sized folded patch antenna with an M-shaped

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slot and a shorting wall along with a triangular parasitic patch. They obtained an impedance bandwidth of 21.17% covering the 4.93–6.09 GHz band. Monavar and Komjani [5] used Jerusalem cross-shaped frequency selective surfaces as an artificial ground plane for improving the bandwidth. They employed the invasive weed optimization technique for optimizing the dimensions of all the structural elements and obtained a bandwidth of 10.44%. Mitra et al. [6] designed two antennas with asymmetrical slot and fed by microstrip and coplanar waveguide. The antennas yielded an impedance bandwidth of 14.76 and 26.61%. Parameswaran et al. [7] replaced the ground plane with an electromagnetic bandgap mushroom-type structure and obtained a bandwidth of 39.20%. Khanna et al. [8] used a fractal patch antenna with gap coupling and obtained an impedance bandwidth of 24–86%. Deb et al. [9] used a modified ground structure with a microstrip-inset-fed patch. Arora et al. [10] loaded a microstrip patch antenna array with a metamaterial superstrate, having a pair of a split-ring resonator, achieving a gain improvement of 86% and improvement in the bandwidth of 60%.

The rest of the paper is organized into the following sections: In Sect. 2, design of the antenna is discussed; in Sect. 3, simulation results are presented and discussed, and Sect. 4 concludes the paper.

2 Design of the Antenna

The proposed antenna (Fig. 1) is a circular patch antenna with annular slots and is fed by a 1 mm wide microstrip feed. The radius of the patch antenna is 8 mm. The widths of the annular slots from the innermost to the outermost slots are 0.5 mm, 1 mm, and 1 mm, respectively. The structure has a cylindrical profile. FR4-epoxy, with dielectric constant $\varepsilon_r = 4.4$, and loss tangent, $\tan \delta = 0.02$, is used as both substrate and superstrate. The height of the substrate, h_1, is taken as 1.6 mm and that of superstrate, h_2, is taken as 1 mm. The radius of the substrate and superstrate is 12.7 mm. The patch, the feedline, and the ground plane were assumed to be perfectly conducting conductors. The antenna structure occupies a total volume of 1317.7 mm^3. As can be seen, the design of the antenna has been kept simple for ease of fabrication.

3 Results and Discussion

Simulation results show that S11 (Fig. 2) was below −10 dB between 18.4 and 26 GHz, i.e., a bandwidth of 8.5 GHz; thus, covering almost the entire K-band, which is used for satellite communications. The lowest S11 obtained was −49 dB at 24 GHz. The proposed antenna also exhibited a bandwidth of 1.7 GHz between 16.3 and 18 GHz, which is designated as upper Ku-band with an S11 of −22.5 dB at 16.9 GHz. It can be seen from Fig. 3 that within these bands, the VSWR remains

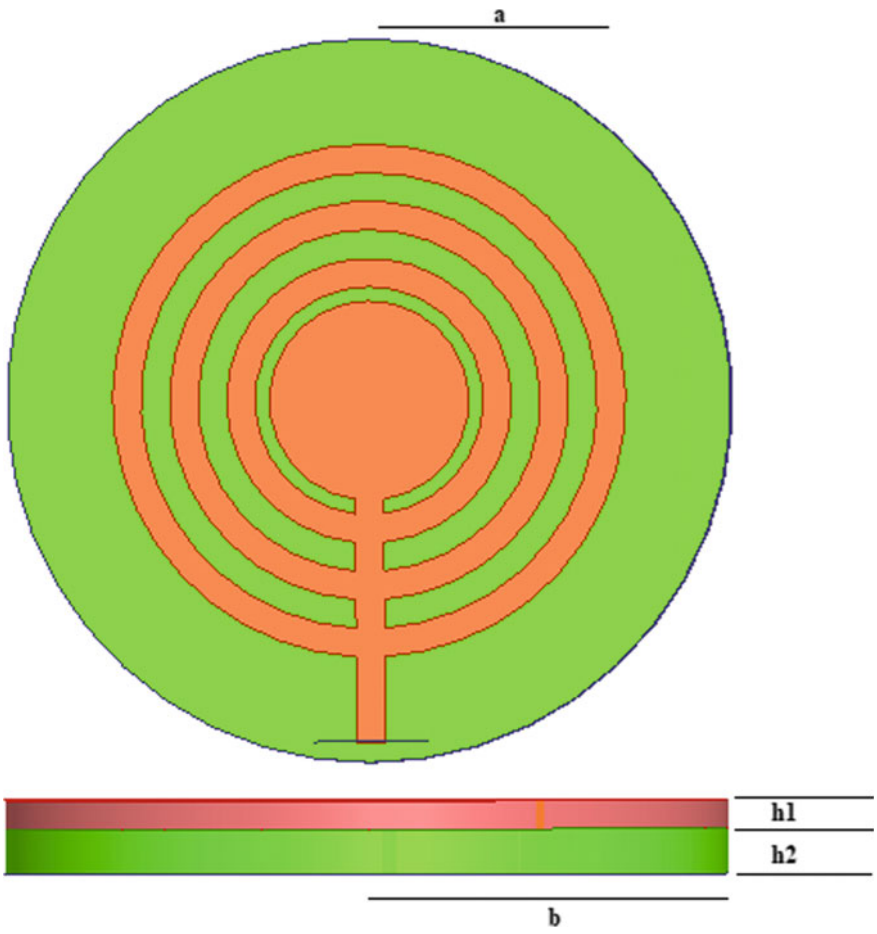

Fig. 1 Proposed design: $a = 12.7$ mm, $b = 12.7$ mm, $h_1 = 1$ mm, $h_2 = 1.6$ mm

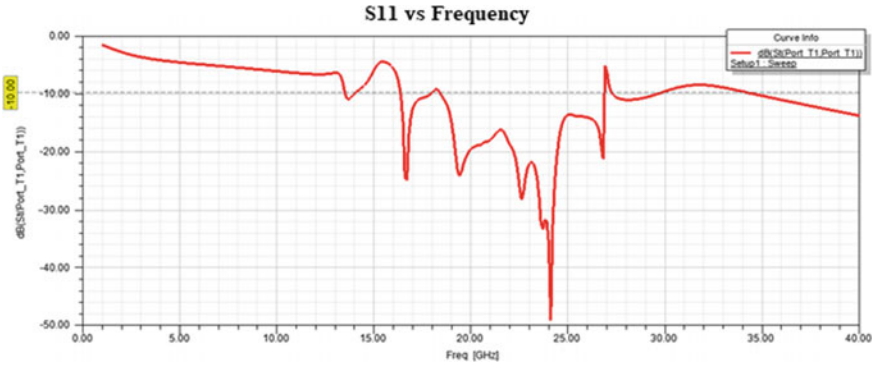

Fig. 2 S11 versus frequency

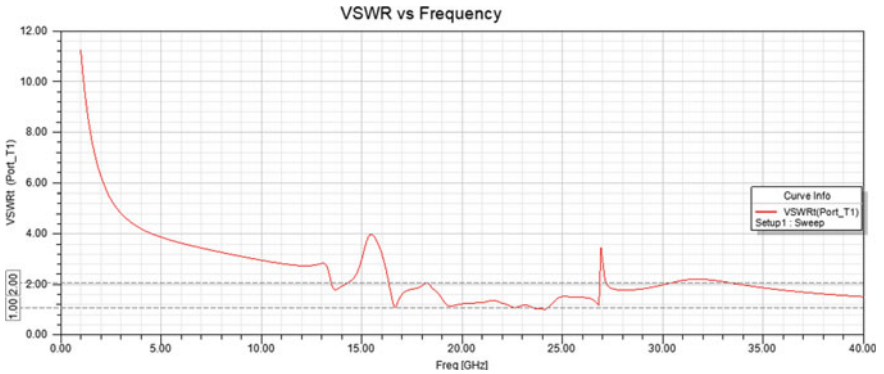

Fig. 3 VSWR versus frequency

between 1 and 2, suggesting that the antenna is well-matched within these bands. In Figs. 4, 5, 6, and 7, the radiation patterns are obtained at 16.6, 19.3, 22.5, and 24 GHz. The gain at 22.5 GHz is around 4.5 dB at phi = 45°. Analyzing the figures, it is found that overall directivity is at phi = 45°.

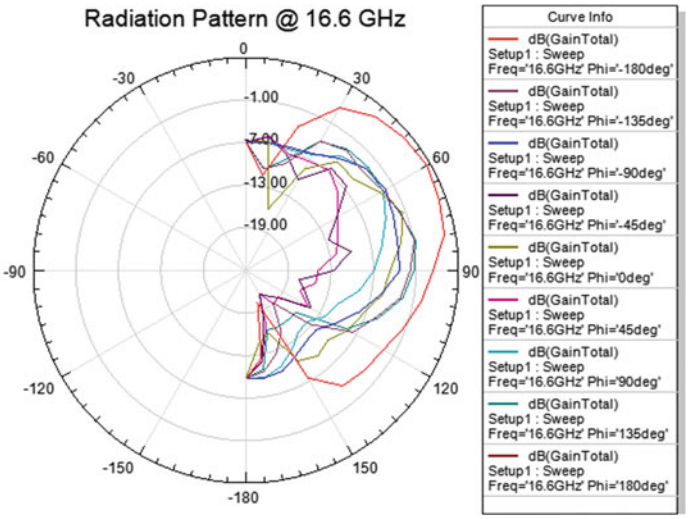

Fig. 4 Radiation pattern at 16.6 GHz

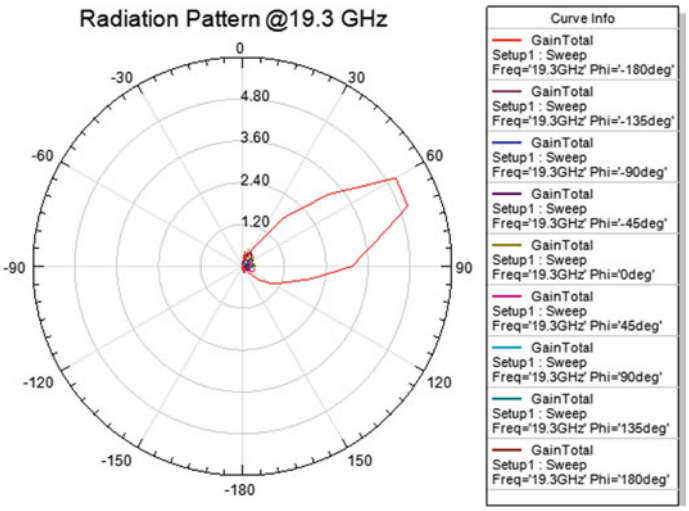

Fig. 5 Radiation pattern at 19.3 GHz

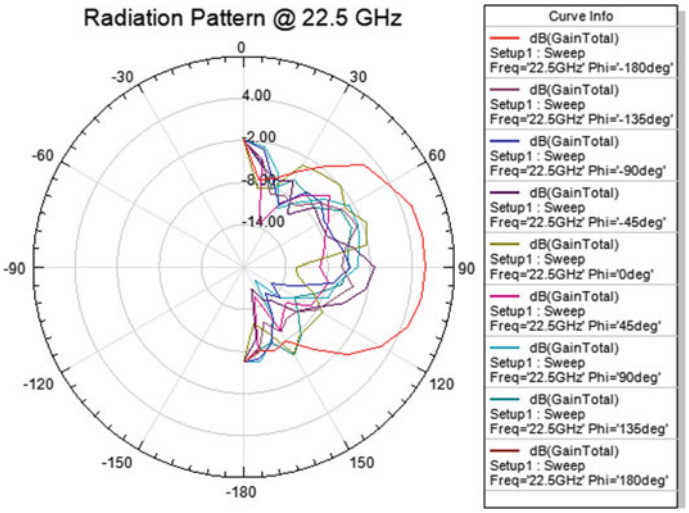

Fig. 6 Radiation pattern at 22.5 GHz

4 Conclusion

A circular microstrip patch antenna with annular slots sandwiched between two dielectric layers has been proposed. The simulations show that the antenna has VSWR between 1 and 2 and impedance bandwidth of 8.5 GHz between 18.4 and 24 GHz

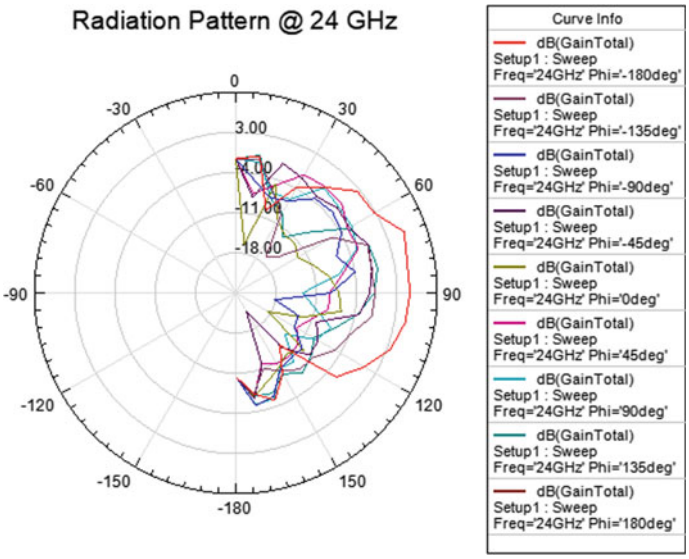

Fig. 7 Radiation pattern at 24 GHz

or the entire K-band. The presence of the upper dielectric layer directly helps in enhancing the bandwidth.

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Automatic Event Detection in User-Generated Video Content: A Survey

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Abstract The aim of event detection is to identify interested events in a user-generated content using multiple modalities automatically. However, it is a challenging task particularly when videos are captured in a restricted environment by nonprofessionals. Such videos suffer from poor quality, deprived lighting, blurring, complex camera motion chaotic background clutter, and obstructions. However, with the rise of social media, there is rising popularity of user-generated videos on the Web day-by-day. Each minute, 300 hours of user-generated video are uploaded on you tube due to which people find difficult to search the appropriate content among a large number of videos. Therefore, solutions to this problem are in great demands. In this paper, we study existing technologies for event detection in user-generated videos using multiple modalities. This paper provides key points about feature representations across different modalities, classification techniques.

Keywords Event detection · User-generated video content · Modalities · Video indexing · Video retrieval · Video summarization

1 Introduction

The growth of social media over the last decade attracted users to create and to immediately post their own content with no restrictions on the content. As a result, the user-generated content has been increasing rapidly on the Web.

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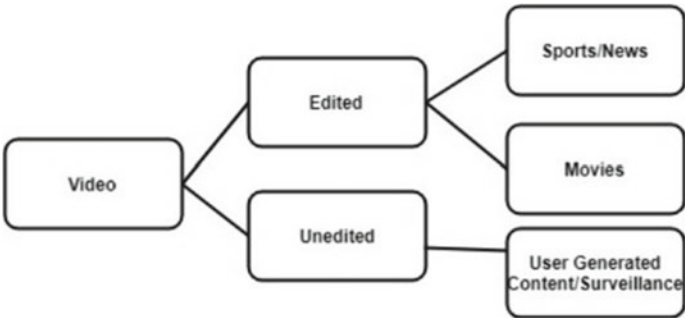


Fig. 1 Overview of types of videos

The most widely used user-generated contents are text messages (tweets on Twitter), audio–speech and music, images or pictures and short sequences of moving images also known as video clips. User-generated content is valuable resources of information capturing people's interests, thoughts, and actions. Automatic video understanding [1] is crucial among them. Different types of videos [2] can be produced as shown in Fig. 1.

2 Video

Video is a short sequence of moving images and audio. A video is the only asynchronous arrangement of several frames, each frame being a 2D representation. So, the important unit in a video is a frame. The video can be considered as a gathering of numerous scenes as shown in Fig. 2, [3] where the scene is an accumulation of shots that have a similar setting. Therefore, video consists of an enormous amount of content in terms of scenes, shots, and frames.

2.1 User-Generated Video Opportunities and Challenges

In general, user-generated video is of poor quality and less organized. As there are restricted capturing situations, they may be of poor quality than professionally edited videos. Both sports and news videos are made after proper editing. However, most UGV is usually captured using own smart phones by individual users, and without any editing, they will be uploaded on the web. So, UGV is unstructured.

According to Twitter statistics, each minute, twitter dynamic users create about 500 million tweets every day and YouTube users post 300 h of videos due to which people find it difficult to look for the appropriate content among a huge number of videos. Therefore, the need for automatic event detection in user-generated video

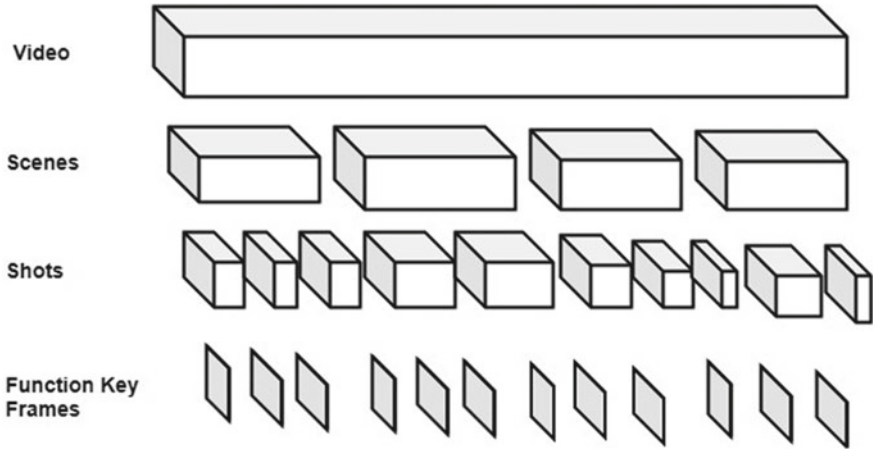


Fig. 2 Internal complex architecture of video

data is obvious in many computer vision applications. Finding a solution to automatically figure out the events captured in this large collection of videos is not an easy task. Therefore, user-generated video data provides both opportunities as well as challenges. The primary challenge is how to handle such huge data in a proficient manner. In addition to that, it is complex to search for videos based on user interested specific events.

3 Event Detection

The aim of event detection in user-generated videos is to automatically detect the video clips based on user interested specific events in a given video. Event detection using single modality features or fusion of multiple single modality features can be performed in sports, news, movies, surveillance, large-scale videos, and user-generated videos. User-specific interested events detection in UGV is a quite challenging task because the videos are captured in a restricted environment by non-professional users. They are unstructured and unconstrained. They suffer from poor quality, deprived lighting, blurring, complex camera motion, chaotic background clutter, and obstructions. An event is a significant occurrence specified by the user. It happens at a certain place at a certain time. For example, human actions like jumping, running, and object-related events like kicking a ball, riding a horse, etc. Events are characterized by its type, time, location, and description. The process of identifying the occurrence of an event in a natural or manmade content is called event detection. Detecting substantial change in sea-level is a natural event detection and detecting events like smiling, frowning, etc., in images or videos is called manmade event detection. The social media platforms allow millions of people to use them

daily to communicate and share information ranging from world level information, for example, the World Cup, to personal information like wedding, graduation. A massive amount of data is created by individual users in the form of texts, videos, and photos. The research done so far could give efficient solutions for large data storage but retrieving, handling, and processing of such a large amount of data particularly in videos are still a challenge. So monitoring and evaluating the user-generated video content can produce undoubtedly valuable information.

3.1 General Event Detection Methodology

- Frame extraction—Depending upon the size of the video, it consists of a number of frames. Frame extraction is to represent the video in terms of image frames (Fig. 3).
- Key frame extraction—Extraction of key frames is the basic step in video-related tasks to get rid of the duplicate frames with unnecessary data. The extracted key frames represent the characteristics of the video.
- Feature extraction—It extracts important features from video data to enable semantic understanding. Using feature extraction process, visual, audio, and audio–visual features can be extracted. Spatial, transform, color, texture, shape, edge and boundary, structure, layout, and motion are some of the visual features. The most common audio classes in videos are speech, silence, music and the

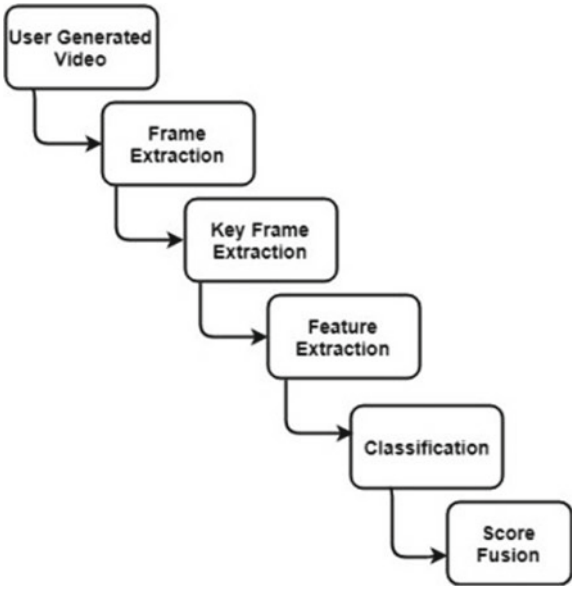
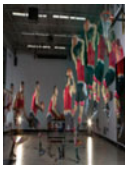


Fig. 3 General event detection methodology

combination of later three. The audio features can be embedded with low-level visual features for key frame extraction.

- Classification—Classification is done using classifiers. After extracting features, classifiers generate scores based on different model formulations and set of features. These are the most significant concepts in image processing; these are computer-based mathematical algorithms developed to encounter the required performance level, at trained data set with a given amount of time. The classifier is trained in such a way that the system must easily differentiate the datasets.
- Score fusion—It combines scores computed from different features from different modalities. Based on this, decision can be made.

Table 1 Overview of different modalities

S.No.	Modality	Example	Description and related work
1	Text		Most of the research work done so far on the single text modality conveyed that the textual features from a video were obtained using either automatic speech recognizer (ASR) or optical character recognition (OCR) [5]
2	Audio (speech and music)		Mel-frequency cepstral coefficients (MFCC) is a popular and standard feature of audio [6]
3	Visual (image)		The most widely used low-level visual features are spatial-temporal interest points (STIP) [7], scale-invariant feature transform (SIFT) [8], histogram of gradients (HOG), histogram of optic flow (HOF) [9], color, GIST, independent subspace analysis (ISA), geometry texton histogram (GTH), transformed color histogram (TCH), local binary patterns (LBP), and speeded up robust features (SURF) [10]
4	Motion		It is the representation of kinetic energy. It is used to measure the variation of pixels within a shot, direction of the motion, and histogram magnitude

To improve the accuracy of event detection in user-generated videos, features can be extracted from four different modalities: text, audio, visual, and motion. Overview of different modalities with an example and description is given in Table 1 [4].

4 Multimodal Event Detection

Multimodal event detection is based on multimodal fusion techniques, i.e., a fusion of multiple features from different modalities which are referred to as multimodal fusion. The fusion of various modalities may give related important information and, therefore, it is better to know which modalities will contribute a major role for accomplishing an analysis task. The fusion of both visual and audio features along with the video textual data in a user-generated video will improve the accuracy of event detection. Hence, the extraction of helpful features from video one by one to get better recognition of events is a further important task due to the discrete features of the concerned modalities.

As different modalities posses different characteristics, it is better to consider the confidence levels of the modalities in completing the required multimedia applications. The multimodal event detection framework [11] is shown in Fig. 4.

In Table 2, we listed the papers that used visual features alone and features combined from multiple modalities for different multimedia tasks.

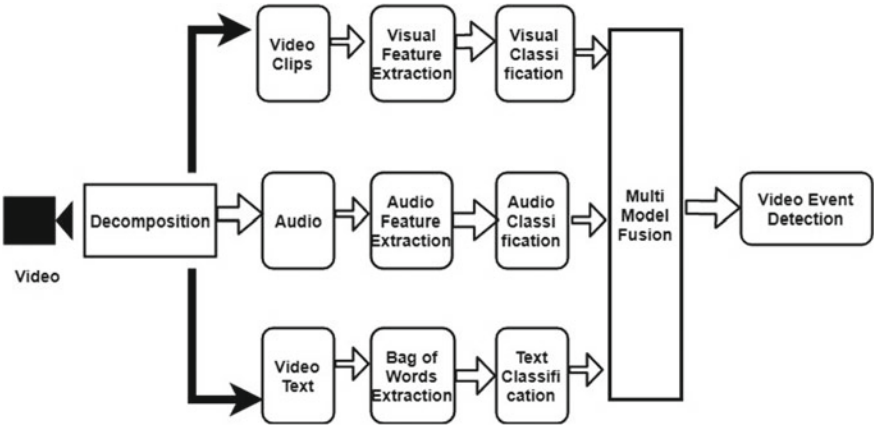


Fig. 4 Framework of multimodal event detection

Table 2 Overview of related work

S.No.	Paper	Modalities used	Classifier	Multimedia task
1	[7]	Low-level video (spatiotemporal descriptors) and audio (Mel-frequency cepstral coefficients) features	CRF-based discriminative learning	Event detection in sports video
2	[12]	Visual features (HOG, CEDD, color histogram, texture, and wavelet)	Decision tree (DT), multiple correspondence analysis (MCA), and support vector machine (SVM)	Automatic video event detection in disaster data set
3	[9]	Visual features (static opponent scale-invariant-feature transform (SIFT) 3D spatial-temporal interest points (STIPs))	Support vector machine (SVM)	Complex event detection in user-generated video
6	[13]	Video (color, structure, and shape) Audio (MFCC), textual cues	Support vector machine (SVM)	Semantic concept detection
7	[14]	Audio (ZCR, LPC, and LFCC) Video (blob location and area)	Bayesian Inference	Event detection for surveillance
8	[15]	Visual (color SIFT) Audio (MFCCs) (acoustic segment model)	Latent support vector machine (LSVM)	Multimedia event detection
9	[16]	Sensor data modalities (auxiliary sensors)	Support vector machine (SVM)	Interesting event detection in UGV and extracting appropriate information about the recording activity.
10	[17]	Video and audio	Modern convolution neural network (CNN)	Audio-visual salient event detection
11	[18]	Visual, audio, and motion features	SVM with Gaussian kernel	Robust event recognition in videos

5 Conclusion

Video is a rich source of information and topics on video data offer a broad range of research applications such as multimodal event detection which further helps in video browsing, video indexing, video summarization, and content-based video retrieval applications. In recent years, multimodal event detection has been receiving widespread research attention because of the exponential increase in the volume of Web video data. This paper focused on multimodal event detection in user-generated

video content where the objective is to detect video clips by the key event happening in the clip by the fusion of different features from different modalities. We discussed a number of challenges that need to be addressed due to the exponential growth of unstructured Web user-generated video content. We have given an outline of the event detection and the general multimodal event detection framework. Key points about modalities, features, classifiers, and fusion techniques were presented.. We think that this paper can give important insights for researchers who are just starting to investigate this area.

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A Comparative Analysis of Biomedical Data Mining Models for Cardiac Signal Classification

Saumendra Kumar Mohapatra and Mihir Narayan Mohanty

Abstract Application of machine learning in healthcare sector is increasing day-by-day. It can be very useful for automated and early diagnosis of different diseases. In the proposed work, authors have compared the classification performance of three different classifiers for cardiac signal classification. The ECG data is collected form Physionet database. Relevant features are extracted from the original signal by applying dual tree complex wavelet transform (DTCWT). Multi-layer perceptron (MLP), radial basis function (RBFN), and support vector machine (SVM) classifiers are considered for classifying the cardiac signal. From the result, it can be observed that, SVM is performing better as compare to other two types of classifiers.

Keywords Machine learning · Biomedical signal · Classification · Neural network · SVM

1 Introduction

Electrocardiogram (ECG) is the graphical representation of the cardiac activity and has many applications including patient analysis and diagnosis and biometric identification. It is the depolarization and repolarization of heart tissues, which generate a potential difference to capture the muscles activity of the heart. P, Q, R, S, and T waves are the five major deflections in a cardiac signal. It is essential to develop an automated computer-aided diagnosis system for analyzing the ECG. In early stage detection by adopting auto-diagnosis system is highly essential before the strokes initiates. Data

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analysis, artificial intelligence, pattern recognition, and decision support will make this system more reliable and accurate [1, 2].

The main steps in the ECG signal classification are preprocessing, feature extraction, and classification. Extraction of useful features from the ECG is one of the important steps in classification system. Several feature extraction methods were proposed by the researchers and are discussed in the literature study section. Dual tree Complex wavelet transform (DTCWT) is one of the signal decomposition technique in which the original ECG signal is decomposed into number of steps. These wavelet decomposed ECG features are used for the classification by using MLP, RBFN, and SVM. The comparison of these three different types of classifiers is presented in the result section.

2 Proposed Methodology

The structure of the proposed method for ECG classification is displayed in Fig. 1. ECG data is collected from the Physionet database. Preprocessing of the ECG signal is done and in given in the next subsection. Feature are extracted using dual tree complex wavelet transform (DTCWT). Those wavelet features are then used as the input to the classifiers.

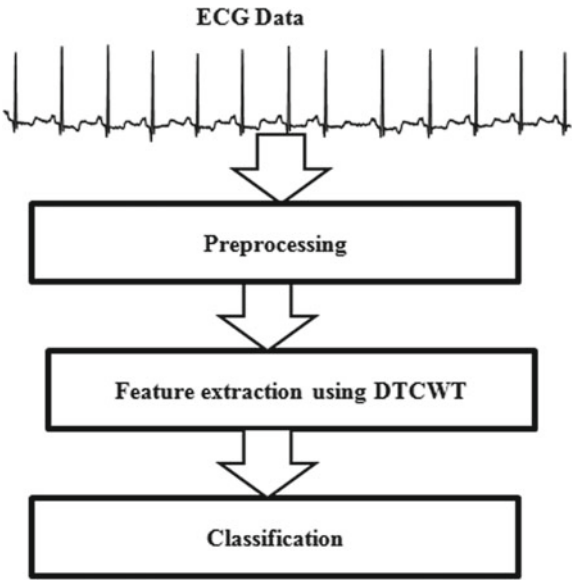

Fig. 1 Structure of the proposed work

Table 1 Physionet dataset description

Class	Samples
Normal	5154
Atrial fibrillation	771
Alternative rhythm	2557
Noisy	46
Total	8528

2.1 Data Collection

ECG signals can be collected directly from the patients or from different open-source databases. 2017 Physionet cardiology database is an open-source ECG database from where single lead ECG data (between 30 and 60-s length) can be collected [3]. The data set contains 8258 ECG signals recorded by AliveCor device with 300 Hz sampling frequency. Total four types of ECG data is available in this database and the size of each class is presented in Table 1.

After successfully collecting all four types of ECG data, the filtering process is done in the pre-processing step. In the next section, ECG signal denoising is presented.

2.2 Feature Extraction

Wavelet transform (WT) is one of the most used tools for non-stationary signal analysis. This technique provides a time–frequency analysis for the input signal that can detect local, transient, components of the signal. The decomposition steps of the signal is shown in Fig. 2. In wavelet decomposition, the original signal is decomposed into detailed and approximate coefficients. In DTCWT, analytic filters are used for performing the wavelet decomposition. Real and imaginary parts are decomposed in DTCWT by two real DWT tree. Here, the signal is decomposed by using mother wavelet $\psi(x)$ and scaling function $\varphi(x)$. For signal t ,the real (r) and imaginary (i) parts can be described as:

$$\begin{aligned}
\psi_r(t) &= \sqrt{2}\sum_n H_a(n)\varphi_r(2t-n) \\
\psi_i(t) &= \sqrt{2}\sum_n H_b(n)\varphi_i(2t-n) \\
\psi_r(t) &= \sqrt{2}\sum_n L_a(n)\varphi_r(2t-n) \\
\psi_i(t) &= \sqrt{2}\sum_n L_b(n)\varphi_{ri}(2t-n)
\end{aligned} \tag{1}$$

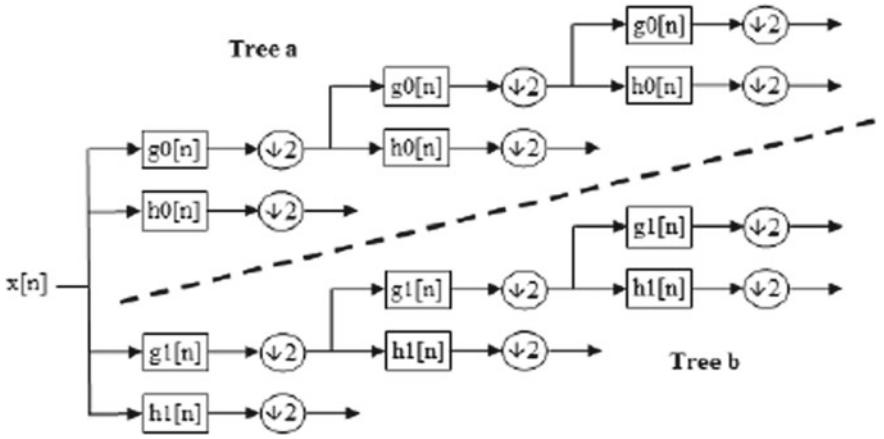

Fig. 2 Structure of DTCWT decomposition process

where L and H corresponds to the lowpass and highpass filters. The wavelet functions ψ_r and ψ_i produce the complex wavelet function ψ_c, which is given by $\psi_r + j\psi_i$ [4].

2.3 *Multi-Layer Perceptron (MLP)*

An artificial neural network (ANN) is a generalized mathematical model which is based on biological nervous systems. The fundamental elements of neural networks are artificial neurons. Input, output, and hidden are three basic layers of a simple neural network as presented in Fig. 3.

In neural network, the output of the hidden layer h and output layer y can be calculated as:

$$h = \sigma(W_1 x + b_1) \tag{2}$$

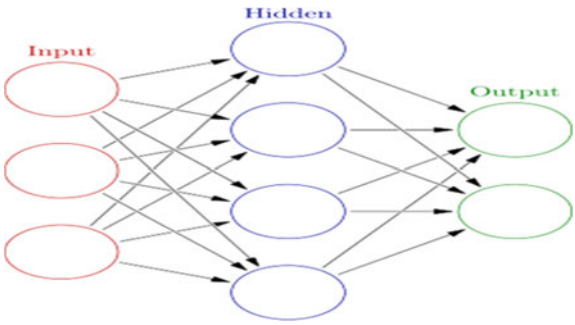

Fig. 3 Standard MLP structure

$$y = \sigma(W_2 h + b_2) \tag{3}$$

where W_1 and W_2 are the weights of neuron and x is the input. b_1 and b_2 are the bias. σ is the activation function. The weights are considered with the wavelet coefficients.

2.4 Radial Basis Function Network (RBFN)

Radial basis function network (RBFN) consists of an input layer, a hidden layer, and a linear output layer as presented in Fig. 4. In the proposed RBFN total of 10 numbers of input, 7 hidden, and 4 output neurons are considered. The input neuron size is same as the number of features. In this case, the Gaussian kernel is used as a kernel function. The hidden layer depends on a nonlinear RBF kernel function [5, 6]. The output of the network is found as the distance between the input vector and the vector of the center of the Gaussian function and can be expressed as:

$$\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_j \end{bmatrix} = \begin{bmatrix} R\|x_1 - c_1\| & R\|x_1 - c_2\| & \cdots & R\|x_1 - c_j\| \\ R\|x_2 - c_1\| & R\|x_2 - c_2\| & \cdots & R\|x_2 - c_j\| \\ \vdots & \vdots & \vdots & \vdots \\ R\|x_j - c_1\| & R\|x_j - c_2\| & \cdots & R\|x_j - c_j\| \end{bmatrix} \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_j \end{bmatrix} \tag{4}$$

where R is the RBF, c_j is the center, $\|x - c_j\|$ is the distance between input and the center. $x_1, x_2, \ldots, x_j$ are the input neurons, $y_1, y_2, \ldots, y_j$ are the output neurons, and $w_1, w_2, \ldots, w_j$ are the weights of the network.

2.5 Support Vector Machine (SVM)

SVM is one of the most popular linear machine learning classifiers with some nice properties. This technique is mostly based on the structural risk minimization method where a hyperplane/decision boundary is created in such a manner that the positive and negative class separation margins can be maximized. Let us consider $\{(\mathbf{x}_j, o_j)\}_{j=1}^{N}$ is the training data set for the SVM classifier where $\mathbf{x}_j$ is the input feature for jth example and o_j is the corresponding output (target). Before beginning the classification process, let us assume that, the output classes are linearly separable and are represented by $+1$ (Positive class) and -1 (Negative class). The output pattern separation process in the hyperplane or decision boundary can be represented by,

$$\mathbf{w}^* \mathbf{x} + d = 0 \tag{5}$$

The output of the SVM classifier can be defined by,

$$\begin{aligned} \mathbf{w}^* + d \geq 0 \quad \text{for } o_j = +1 \\ \mathbf{w}^* + d \leq 0 \quad \text{for } o_j = -1 \end{aligned} \tag{6}$$

where $\mathbf{x}$ is the input feature vector, $\mathbf{w}^*$ is the corresponding adjustable weight vector, and d is the bias or threshold. In linear SVM, the separation between two classes in $\mathbf{x}$ is done by maximizing the separation margin in the optimal hyperplane. In the case of nonlinear SVM, the two classes are first mapped with the kernel function in feature space with a high dimension. The representation is presented in Fig. 5 [7, 8]. The mathematical representation for nonlinear SVM is,

$$\sum_{j=1}^{N} \mathbf{w}_j^* \phi_j(\mathbf{x}) + d \tag{7}$$

where $\phi(.)$ is the mapping function. The main goal is to develop an efficient classifier by using a set of training data $\left\{\left(\mathbf{x}_j, o_j\right)\right\}_{j=1}^{N}$. The optimized value of the weight vector $\mathbf{w}^*$ and bias d can be stated as,

$$o_j\left(\mathbf{w}^* \mathbf{x}_j + d\right) \geq 1 - \xi_j \quad \text{for } j = 1, 2, 3, \ldots, N \tag{8}$$

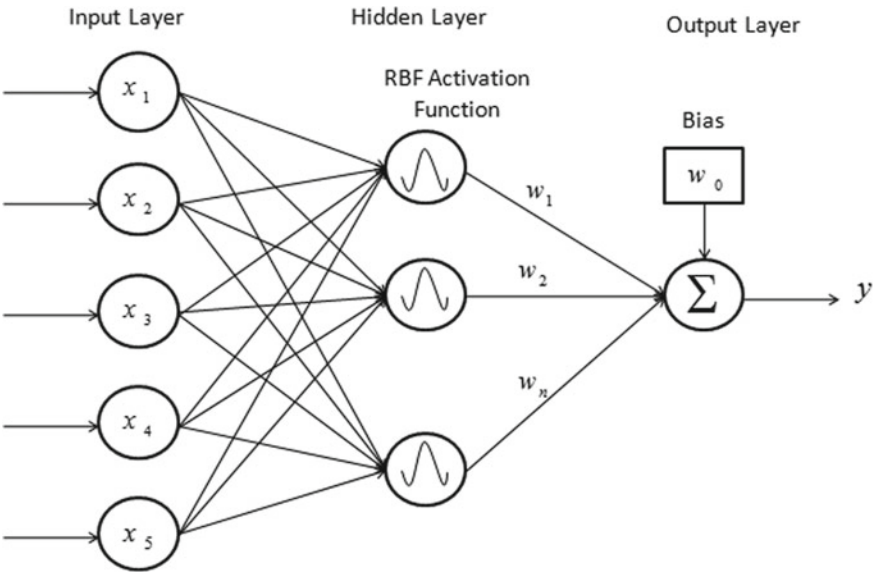

Fig. 4 Structure of RBF network

where ξ is the slack variable for all j [9]. The weight vector $\mathbf{w}^*$ and the slack variable minimize the cost function which can be represented by,

$$\varphi\left(\mathbf{w}^*, \xi\right) = \frac{1}{2}\left\|\mathbf{w}^*\right\|^2 + R\sum_{j=1}^{N}\xi_j \tag{9}$$

where R is a regularized parameter, i.e., used to control the discriminant function size. The final output of the SVM classifier is represented as,

$$o(x) = \sum_{j=1}^{N} K\left(\mathbf{x}_j, \mathbf{x}\right) \tag{10}$$

The kernel function $K\left(\mathbf{x}_j, \mathbf{x}\right)$ is a special case of Mercer's theorem which arises at the time of functional analysis.

3 Results and Discussion

Four types of ECG have been considered in this work as found from '2017 Physionet/Computing Cardiology Challenge database'. The corresponding signals of each class are shown in Figs. 6, 7, 8 and 9. As shown in Fig. 8, the P wave is not visible in the atrial fibrillation affected ECG.

The wavelet features are classified using three types of neural network classifiers. The features are considered as the input for the MLP, RBFN, and CNN classifier. About 80% data is considered for training purpose and rest 20% data is used for validation purpose of classifiers. Accuracy, sensitivity, and specificity are calculated from the confusion matrix to measure the performance of three types of classifier. Confusion matrix obtained from these three types of classifier is presented in Tables 2, 4 and 6. Performance of each classifier is presented in Tables 3, 5 and 7.

From these obtained result, it can be observed that SVM classifier is performing better as compare to MLP and RBFN. It is because of the presence of more number of hidden layers.

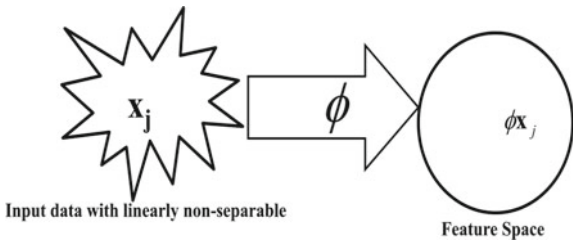

Fig. 5 Transformation of linearly non-separable data to feature space

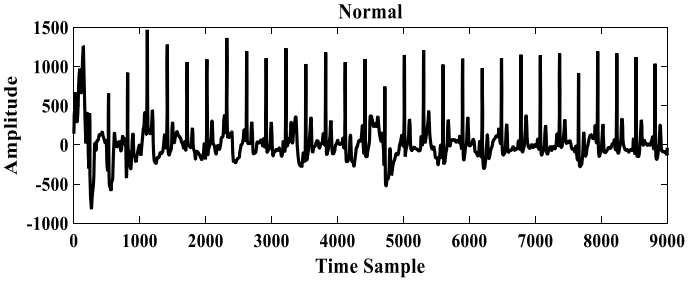

Fig. 6 ECG signal of normal class

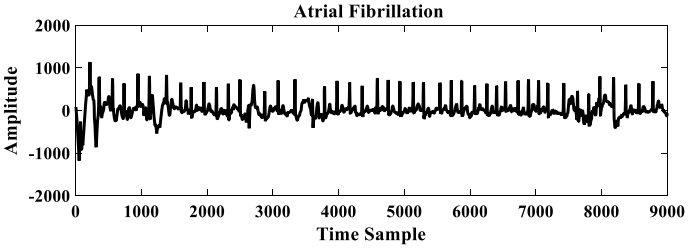

Fig. 7 ECG signal of atrial fibrillation class

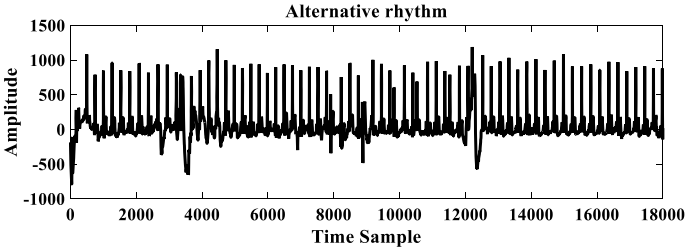

Fig. 8 ECG signal of atrial alternative rhythm class

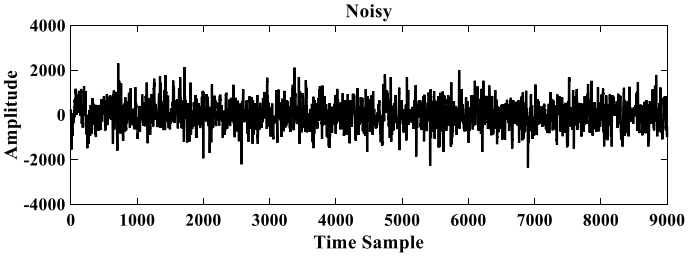

Fig. 9 ECG signal of atrial noisy class

Table 2 Confusion matrix of MLP classifier

Beat type	Normal	LBBB	APB	RBBB
Normal	479	6	20	3
LBBB	1	54	13	0
APB	54	20	174	2
RBBB	8	2	1	16

Table 3 Classification result of MLP classifier

Class	Sensitivity (%)	Specificity (%)	Accuracy (%)
Normal	94.29	81.73	89.21
LBBB	79.41	96.41	94.72
APB	69.6	94.36	87.10
RBBB	59.26	99.39	98.12
Average	**75.64**	**92.97**	**92.89**

Table 4 Confusion matrix of RBFN classifier

Beat type	Normal	LBBB	APB	RBBB
Normal	495	5	8	0
LBBB	0	66	2	0
APB	40	8	200	2
RBBB	1	1	1	24

Table 5 Classification result of RBFN classifier

Class	Sensitivity (%)	Specificity (%)	Accuracy (%)
Normal	97.44	88.08	93.55
LBBB	97.05	98.12	98.12
APB	80	98.17	92.84
RBBB	88.88	99.75	99.41
Average	**90.84**	**96.03**	**95.98**

Table 6 Confusion matrix of SVM classifier

Beat type	Normal	LBBB	APB	RBBB
Normal	505	2	0	1
LBBB	1	67	0	0
APB	1	1	248	0
RBBB	1	0	0	26

Table 7 Classification result of SVM classifier

Class	Sensitivity (%)	Specificity (%)	Accuracy (%)
Normal	99.40	98.27	99.29
LBBB	98.52	99.61	99.29
APB	99.20	100.00	99.41
RBBB	96.269	99.87	99.76
Average	**98.35**	**9.43**	**99.44**

4 Conclusion

Machine learning-based automated disease diagnosis system is one of the most popular researches in bioinformatics domain. Cardiac problem is a widespread disease and is vital to detect accurately. Though numerous researchers have worked on it, still different techniques were developed to test the same. SVM-based ECG classifier is performing better as compared to other two types of classifier. The features are extracted using DTCWT and considered as the input to the neural network. Further, the accuracy can be improved by modifying the SVM model.

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Hybrid Intelligent System Tool to Improve Technological Growth in Science and Technology(S&T) Sector by Identifying the GAP

Vithya Ganesan, J. Naren, Pellakuri Vidyullatha, P. Ramadoss, and U. Harita

Abstract A priority analysis and prediction is required to study about consistent growth in Science and Technology Sector (S&T). It is by developing a artificial intelligence tool to bolster technological growth by studying and comparing behavioral factors of temporal and current data. Obtain the epidemiological, temporal, and cohort study about Technological Growth (TG) on the sectors such as Environment Engineering Science (EES), Health Engineering (HE), Energy and Resource Engineering (EE), and Agricultural Engineering (AE) to find deviated habitat behavioral data for observation and analysis to strengthening Technological Growth (TG). Knowledge of deep learning in hybrid intelligent system tool confers an alarm and pavement to smart, healthy, and quality innovation to overcome the interdependent pitfall.

Keywords Mapping of science and technologies · Hybrid intelligent system tool · S and T domain · Gap in S and T

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1 Introduction

A VISION is needed to promote India as in the line of developed country. It is naturally inferred from Environment Engineering Science (EES), Health Engineering (HE), Energy and Resource Engineering (EE), Agricultural Engineering (AE) agriculture areas, and they are the primary eye opener for countries VISION.

A mapping formula and simulation tool are required in the following emerging challenged domain to identify their interdependency, individual growth, gap and blemishes for sustainability of S and T sectors for VISION 2025. The materialize challenges are: innovation—product, process, and production, emerging technologies, business, and industries, temporal data enhancement for new technologies, cost, and quality.

The holistic view of the S and T sectors such as.

Environment Engineering Science (EES), Health Engineering (HE), Energy and Resource Engineering (EE), and Agricultural Engineering (AE). S and T have to be analyzed by technology simulation tool for finding innovations, gap, emerging technology, business, and industries. The tool helps to identify the trade-off between the thirst areas and to attain a goal of VISION 2025 (Fig. 1).

Science and technology (S&T) should take a major role in investment, manpower, infrastructure on the thirst areas such basic science, risk, pollution, waste, health, intelligence engineering, energy and renewable and non-renewable resource engineering, agro and habitat engineering for VISION 2025 goal and its attainments (Fig. 2).

This diagram is inherited by four thirsty cognate EES, HE, EE, RE, and agricultural engineering by its core and allied areas for "2025" as by the target as export, eco- automation, patent, collaborations, 7G products, analysis, marketing in all basic science, health, manpower, infrastructure investments.

Mapping has been analyzed by the following factors to deploy a mapping tool for agenda of "VISION 2025" as on year 2020, and a pathway for "2025" is by the following:

Interdependencies—Improve "policy-based evidence" in innovation, emerging technology, quality, and marketing.

Interdependencies—Gap and flaws in S and T domain.

Intra dependencies—Improve "policy-based evidence" in innovation, emerging technology, quality, and marketing.

Intra dependencies—Gap and flaws in S and T domain.

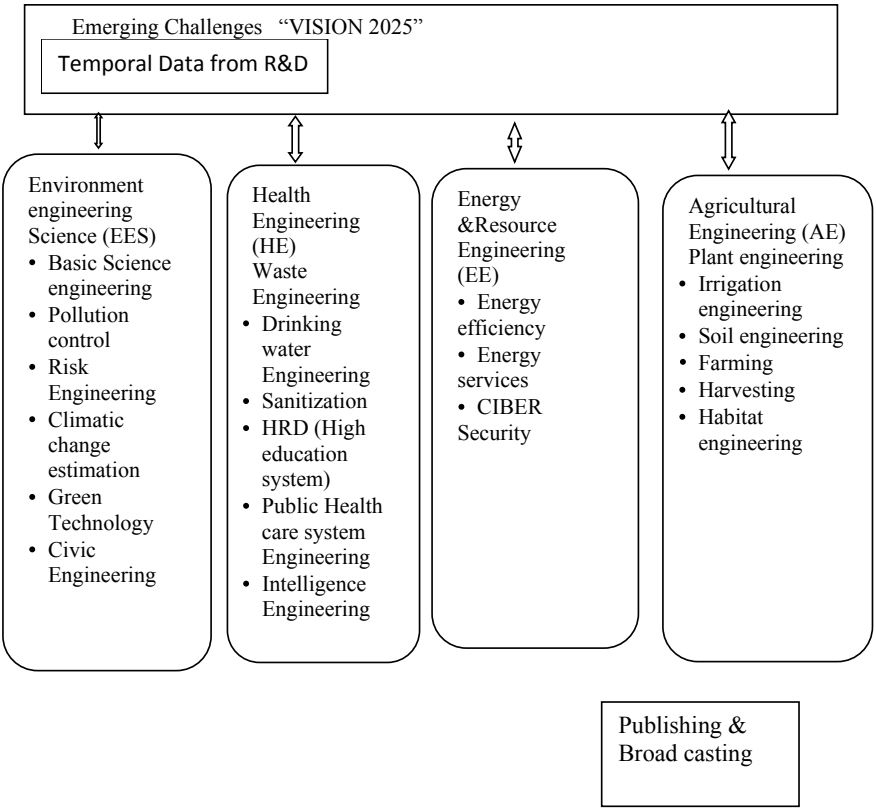

Fig. 1 Inter and intra dependencies analysis of Domain on S and T

2 Literature Survey

National status review—Assessment in Science and technology sectors.

The following are engineering sector in S and T field:-

Environment Engineering Science, Health Engineering, Energy and Resource Engineering (EE), Agricultural Engineering (AE).

The above domain faces difficulties and critical problems by.

- Un-identified newly emerging areas as well as its gap.
- Inadequate information directories on S and T, appropriate technology transfer
- Lack of innovation and high cost of user-friendly mechanization, labor
- Illiteracy in technology, scarcity, linkages, and marketing facilities.

VISION 2025 skills go through three stages to solve the above problems.

Innovation—Product, process, production.

Emerging technologies.

Business and industries.

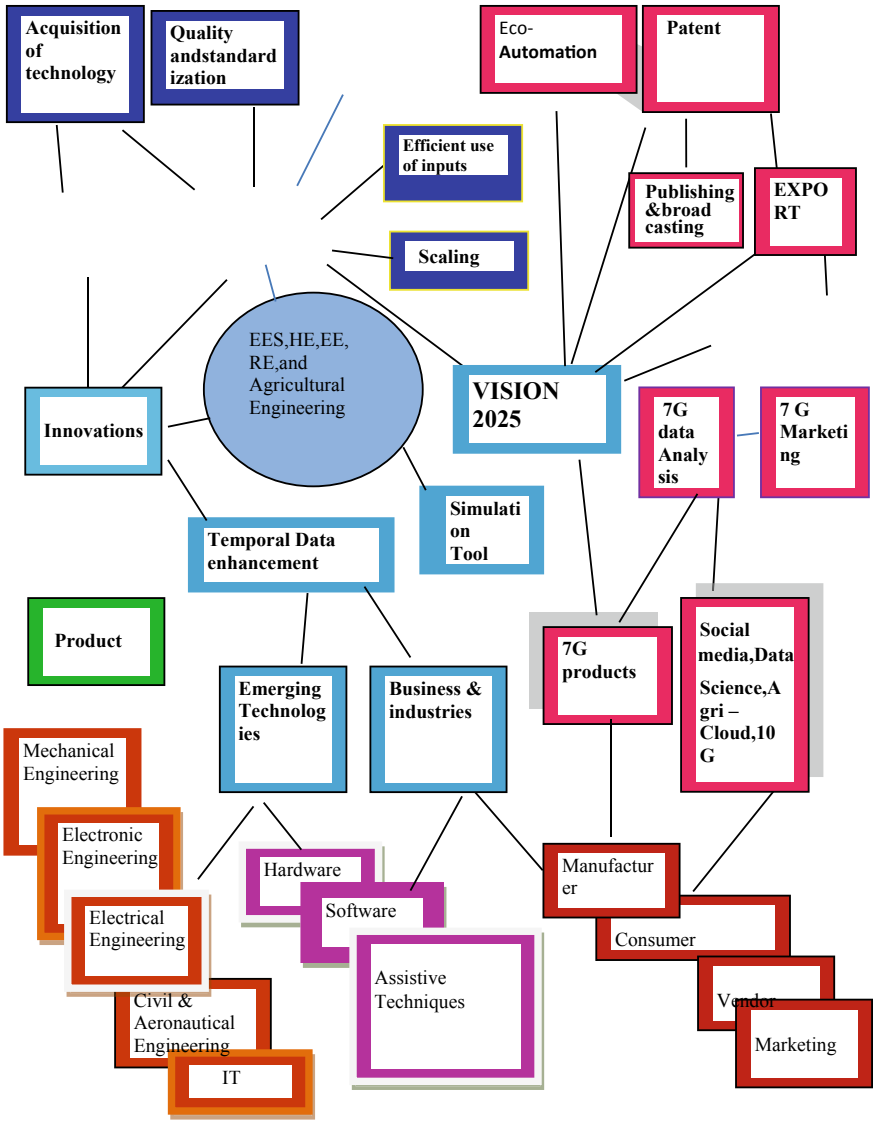

Fig. 2 S and T sector mapping of domains for "VISION 2025"

In fact, technology has come to play a very significant role in all domains.

Environment Engineering Science: Innovation—Product, process, production.

Basic science engineering such as modern physics, quantum physics, bio chemistry, and crystalline chemistry research mathematics are the emerging and basic for all the inventions. So more encouragement in this field is required to frame the law of inventions. Pollution control: Proper measures about air, water, noise will give

a helping hand for environmental engineering by eradicating health decease. Like polio, all chronic decease should be eradicated in the cultured smart India.

Risk Engineering: Risk management and service are the platform to implement innovations. India should estimate the risk because of its densely population.

Climatic change estimation: In India, the climatic condition is predicted with the help of sophisticated weather instruments, and it is very helpful to fisheries and farmers.

Civic Engineering: Tree plantation, forestation, civic infrastructure planning will lead to live in ultra luxurious style.

Green Technology: India should give more support to global warming by insisting bio industry emission.

Health Engineering: Innovation—Product, process, production:

The major domains such as waste engineering, drinking water engineering, sanitization, high education system (HRD), public health care system engineering, home department engineering are still in developing stage. Mainly to change education system to stop the brain drain.

Energy and Resource Engineering (EE).

In addition to renewable and non-renewable energy, renewable energy a powerful hybrid robust engineering is required to underpin the energy and resource engineering sector. For example, in India, the amount of energy from the sun that reaches the earth on each day which is absolutely enormous than any other country. To improve the utilization of natural energy and resource by an optimized use of water, sun, air, and soil in production and process are an innovation idea for hybrid robust engineering. India is in debut stage way to implementing the innovations in hybrid robust engineering. So more attention will give an enlightened platform for India's "VISION 2025."

Agricultural Engineering (AE).

- Field preparation, sowing and cultivation, feeding and protection crops, irrigation, harvesting and storage, marketing are the stages of agriculture
- Blemish in agricultural machinery for farming

The agricultural sector continues to lag in various sections due to overwhelming market size. The production of per hectare of crops in India is low compared to international standards. Table 1 describes the current status and flaw in agricultural engineering.

Emerging Technologies:

The emerging technologies such as Artificial Intelligence (AI), Internet of Things (IoT), Machine Learning (ML), Augmented Reality (AR), Virtual Reality (VR), robotics and automation are transforming the technology to the next level. But in India, more research, inventions, innovations are required to facilitate the technique in the skilled populated country.

Table 1 Current status and flaw in agricultural engineering

S. No.	Product of agriculture in India	Process	Production of current machinery	Blemish	Agricultural machinery needs
1	Field preparation—Plow and rollers	3 phase: soil reversing soil loosing soil flattening	Mix organic breakup crusted soil Loosen up soil	Not checking the deep (less than 12 inch is better)	A machine with checking of deep and soil moisture is needed
2	Sowing	Seed drilling	Seeds to be easily planted deep into the earth instead of on top	Machine rotating drills or runners	Automatic drillers can be used
3	Transplanting	Planting	Rotary transplanting picker mechanism with a row spacing of 30 cm	Takes more time	Batch transplanting can take less time per hour
4	Irrigation technology	Dripping	water-saving technology	No precision Technology	Need a contextual dripping
5	Harvesting and storage	Reapers, Mowers	Eco-friendly and are less messy to maintain	Noisy and pollution	Precision harvesting should implement
6	Weather tracking, satellite imaging	To know about weather	Partial usage by farmers	To give more training	Audio and video forum with training

Business and Industries:

S and T sectors need the support of data management, decision support, farm management, risk management, data science to facilitate per minute bulk amount of data transfer. But, we fully depend on developed countries for digital marketing, forum window to promote the product.

International Status Review: S and T sectors: Innovation—Product, process,production.

The international status on technology and electronics, production, and environment is shown in Table 2.

Table 2 Product, process, and production frequency of world scientific literature (1945–2018)

Management							
Factors	Terms	China %	USA %	S. Korea %	Germany %	Japan %	Other %
Technology and electronics	Wireless sensor	50.0			5.3	5.3	39.4
	Big data	2.1	21.3	12.8	4.3	34.0	25.5
	Cloud computing	50.0	5.6			11.1	33.3
	IoT	75.6	5.5		1.2		17.7
	Smart agriculture	9.5	4.8	28.6	4.8	14.3	38
Production and environment	Agricultural production	78.6					21.4
	Field information	100					-
	Sustainable agriculture		75.0				25.0
Management	Data management	66.7			16.7		16.6
	Decision support	17.8					82.4
	Farm management		7.4	22.1			70.5
	Risk management	84.6		7.7			7.7

Emerging Technologies

Smart farming (SF), based on the incorporation of information and communication technologies into machinery, equipment, and sensors in agricultural production systems, allows a large volume of data and information to be generated with progressive insertion of automation into the process.

By considering technology and electronics, the usage of wireless sensor in the field of agriculture is very meager. There is some sensors available in the agriculture. They are temperature sensor, humidity sensor, image sensor, audio sensor, optical sensor, and electro chemical sensors used in the agriculture.

Business and Industries: Developing countries taking the technology led to the development of more sophisticated and efficient methods of undertaking agricultural practices by using advances in computing power, connectivity, artificial intelligence, biotechnology, and GIS for precision agriculture and rural growth.

Big data, cloud computing, IoT, smart forming all rely on data transmission and the concentration of data in remote storage systems to enable the combination and analysis of various farm data for decision making.

Naren.J et.al proposed a system based on big data analytics which was helpful in classifying students in a university using deep learning techniques. This system was efficient and helpful in evaluating the performance in academics [1].

Dr. Vithya et al. designed a computer-aided system for diagnosing patients who were suffering from Autism spectrum disorder using deep learning. The severity of the patients suffering from Autism was diagnosed, and based on the classification, therapies were suggested [2].

Vidyullatha et.al designed a system which studied the way in which an artificial neural network was working with multi-layer feedforward and backpropogation. The study of the methods of training an ANN gave much confidence to the authors in the application of it further on many technologies and for more applications in the real world [3].

Vidyullatha.et.al designed a hybrid intelligent learning system for giving training for an artificial neural network fuzzy inference system with a novel particle swarm optimization method. The learning system was a called a hybrid intelligent learning system due to the amalgamation of technologies. The system gave wonderful results [4].

Sarada Pyngas et.al designed a computer-aided diagnosis system for epilepsy from EEG signals which gave the classification with machine learning techniques for diagnosing the severity of epilepsy at various levels [5].

Jithendran et.al did a pilot study on emotions in an e-learning community for improving the outcomes in learning based on machine learning techniques. The pilot study gives an outline on the various emotions that affect a student while doing an e-learning course [6].

Prahathish et.al proposed a framework for tackling the various issues in handling supply chain dataset with machine learning techniques. The framework can help us further in making supply chain forecasting better [7].

Rakshanasri et al. proposed a systematic framework using Internet of Things for making a home smart and one's health smart. The application serves dual purpose, and hence, the framework is called health smart home [8].

Zarina banu et al. gave an application which was a recommender system for the student community which helped in the course selection. The system's efficiency was effectively taken into consideration [9].

Vasuda, Vivek et al. proposed a system for recognizing spellings using Indian sign language. This helps people to learn spellings effectively for the deaf and dumb [10].

3 Methodology

Data science in science and technology.

The data science in Vision 2025 for science and technology is sorted out by the following.

Table 3 The challenges in data collection for science and technology

Challenges	Data collection activity	Target population
Product, process, production	Temporal data of product, process in S and T sector Acquisition of technology, alternative material assistive techniques	S and T engineering sector manufacturer, machineries, farmer, scientist, researcher suppliers, vendor, consumer, skilled and unskilled man power
Emerging technologies	Artificial Intelligence (AI), Internet of Things (IoT,) Virtual reality(VR)	S and T sector consultants, commercial labs. or private R and D institutes, components or software, information technology in S and T sector
Business and industries	S and T sector management and e-marketing	Suppliers of equipment, materials, Web developer, advertising agent, marketing manager in the target field engineering

Challenges.
Meta data of science and technology.
Method of data collection.
Source of S and T: State, central govt., public and private sector.
Data on data.
Challenges: The challenges in data collection for science and technology (Table 3).

3.1 Meta Data of Science and Technology: Method of data collection

See Table 4.

3.2 Sources of S and T (state, central govt., public and private sector)

See Table 5.

Table 4 Method of data collection

S and T sector domain	Target population	Methods of data collection	Information to be collected
Product, process, production	Farmer, scientist, researcher	Interview, questionnaire case study	Temporal data of S and T sector engineering, S and T sector industries, real-time data, and
			blemishes
	S and T sectors	Interview survey, case study	Raw materials, engineering machineries, Up scaling data, future needs and gaps
	(Environment,		
	health, energy,		
	resources,		
	agriculture		
	engineering)		
	S and T-environment engineering- Civic engineering	Infrastructure plan, rural, urbanization tree cultivation	Road, building, heritage, monuments details Tree planting data
	S and T—environment engineering—Irrigation department	Camera, Survey, Observation	Sources and availability of water, status of nature, and artificial water storage
	S and T—Environment engineering—meteorological department	Camera, survey, observation	Temperature, annual rain fall data
	S and T—Health engineering	Interview survey, case study	Health engineering data (Food, immune, decease real-time data, and blemishes)
	S and T—Agriculture engineering	Interview survey, case study	Agriculture machineries, crop type, crop intensity, requirements
	S and T—Energy and resource engineering	Interview survey, case study	Renewable and non-renewable resources, energy engineering
	Skilled and unskilled manpower	Interview, questionnaire	Raw material data, skilled and unskilled man powers, demand based and entrepreneurship data

(continued)

Table 4 (continued)

S and T sector domain	Target population	Methods of data collection	Information to be collected
	Suppliers, vendor, manufacturer, consumer, machineries (Private and Government)	Distributor or store audit, panel method, consumer panel	International standards, quality improvement techniques Machinery enhancements vendors feedback, machines flaw
Emerging technologies	Consultants, commercial laboratories or private R and D institutes, components or software, information technology from private and government	Interview, questionnaire case study	Training details conferences, trade fairs, exhibitions, white paper presentations, startup acquisitions
Business and industries	Suppliers of equipment, materials, web developer, advertising agent, marketing manager from private and government	Distributor or store audit, panel method, consumer panel	Customers feedback, advertisement, marketing synergy

4 Method of Processing and Analyzing

Issues involved in S and T sector and its domain:

The emerging challenging issues on S and T are:

- Knowledge factor—Difficulty in finding information, innovation, invention
- Cost factor—For finding information, innovation, invention
- Market factor—For innovative goods or services
- Quality and accuracy—For finding information, innovation, invention.

State-of-the-art analysis on S and T sector and its domain interdependencies and overlapping**:**

S and T Sectors:

Environment Engineering Science (EES), Health Engineering (HE),

Energy and Resource Engineering (EE), Agricultural Engineering (AE).

Domain:

Innovation—Product, process, production.

Acquisition of technology.

Quality and standardization.

Table 5 Sources of S and T

S. No.	Data	Sources of the data
1	Raw material	Sources within enterprise or group
2	S and T engineering machineries	Professional and industry associations data on S and T (Govt., Public, Private)
3	S and T scaling, future needs	Organic products Enhancement needs
4	Environment Engineering Science (EES)	Basic science engineering Pollution control data Risk engineering data Climatic change estimation data Civic engineering data
5	Health Engineering (HE)	Public health care system engineering data Waste Engineering data Drinking water engineering data Sanitization data High education system (HRD) data Home department engineering data
6	Energy and Resource Engineering (EE)	Energy efficiency data Energy services data CIBER security data
7	Agricultural Engineering (AE)	Plant engineering data Irrigation engineering data Soil engineering data Farming data Harvesting data Habitat engineering data
8	Raw Material based, entrepreneurship, skill based, demand based, and unskilled man powers,	Higher education department data statistical department data, employment office data Corporations of south TamilNadu data
9	International standards	Government policies data, international engineering Standards organization data
10	Quality improvement techniques, machinery enhancements	Sources within enterprise data or industry group data, sales group data feedback data
11	Vendors, supplier, consumer feedbacks	S and T sector vendors data Supplier data, consumer data
12	Training details Conferences, trade fairs, exhibitions, white paper presentations, Startup acquisitions	Universities, engineering colleges, and institutes, polytechnics government or public research institutes data, commercial laboratories or private R and D institutes data

(continued)

Table 5 (continued)

S. No.	Data	Sources of the data
13	Customers feedback	Competitors or other enterprises in S and T sectors
14	Product marketing synergy	Shares, equities, NAV data
15	Advertisement	Portal, apps, stalls, notices, banners data

Alternative material.

Efficient use of inputs.

Scaling.

Emerging technologies.

Hardware, software, assistive technique.

Mechanical, electrical, electronics, civil, aeronautical engineering.

Business and industries.

Manufacturer, vendor, marketing, consumer.

Analysis Factors:

The powerful tool that helps (1) to analysis these issues are:

Process design.

Cost assessment.

Profitability analysis.

Sensitivity analysis.

Each domain has its own analysis factor such as process, cost, profitability, and sensitivity to overcome the emerging challenges. Mapping of technology to meet challenges such as knowledge, cost, marketing, and accuracy is obtained by finding the interdependencies between S and T sector and its domain with analysis factors. The following diagram shows the interdependencies of S and T and its domain (Fig. 3).

Let EES, EE, AE, HE are the S and T sectors, and X1, X2, X3, X4, X5, X6, X7, and X8 are the domain interdependencies between the S and T sectors.

where

X1- (EES ∩ EE), X2- (EE ∩ AE), X3- (AE ∩ HE), X4-(HE ∩ EES).

X5- (X1 ∩ X2), X6- (X2 ∩ X3), X7- (X3 ∩ X4), X8- (X4 ∩ X1),

X9- {(EE) U (AE) U (EES) U (HE) and {(EE) ∩ (AE) ∩ (EES) ∩ (HE)}.

The identified interdependencies reduce time, cost and improve profitability and sensitivity.

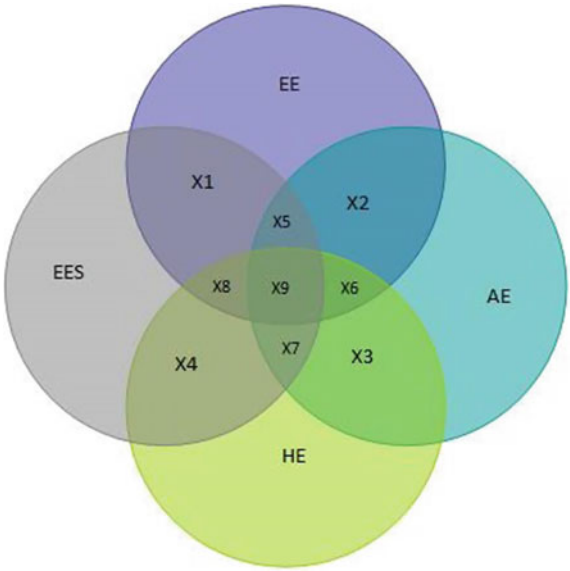

Fig. 3 Mapping and analyzing technologies to meet emerging challenges

5 Implementation

Deep learning is implemented for identifying S and T sector gap by regression for time to time performance and classification for growth alert (Fig. 4).

6 Conclusion

The RNN tool extends its great support to identify the gap in the science and technology sector from the temporal meta data. It provides efficient growth rate, and gap in the sectors to reach the goal future work lies in developing priority levels in an octree structure and to develop destination by query-based structured tool and building a web UI browser-based configuration.

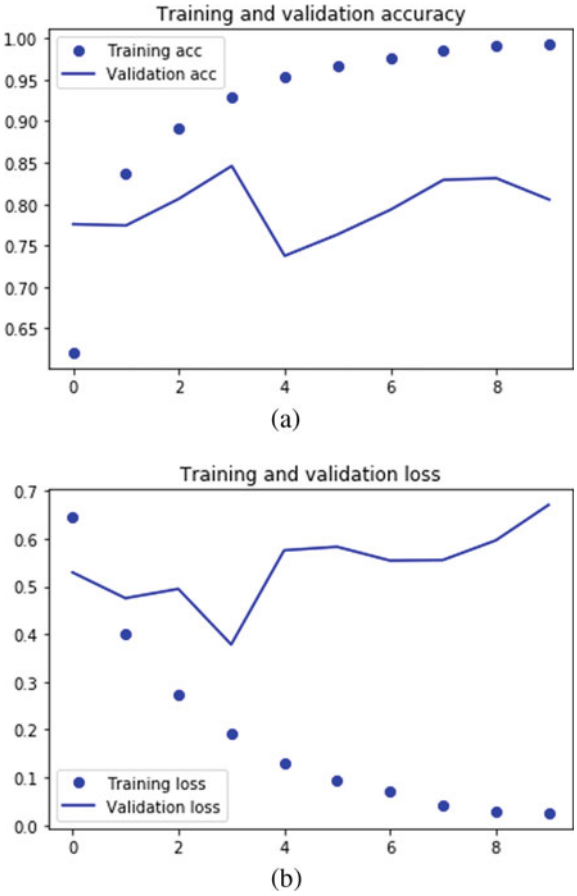

Fig. 4 (**a**, **b**) Training and validation accuracy of S and T sector gap identification

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A Machine Learning Model for Predicting Academic Performance of Students Through Internet Usage

J. Naren, Vithya Ganesan, P. Gayathiri, K. K. Dhivyhalakshmi, and Praveena Ramalingam

Abstract Internet is a powerful platform for students to develop the areas of interest and improve existing skills. Students in the age group of 18–25 are most frequent users. People in general, especially students, use the Internet mainly for research and educational purposes. The way in which people use the Internet meaning the websites browsed indicates the behavior seeking perspective. The outburst of Internet has aided students in many ways, but it also brings negative impact in academic performance. Study on people has also told that the balance maintained between students with study and Internet has a good impact in their academic performance too. The proposed work uses machine learning algorithms to quantify the relationship between performance in academics and behavior perspectives of a student in the usage of Internet and to bring out novel features that have a generalized value. Students are grouped according to academic performance and grades obtained with further processing by decision tree, support vector machines (SVM), and neural networks algorithms. Students' Internet logs could be obtained and expose affluent information on students' behavior. The proposed work has strong practical value for improving management skills of students' in education with the university and college sector.

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Keywords Academic performance · Machine learning · Support vector machine · Neural networks

1 Introduction

Internet is one of the largest resources utilized in terms of learning. The most intermittent users of the Internet are between the age group 18–25. The age group mentioned above comprises a majority of students.

An individual uses the Web to interface with others, sharing documents, data, and bunches of different exercises that are helpful.

Today, practically, all schools and universities have moved to PCs and projectors, by discarding the use of blackboards. Pupils are instructed through online recordings. They log on to the online research portals which, obviously, must be obtained by means of the Web.

The Web causes researchers to trade ideas and materials in the midst of virtual devices for their examination and scholarly works. It permits and makes it feasible for schools and students to trade information with corporate groups associations identified with different subjects. Such intercessions help students to be pragmatic and subjection which will help them sometime down their career.

Students, nowadays, are being provided with easily accessible e- learning platforms which is defining the new age of education.

Some of the courses from MOOC, Swayam, etc., are also being provided as compulsory courses in many colleges and universities for getting grades by submitting the certifications of courses. In the modern era, Internet is growing as a measure of academic achievement. Internet usage logs are the most feasible way to measure ones' Internet usage activity. The higher usage of Internet can immensely affect academic performance as well [1]. The Internet usage behavior of a student is broken based on online duration, upload volume, download volume, and their logging in timings.

2 Literature Survey

Teachers can easily interpret about the impact of students' Internet usage [2]. The diverseness of students may be useful in estimating academics and thereby helps in boosting their performance [3]. Moreover, students can be split up at the very earlier possible to boost their performance [4]. Focus on the learner's long-time goals can be forecasted by having a control check on academics [5]. Some students may show exceptional performance in particular subjects when compared to others that could be focused upon for improvement [6]. Deciding on the components of academics and predicting the fakeness on non-cognitive predictors [7, 8]. Each learner may take up various grasping time for understanding the concept [9]. Cognitive predictors such as peer pressure, social media can influence the learner's performance [10].

Social media addiction is one of the main factors of impact in learning process [11]. The level of recognition plays a major in impact of academics and its effect in the lives of students [12, 13].Users of social media may differ on their skills of multitasking on their university performance [14]. Cases of suicide and depression are prevailing among students in recent times [15]. Universities are meeting places for different ethnicity, race, and culture which can influence the mindset of students [16]. Online discussion forums and blogs are stages for various discussions [17]. Academic performance of students can be deeply affected by their physical and mental health [18]. Abusing or bullying can deeply affect the emotional balance in students [19]. Transition from high school to college can be an anxious period in a person's life because of the change of atmosphere [20, 21]. Facebook is a common addiction among different age groups specifically on the teenagers because of the raise of content such as memes and vine videos [22].

3 Architecture

See Fig. 1.

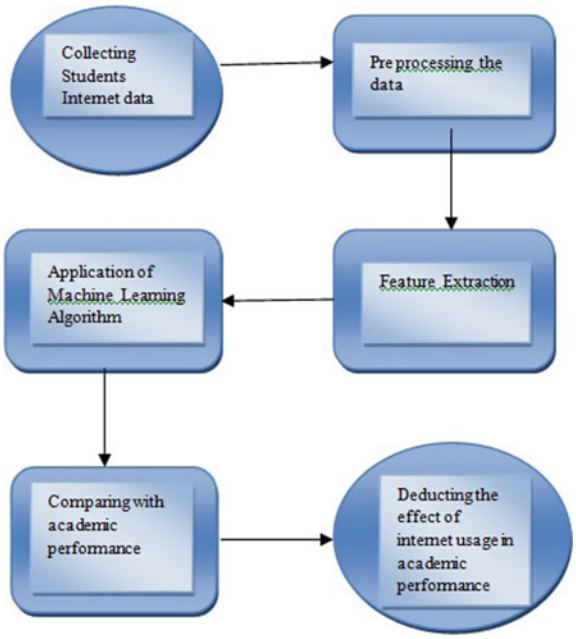

Fig. 1 Design model of the computer system

4 Methodology

Detection on how far Internet affects academic performance and behavioral aspects in a student is the main motive of application design [23]. Social media is major cause for students' behavioral change [24]. Excessive use of social media brings out poor academic performance [25]. It distracts students' mind and makes them inactive in classroom during lectures [26]. The dataset on students' performance in age group 18–21 of SASTRA Deemed to be University, Thanjavur, was collected. People in adolescence age have worsened self-control compared to middle aged people [27].

These people behavioral changes reflect in their academics clearly. The data was collected in two phases: Before continuous internal assessment (CIA), after continuous internal assessment (CIA) [28]. The dataset consists of various attributes which includes register number, start time, stop time, upload volume, download volume, CGPA. The amount of time they are spending in the Internet is one of the important features of this analysis [29]. The students are categorized into two groups as pass students and fail students based on academic performance of students. Followed by CGPA and is further classified as PASS or FAIL depending on the number of standing arrears. The Internet usage activity is mapped along with academic performance and as two slots (i.e., before CIA and after CIA) and results are predicted by applying machine learning algorithms [30] (Tables 1 and 2).

Table 1 Dataset of students

Register no	Start time	Stop time
120003229	00:00:02	00:02:39
120015023	00:00:02	00:35:49
120015031	00:00:05	00:25:19
120015089	00:00:10	00:30:54
120015096	00:00:15	00:45:24

Table 2 Dataset 2

Register no	Upload volume (GB)	Download volume (GB)
120003229	0	2
120015023	7	0
120015031	0	4
120015089	1	5
120015096	2	8

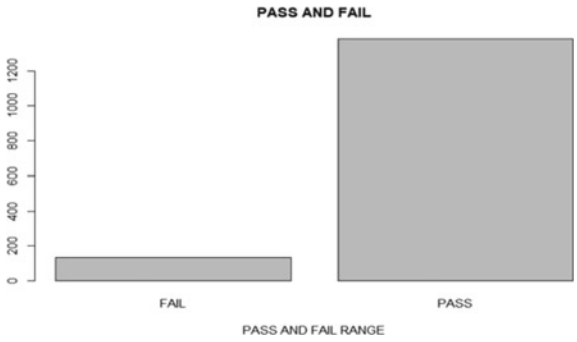

Fig. 2 Relation between Student's academic performances with respect to Internet usage

4.1 Specific Test

Mann-Whitney U test is used to test significance of the differences between clusters based on skewed distribution.

Spearman's correlation coefficient is implemented to quantify the correlation between scholastic performance and students' behavioral aspects (Fig. 2).

4.2 Classification Algorithms

4.2.1 Decision Tree

Decision tree (DT) induction is a classification algorithm which learns how to take decisions from a tree by forming class-labeled training tuples. The creation of DT does not require any domain understandings or parameter settings. It is appropriate for exploratory primarily based understanding discovery. Tree pruning is used to refine data by taking out noisy branches which assist in enhancing the accuracy. The three popular DT algorithms are: Classification and Regression Tress (CART), ID3 (Iterative Dichotomiser), and C4.5.

The DT algorithm adopts a greedy technique where trees are constructed in a top-down recursive divide and conquer manner. Attribute choice techniques are known as splitting regulations which determine how the tuple at given node are to be split. Information Gain, Gain Ratio, and Gini Index are used to select attributes by ID3, C4.5, and CART, respectively. These algorithms are broadly applied to discrete as well as continuous valued attribute of dataset.

4.2.2 Support Vector Machine

Support vector machine (SVM) is a supervised machine learning method applicable to both classification and regression. It handles several continuous and categorical values.

All elements of dataset are plotted as a point in n-dimensional plane. Hyperplane is used differentiate classes thereby performing the classification. The primary motive is on maximizing the gap from hyperplane to the closest data point of each of two classes. The hyperplane which separates classes is called as a maximum margin hyperplane (MMH).

The "Kernel trick" is used to analyze a linear classifier to categorize a non-linear dataset. It transforms the linearly indistinguishable data into a linear distinguishable by extruding it into a higher dimension. A kernel method is carried out on each instance of data to map the authentic nonlinear data points into higher dimensional space in which they turn out to be linearly separable. The kernel defines the similarity or a distance measure between new tuples and the support vectors.

Neural network: A neural network is a popular deep learning algorithm that endeavors to differentiate bottom-lining of relationships in a set of data through a procedure that mimics behavior of human brain. A "Neuron" in a neural network is a systematic feature that collects and classifies information by considering a selected design. It incorporates layers of interconnected nodes where each node is called as a perceptron.

In multi-layered perception (MLP), perceptron are organized with interconnected layers. The input layer collects input patterns. Until achieving minimal margin error, hidden layers refine the input weights. Classification algorithm used in output layer maps input pattern. "Gradient Descent" is commonly used optimization algorithm that optimizes the task rapidly.

"Back Propagation" is the process of updating bias and weight. This algorithm functions by finding the loss at output layer and then transmitting it back into network. Error has been minimized updated weights on account of each neuron. Thus, the output in an artificial neural network is the closing layer of neurons that produces end result.

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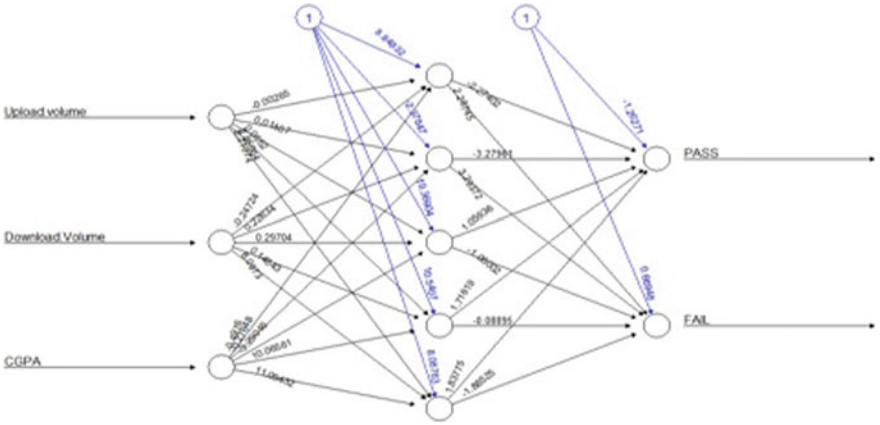

Fig. 3 Neural network

output in an artificial neural network is the closing layer of neurons that produces result (Fig. 3).

5 Result

The performance measure accuracy is used to test the individual measures.

5.1 Accuracy

Accuracy defines the closeness of a deliberate and incentive to a standard or known value. It is the ratio of correctly predicted values to actual values (Tables 3 and 4).

Table 3 Accuracy of different classifiers

Classification algorithms	Accuracy (in percentage)
Decision tree	90.76
Neural network	84.88
Support vector machine	55.7

Table 4 Spearsmen coefficient value for various attributes

Relationship between attributes and different groups	Spearsmen correlation coefficient
Register number	0.03711368
Upload volume	−0.0038663
Download volume	−0.00077657
CGPA	0.46641731

6 Conclusion

From the proposed system implementation, Internet usage was high by low-performance students when compared to high-performance students. The low-performance students were addicted to Internet compared to high-performance students because of worse self-control. The online game addiction is main reason for the students to loss their self-control [31]. Students' birthplace, family conditions, growing environment creates very big impact in their Internet usage. Hence, an inference was drawn that Internet usage data with the application of Machine learning techniques is effective in predicting academic performance and behavior of students especially in residential universities and colleges. This prediction will be useful to improve themselves in earlier stage [32]. These improvements will help them to shine in their future goals [33]. Students' Internet behavior reflects their cultural backgrounds, behavior, and keen interest [34].

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Egocentric Vision for Dog Behavioral Analysis

Vithya Ganesan, P. Ramadoss, P. Rajarajeswari, J. Naren, and S. HemaSiselee

Abstract Egocentric vision, an offshoot of computer vision, offers unique insight into the visual world by examining images and videos taken by a digital camera. This research, with the aid of ecocentered view, describes the actions of the different dog breed in different situations. It will improve predicting the breed behavior of the dog and gaining more knowledge of the breed of dog. To understand the breed behavior of the dog is to evaluate the historical breed data of the dog with current data. The comparison between dog's current situation and dog's activities will predict behavior in indoor and outdoor situations.

Keywords Egocentric vision · Dog behavior · Image acquisition

1 Introduction

A mixture of feedback from their five senses including sight, taste, smell, sound and touch determines the behavior of the dog. Behavioral research is by studying the interaction with their surroundings and behavior between the dog's breed. Table 1

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Table 1 Profile of dog breed

No	Breed name	Gender	Weight	Height	Color	Life Span	Coat
1	Boxer Dog	Male	63–81 lb (29–37 kg)	22–25 in (56–64 cm)	Fawn, brindle and white	Average 9–15 yr	Short, shiny, smooth, close lying
		Female	55–71 lb (25–32 kg)	21–24 in (53–61 cm)			
2	Labrador Dog	Male	65–80 lb (29–36 kg)	22.5 -24.5 in	Black, chocolate, yellow (nearly white) to fox red	Average 12–13 yr	Black,brown, yellow
		Female	55–70 lb (25–32 kg)	21.5–23.5 in			
3	Doberman dog	Male	88–99 lb (40–45 kg)	27–28 in (68–72 cm)	Black, red, blue, fawn	Average 9–12 yr	Short coat
		Female	71–77 lb (32–35 kg)	25–27 in (63–68 cm)			
4	Beagles Dog	Male	22–25 lb (10.0–11.3 kg)	33–41 cm	Tricolor or white in combination with black & tan/brown or brown/tan	Averae 12–15 yr	Short haired, hard coat of medium length
		Female	20–23 lb (9.1–10.4 kg)	33–41 cm			

Table 2 Dog's breed food behavior

Breed of dog	Gender	Breakfast	Kind of food	Eating performance
Labrador	Male, female	Veg	Pedigree adult dry dog food	Well
Doberman	Male, female	Non-Veg	Cooked meat	Well
Boxer	Male, female	Non-Veg	Cooked meat	Well
Beagles	Male, female	Veg and non-veg	Dry dog food and cooked meat	Well

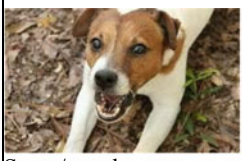
shows the attribute of four different breeds of dogs used for prediction and research. Table 2 shows the dog's food behavior, and Table 3 shows the behaving pattern.

Figure 1, 2, 3 and 4 shows the activities of dog's breed (Tables 4, 5 and 6).

1.1 Literature Survey

Animal behavior and animal welfare scientists' video-based analysis is one of the most important tools [1]. A framework for analyzing dog behavior should be created, which can serve as an indicator of their welfare [2]. To analyze the prediction of

Table 3 Behaving pattern of dog's breed

Breed name	Gender	Known people	Unknown people
Labrador	Male,female	 Friendly	 Scare/attack
Boxer	Male, female	 Friendly	 Ready to attack
Doberman	Male, female	 Friendly	 Ready to attack
Beagles	Male, female	 Friendly	 Barking

different dog breeds, an analysis a tool is needed. [3, 4]. Habitat selection studies provide key information for conservation initiatives by identifying important habitat and anthropogenic characteristics influencing the distribution of threatened species in changing landscapes. [5, 6]. Dogs do not only fulfill all behavioral and polygraph criteria of sleep, but are characterized by sleep homeostasis, diurnal pattern of activity, circadian rhythms, ultrafine sleep cycles, socio-ecologically and environmentally shaped wake-sleep structure, sleep-related memory improvement, as well as specific sleep disorders [7]. Study on demands therapy during their performance in therapeutic environments of accepting close social contact with strangers [8] is analyzed to predict the behavior. The egocentric effects of these enrichments on the dogs' adoption frequency and time to adoption were evaluated [9] to improving dogs' behavior and reducing the stress of the shelter environment.

Fig. 1 Different activities of boxer dog

1.2 Methodology

1.2.1 Activities of Dogs

The dog activities such as happiness, alert, angry, aggressive, playing are analyzed and quantified into data for prediction.

Feel Happy

A happy dog will look relaxed and 'normal,' showing no gestures, or trying to make himself look big or small. He will stand comfortably on all four legs, with tail and ears holding naturally, relaxed facial muscles with his mouth closed or slightly open

Fig. 2 Different activities of Doberman dog

while panting to cool down. Normally, his tail will be at a neutral height and wag from side to side wagging softly (Fig. 5).

High Alert

The alert dog looks very focused and concentrated. He must stand upright with all fours based on weight. His head and neck will be up tall, with his eyes looking normal but directed at whatever happens to have his attention, while his ears will be up and turning around to try to capture any sounds. His tail will either be in its natural position or held slightly high and it will be rigidly standing still. His mouth is usually closed, but he may complain or bark sometimes (Fig. 6).

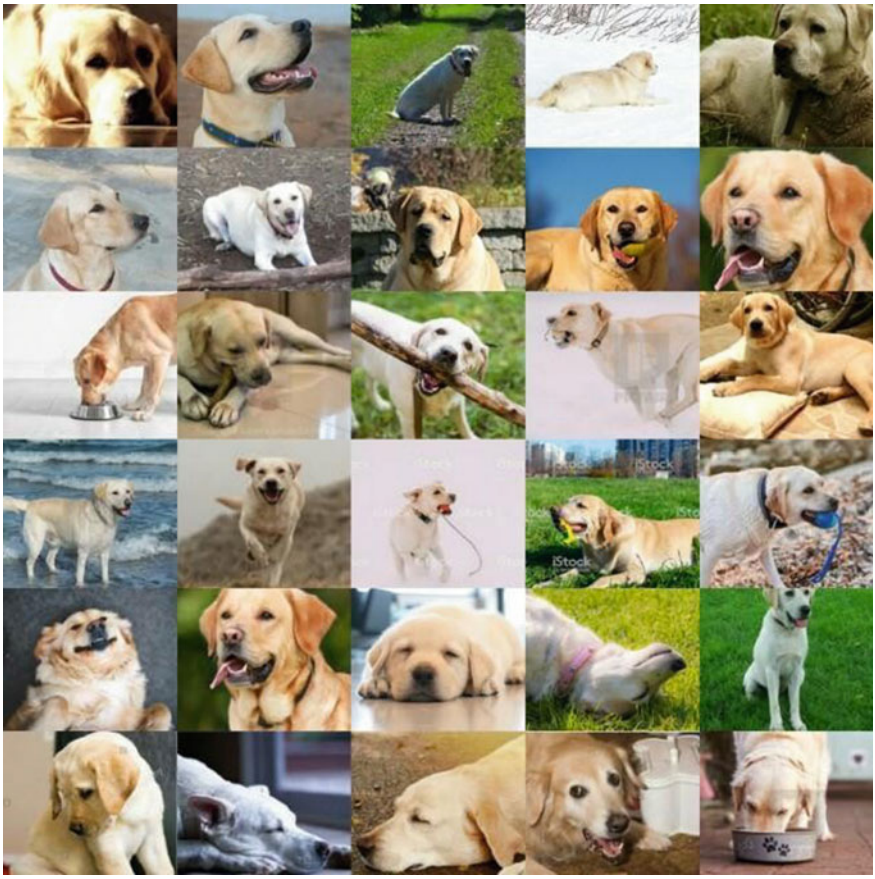


Fig. 3 Different activities of Labrador dog

Feeling Angry and Aggressive

If your dog feels angry and aggressive, he will do his utmost to make himself look big and imposing, adding aggressive and threatening signs to your body. It is divided into two groups according to aggressive dogs (Fig. 7).

Offensively Aggressive

He is going to make himself look big and intimidating, keep his head high, bring his ears up and down, lift his tail up and hold it rigidly, place his hair on his back, move his weight forward ready to lunge, and look at the person or other dog directly. These are the signs of a dog that is confident and assertive.

Fig. 4 Different activities of Beagles dog

He will also be exposing his teeth in addition to these offensive signals by raising his top lip vertically and wrinkling his muzzle. Normally, in an unmistakably threatening way, he will become very aggressive, growling, snarling and barking loudly.

Fearfully Aggressive

If your dog feels fearfully violent, he will take all the postures mentioned above in 'fearful, fearful, or fearful, but he will bare his teeth, snarl, and groan.

Many frightened Labradors do not get violent, escaping the cause of their fear rather than battling it. But if they are cornered or blocked in otherwise, they may feel that there is no other choice than bite. He will always look scary at this moment, but the violent signs of teeth bearing and groaning will be seen as being addressed.

Table 4 (**a**, **b**) shows the dog behavior at day and night time, **a** Daily behavior of dog: Day time, **b** Daily behavior of dog: Nighttime

(**a**)				
Day timing	Boxer	Doberman	Labrador	Beagles
6 am–8 am	Active	Sleep	Play	Active
8 am–10 am	Sleep	Play	Active	Sleep
10 am–12 pm	Play	Sleep	Active	Play
12 pm–2 pm	Active	Play	Sleep	Play
2 pm–4 pm	Active	Play	Play	Active
4 pm–6 pm	Sleep	Sleep	Play	Sleep
(**b**)				
Night timing	Boxer	Doberman	Labrador	Beagles
6 pm–8 pm	Active	Sleep	Play	Sleep
8 pm–10 pm	Sleep	Play	Active	Play
10 pm–12 am	Play	Sleep	Active	Play
12 am–2 am	Active	Play	Sleep	Active
2 am–4 am	Active	Active	Play	Active
4 am–6 am	Active	Active	Active	Active

Table 5 Health and play analysis of dog

Breed name	Running speed	Learning activities	Health problems	Doctor check up
Boxer	32 km/h	Quick learning	Obesity, epilepsy, allergies, cherry eye and hypothyroidism	Monthly once
Labrador	29 km/h	Need training	Joint problem, obesity, ear infection, heart disease	Monthly once
Doberman	50 km/h	Quick learning	Bloat, skin problem, thyroid	Monthly once
Beagles	40–48 km/h	Need training	Allergies, hypothyroidism, Idiopathic epilepsy, intervertebral disk disease	Monthly once

Feeling Excited

The body is tense and ready for action when your dog is excited, but he will also take a friendly look. His ears will be raised, his eyes open and focused, he will look at the source of the excitement, and there is every possibility that his mouth will be open, but his teeth will be hidden, his tail held high, generally wagging side by side,

Table 6 Indoor and outdoor activities

Timings	Gender	Boxer		Doberman		Labrador		Beagles	
		Indoor	Outdoor	Indoor	Outdoor	Indoor	Outdoor	Indoor	Outdoor
6 am–8 am	Male	Active	Play well	Active	Walking	Sleep	Happy	Active	Happy
	Female	Sleep	Active	Sleep	Normal	Active	Happy	Active	Normal
10 am–12 pm	Male	Sleep	Play	Sleep	Play well	Sleep	Normal	Sleep	Walking
	Female	Active	Play well	Active	Play well	Sleep	Walking	Active	Normal
2 pm–4 pm	Male	Active	Happy	Active	Walking	Active	Walking	Sleep	Happy
	Female	Active	Play well	Active	Play well	Active	Play well	Active	Walking
5 pm–7 pm	Male	Sleep	Walking	Active	Happy	Sleep	Normal	Sleep	Normal
	Female	Sleep	Normal	Sleep	walking	sleep	Play well	Active	Happy

Fig. 5 Pictures of dogs feeling happy

Fig. 6 Pictures of dogs highly alert

Fig. 7 Pictures of dogs feeling angry and aggressive

Fig. 8 Pictures of dogs feeling exited

and sometimes with such vigor that his entire rear end will be covered and it's the end of it (Fig. 8).

In short, excited little outbursts sometimes bark excited dogs, and this should not be confused with any hostility at all.

While Playing

The energetic and bouncy dog is a playful dog, jumping and spinning, barking and pawing. They like to run around you, or back and forth, possibly knocking against you slightly before sprinting away in the hope that you will chase after them or start playing.

His heads will be up and forward, and with a sparkle of happiness in them, his eyes will be wide open. The Labrador will jump into a stance during a play bow where his front legs are forward and very close to the ground, his back legs will be straight and his tail high in the air. Generally, he can bark a high- pitched, yapping, enthusiastic bark, begging for a little love.

2 Implementation

Using Weka Tool, the collected temporal and current data are analyzed to predict dog interactions with known and unknown populations, graph for dog speed and different dog race learning activities. Blue means dogs from Boxer and Doberman, red indicates dog from Labrador, light blue indicates dog from Beagles. Figures 9, 10 and 11 show the dog behaviors with known and unknown people.

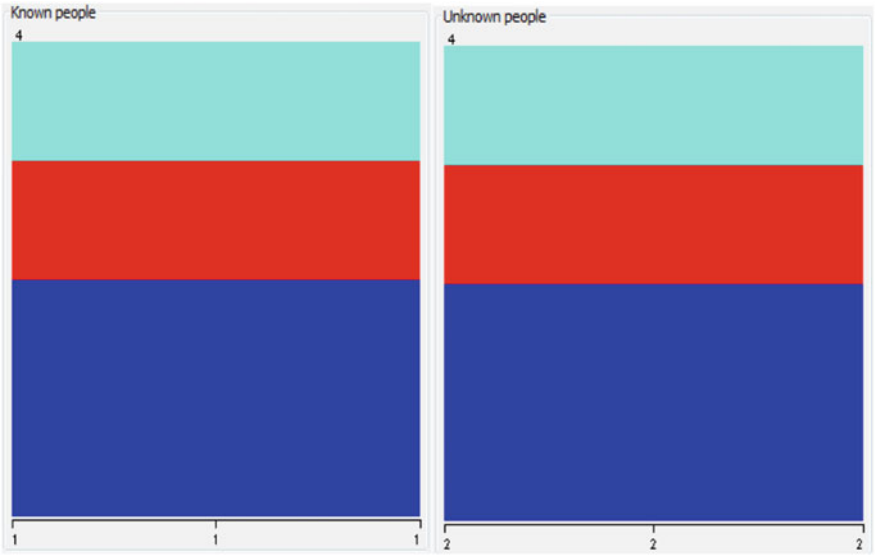


Fig. 9 Dog behaviors with known and unknown people

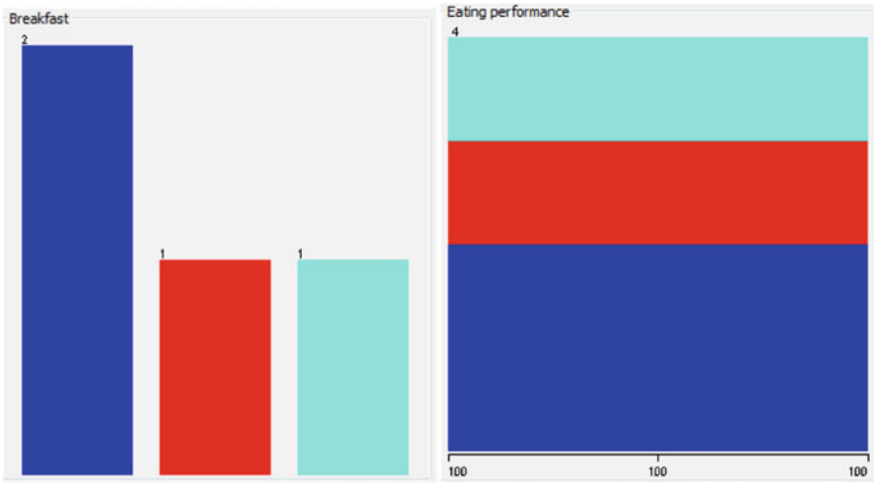


Fig. 10 Graph for dogs' breakfast and eating performance

3 Conclusions

The plan is very useful to define the habits of each dog and can take action based on the owner's dog behaviors. Machine learning has done the entire process. We will improve communication between the owner and the dogs by this plan. Further photos

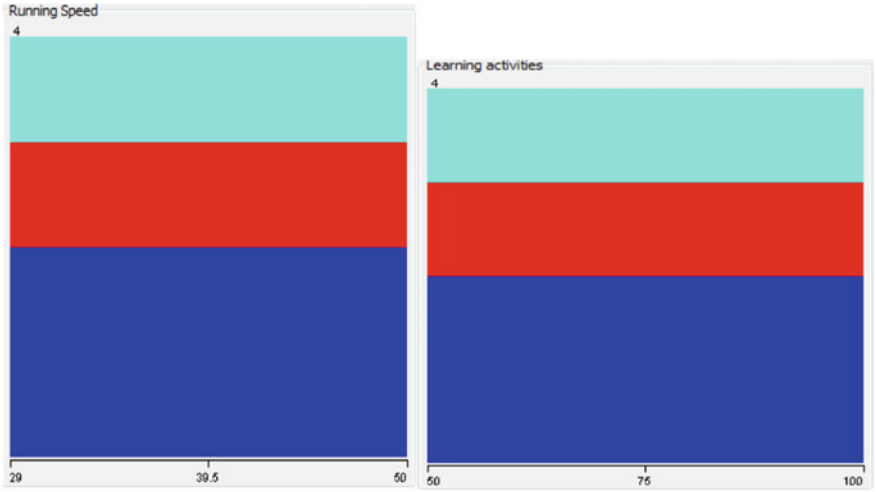


Fig. 11 Graph for dogs speed and learning activities

have been used to classify dog behaviors for this study. This is mostly important for the military and the blind.

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A Deep Learning Model for Investigation on Human Body Movements and Action

J. Naren, Vithya Ganesan, Nivedha Jayaseelan, Srivats S. Ramanujam, and P. Vijayalakshmi

Abstract Recognizing body movements are vital for fields like virtual reality, human computer interaction, and safety monitoring. The research seeks to overcome the limitations of existing body movement recognition systems, which include individual human body recognition rather than multiple recognition and also fails when the body is partially visible. Since most of the real-world applications, like accident monitoring requires recognition of multiple people; at the same time, the existing methodology has reached an impasse. Classification algorithms are predominantly used to recognize various body movements and actions. Even Kinect, which is well known for recognizing human actions and movements, uses a random forest algorithm to track the movements. With recent technological advancements, researchers are keen to increase the accuracy of tracking the movements. New research methodologies seek to overcome the above limitations by using deep neural networks and many other machine learning algorithms. With the inspiration of the success of convolution neural networks (CNNs), the implementation explores usage of the mentioned deep learning algorithm in estimating human poses and recognizes corresponding actions. The idea is to build a scalable model that can be used for many applications and get accurate results as much as possible.

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Keywords Deep learning · Pose estimation · Action recognition · Convolution neural networks

1 Introduction

In the past decade, human pose estimation has played a vital role in many modern applications. Evaluating human poses are extremely challenging, and its recognition is usually rife with inaccuracies due to high changeability in the shape and size of human limbs in combination with the high intensity of articulation of human joints. The existing models for pose estimation have a few drawbacks.

Firstly, these models take a fixed size of input vector. However, in real-time videos captured from public places, such as roads or markets, it is increasingly common to find multiple people within the same frame. [2] Secondly, only a part of the human body might be captured in the frame. For example, in a video containing two players playing table tennis, only the upper portion of the body of the players might be visible [3]. These methods directly broaden architectures constructed for RGB images, which are 2D and employ depth maps as elementary 2D images. The elementary complexity lies in the challenge to fully exploit the human pose information available to us. [4] Therefore, in order to fully utilize the available poses, the methodology uses light spot information as the input. Pose information is disintegrated into dynamic and static elements, which are then encoded into light spot images (Fig. 1).

In this work, the paper seeks to combine global and pose features which are loosely coupled. That is, the idea examines the effects of connecting optical flow and RGB with human poses for motion detection and recognition of various actions. High accuracy can be achieved using these architectures which are based on convolution neural networks. [1].

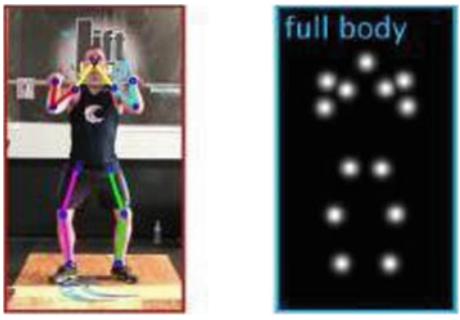

Fig. 1 Light spot images

The pose base CNN descriptor employs joint positions to yield optical flow and RGB images into part patches as the initial vectors for two-stream ConvNets, consequently utilizing the derived features for video classification. The paper accomplishes the proposed system using the Penn action dataset. The above method helps to overcome the anomalies of the existing systems. In recent times, using CNNs have been found to be widely useful in obtaining accurate results [15]. It is important to note that the efficiency of CNN-based algorithms is highly dependent on whether annotated images are available or not. Training a pose estimation system, which is practically useful, requires a huge dataset that consists of instances with limited obstructions, firm diction, and curtailed image borders.

Gaining knowledge about the correlation between body parts and joints is crucial in order to perform pose estimation, and extensive research has been performed for the same. High accuracy was achieved in a few of these studies, by encoding constraints on the body parts in order to predict locations of the body joints accurately. DeepPose, which utilizes CNN architecture, codifies the pose evaluation conundrum as a regression problem, thereby causing a shift in the approaches used for pose estimation, from classical to deep network.

2 Pose Features

Body pose is a vital criterion for evaluating various human actions, and some of these can also be differentiated from a lone frame in the video sequence. A few methods commonly consider only the pose features of human body for action recognition [12, 13]. A few of these methodologies evaluates various pose features including plane, joint, and velocity. It is experimentally observed that velocity features are prone to corruption by noise and joint features surpass the others in terms of performance. [4].

High-level pose features (HLPF) contain relationships (spatial and temporal) between joints. A pose is characterized by a collection of corresponding locations of main and sub-parts and is immune to a slight modification in the overall body pose [14]. This is because the position of a specific part relative to its sub-parts is independent of the positions of other main parts with respect to their sub-parts.

2.1 Literature Survey

Li et al. propose an innovative pose-based motion detection and recognition system that facilitates identification of actions with flexible body pose input vector that consists of partially or completely visible bodies, by combining pose and global feature-based action recognition by using Penn action dataset and sub-JHMDB datasets [1]. Lorincz et al. brought into picture a siamese network incorporated with equivariant incorporation that introduces regularization in 3D pose evaluation. The

method was shown to perform efficiently only in cases, where 2D pose detection data was utilized [5]. Bouganis et al. [4] propose a 3D CNN framework for pose evaluation for videos containing multiple people. The work, which is the first of the works which briefs about multi-person 3D human pose estimation, achieves a high accuracy of 98% on three-person datasets [6].

3 Business Case Scenarios

There are various advantages and useful business case scenarios in keeping track of human poses over a period of time. Some of them include recognizing gestures and activities. There are several use cases for the same, including.

3.1 Motion Capture and Augmented Reality

Manual programming of robots can be tedious, and thus, they can be used to follow the trajectories of a human pose skeleton that is performing an action. Robots can be taught certain actions by demonstration by human instructors. The robot then calculates how to perform the same action by moving its articulators.

3.2 Motion Tracking Pose Estimation

Fancy enhancements, graphics, artwork, equipment, and styles can be superimposed on the person if estimation can be made of their human poses. By tracking the variations of the postures of human, the graphics rendered can "naturally fit" the person as and when they move. A group of moving people can also be tracked.

3.3 Training Robots For Consoles

Interactive gaming is an interesting application of pose estimation as it tracks the motion of humans in real-time. Xbox Kinect uses 3D human pose estimation to track the motion of the human players and to render the actions of the virtual characters.

3.4 Detect if a Person Has Fallen Down or Is Sick

Pose estimation methods can be used to detect if a person has fainted suddenly. This can also detect if a person is healthy or is sick depending on his posture. A sick person probably has a drooping posture.

4 Problem Statement

The proposed system seeks to overcome the limitations of the existing systems. In this work, a motion detection and recognition system are developed using deep learning algorithms. Different human actions such as running, walking are detected and recognized. A scalable model is constructed so that most datasets can be used to train it and achieve high accuracies.

4.1 Dataset

The Penn action dataset consists of 15 various sports categories and 2326 videos in total. 13 human joints are annotated in each video clip. The various actions are: tennis forehand and serve, jerk and clean, push ups and pull ups, strumming a guitar, swinging in golf, and baseball, jump rope, jumping jacks, pitching a baseball, sit-ups and squats, bowling, and bench press, with action type having about 82–231 videos. The dataset also supplies visual labels for each setting. The frame lengths in the videos range from 18 to 663. Out of the 2326 video sequences, about 662 are multi-person videos. The dataset displays uncontrolled actions which comprise self-obstruction and complicated articulations.

4.2 Methodology

When a video input is given, body poses can be derived in every frame by utilizing pose estimation or annotation. Firstly, video is divided into clips, each having about ten frames, and we change them into light spot images and then calculate joint displacement volumes. In this work, pose features and global features are combined to perform pose estimation. Pose features include static and dynamic features which can be deduced from the light spot images and displacement volumes. The sixth frame in the series of clips is fed as an input to the static pose stream, and the ten frames are stacked in order to obtain a volume of 20 stacked channels that are given as input to the dynamic pose.

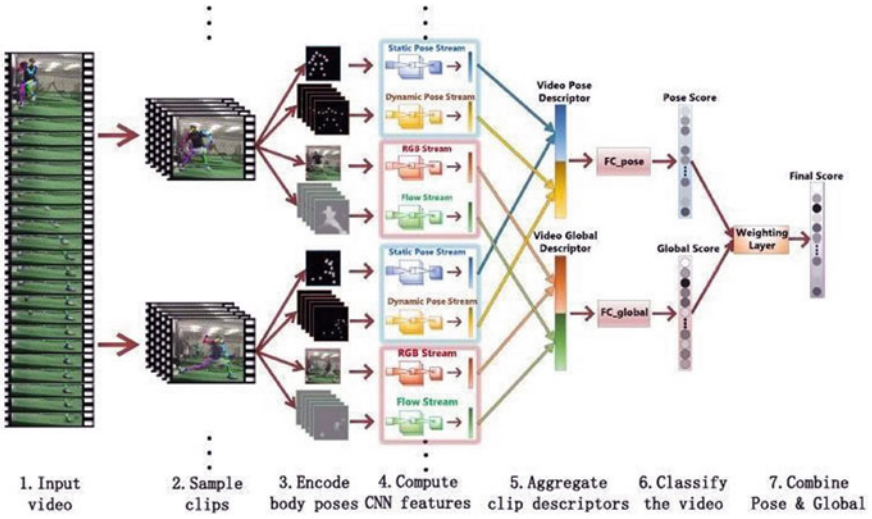

Fig. 2 Methodology

2D convolutional kernels are utilized in dynamic pose streams. VGG-M with five convolutional and three fully connected layers is used for both the streams, thereby making feature extraction effective. A comprehensive video pose descriptor is formed using descriptors for static and dynamic pose streams, and a comprehensive video global descriptor is formed from the RGB stream and optical flow stream. Both the descriptors are fed into a fully connected layer to predict classification confidence scores.

A pre-trained VGG-M model is used to deduce global features, and this is pre-trained on the ImageNet dataset [10] and on the UCF-101 dataset [11], thereby obtaining optical and RGB features, respectively, [7]. As mentioned above, the sixth frame of every clip in the RGB series is given as input to the RGB stream, and the optical flow features of the ten frames are stacked to form an optical flow volume of 20 stacked channels to be fed into the flow stream (Fig. 2).

All frames are reshaped to 128×128 and are passed through the VGGM model which contains five convolutional and three fully connected layers which produce high accuracy after training.

4.3 Implemetation Details

The training is separate for the clip feature extractors of the dynamic and static pose streams. For the Penn action dataset, the dynamic and static pose stream are trained using the same model, which is determined on an 80/20% train/validation split. The dataset is passed through the OpenPose pose detector, and the poses of all

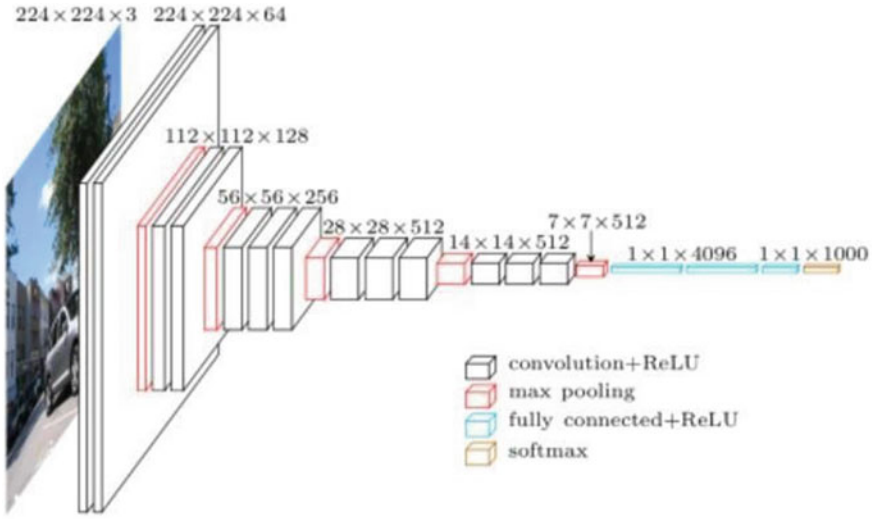

Fig. 3 VGGM architecture

images are saved. Every action is then assigned with labels so that the videos can be classified. It is then passed through the VGGM model pre-trained in ImageNet dataset to recognize the actions. To avoid overfitting, the implementation adopt dropout and data augmentation.

All frames are reshaped to 128 × 128 and are passed through the VGGM model which contains five convolution and three fully connected layers which produce high accuracy after training (Fig. 3).

4.3.1 Implementation

The combination of both global and pose features gives an accuracy of 98.2% on the dataset, which is comparatively higher than that obtained using either global or pose features. As we can see, even though action recognition with any one of pose or global features achieves high accuracy, the combination achieves a much higher accuracy, thereby a great improvement in the performance of the model. The other available methods provided 97.4% accuracy which makes this methodology better. Currently, a state-of-the-art model, it surpasses the accuracy of RPAN which was previously the best model for recognizing actions and estimating poses (Tables 1 and 2).

Table 1 Difference in accuracies based on features

Model	Accuracy
RGB	81.4
Optical flow	94.4
Static pose	90.6
Dynamic pose	92.4
Global features	95.1
Pose features	93.6
Combined features	98.2

Table 2 Difference in accuracies with respect to previously employed models

Method	Penn action	Sub-JHMDB
Global features only		
Dense [5]	73.4	46.0
Action bank [42]	83.9	–
C3D [36]	86.0	–
Pose features only		
HLPF [14]	–	54.1
Pose [43]	79.0	61.5
Ours	93.6	65.7
Pose + global features		
Actemes {42}	79.4	–
MST [33]	74.0	45.3
Graph model [44]	85.5	61.2
JDD [36]	87.4	77.7
Pose + idt-fv [43]	92.9	74.6
RPAN [37]	97.4	78.6
P-CNN [35]	–	66.8
Ours	98.2	79.0

5 Conclusion and Future Work

The paper proposes a novel human pose action recognition system that can accurately model various actions of humans with flexible 2D body pose given as input which has multiple bodies or partial or fully visible and multiple bodies. A human pose encoding scheme is designed to encode static and dynamic pose components into sparse light spot images and joint displacement volumes, respectively, which can be directly used as network input.

Fig. 4 Baseball pitch

The paper experimentally demonstrates that pose features and global features are highly complementary. Thus, the paper proposes an action recognition framework to perform multi-modal action recognition in monocular videos. The approach not only handles more flexible pose input but also relies on overall pose structures; thus, it is more robust to pose errors. In the future, the plan is to combine pose estimation and action recognition in a unified framework since the two tasks are naturally highly coupled. Although there have been several attempts exploring such a framework, it is still a less explored area in the scope of deep learning architectures.

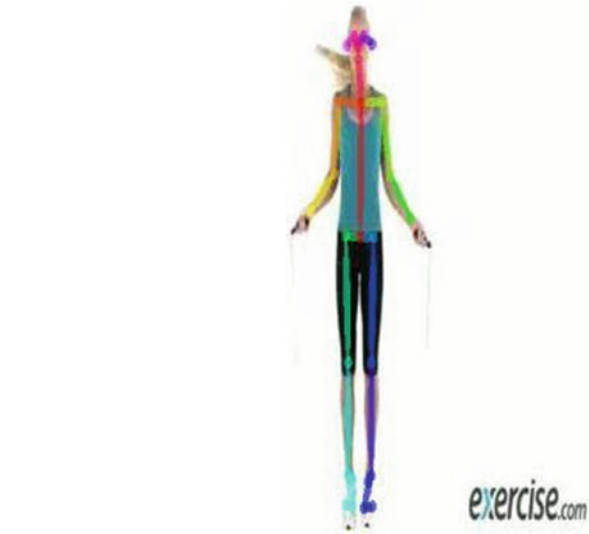

Fig. 5 Jump rope

Fig. 6 Bench press

Fig. 7 Golf swing

Fig. 8 Bowling

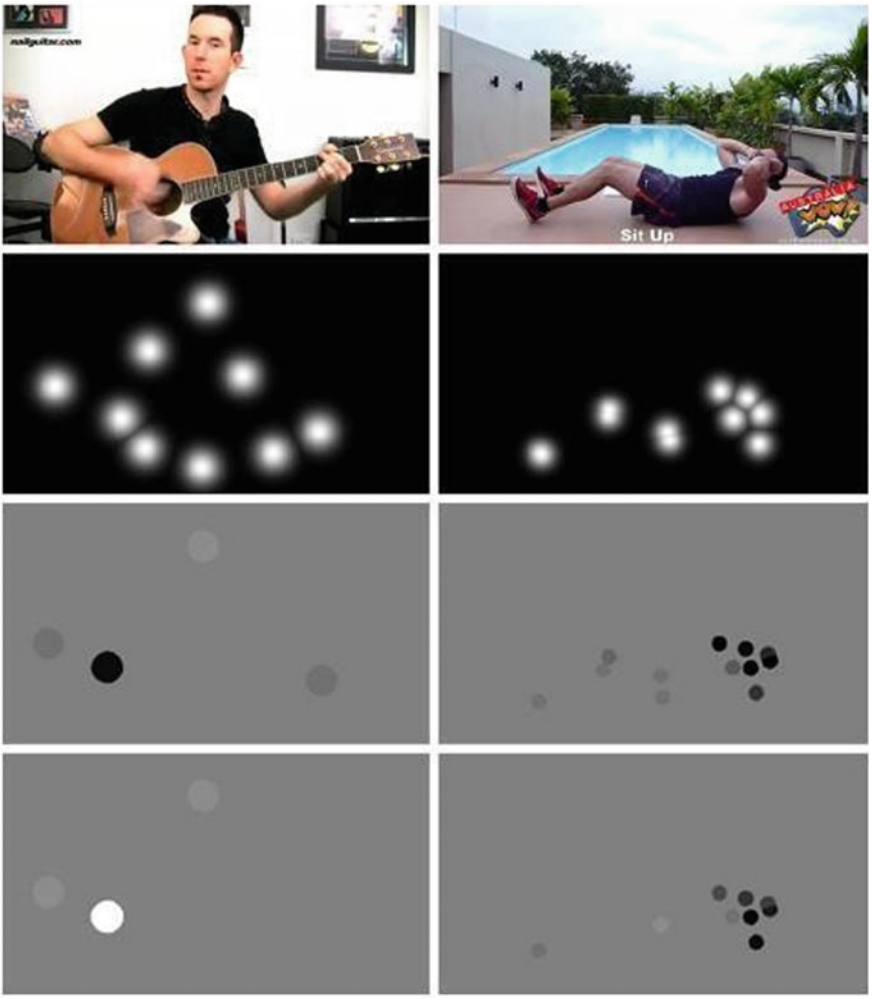

Fig. 9 Strumming guitar and sit up

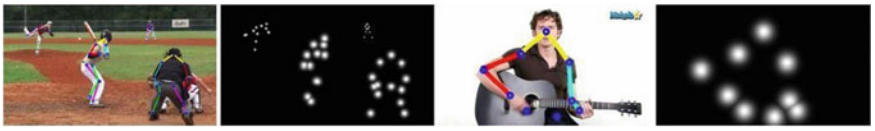

Fig. 10 Images with multiple person and partial visible body

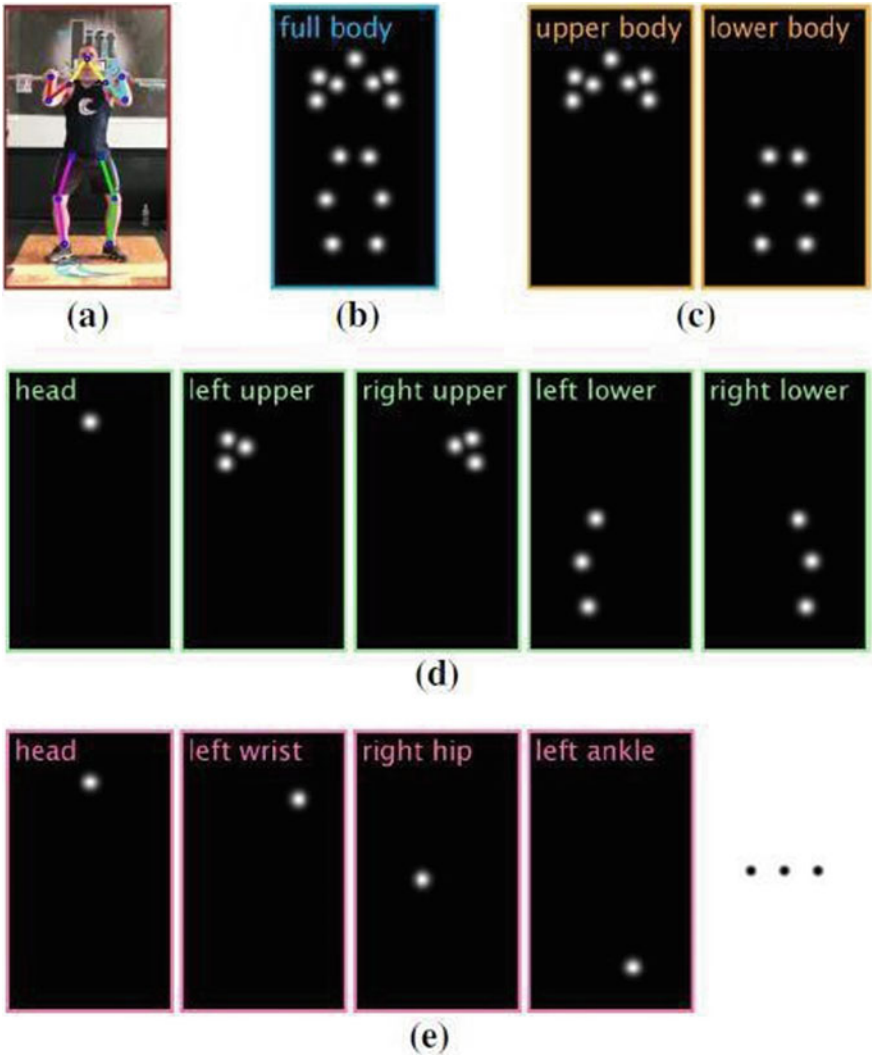

Fig. 11 Light spot images generated according to different grouping schemes

Fig. 12 Estimated poses for different actions

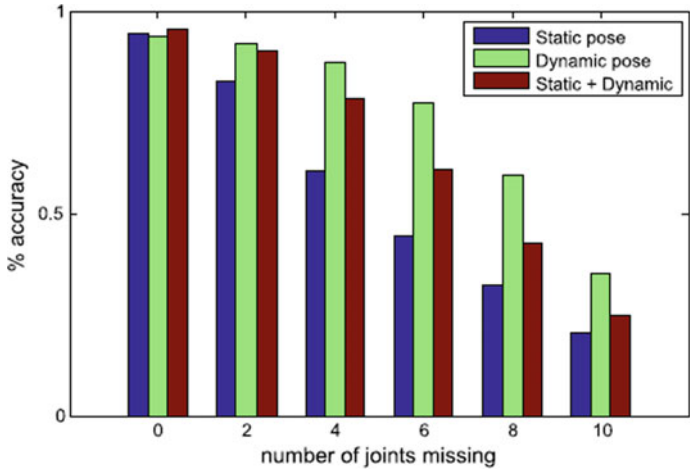

Fig. 13 Action recognition accuracy with different numbers of missing joints

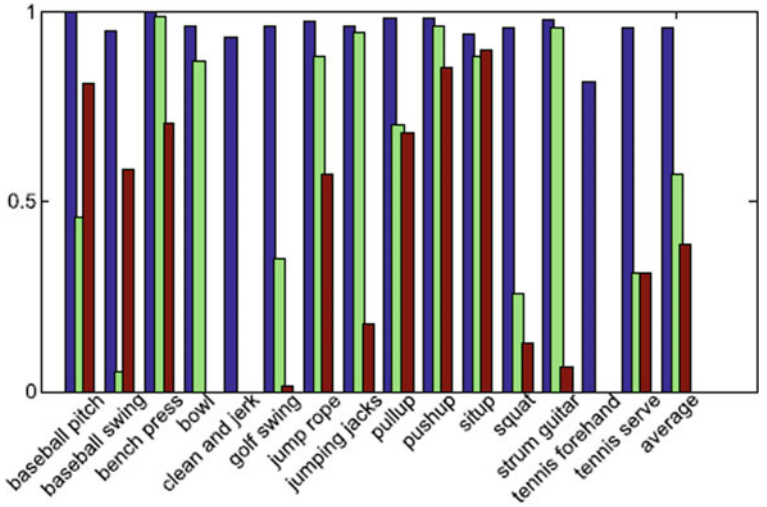

Fig. 14 Per class accuracy on the Penn action dataset for full-body pose (blue), upper-body pose (green), and lower-body pose (red)

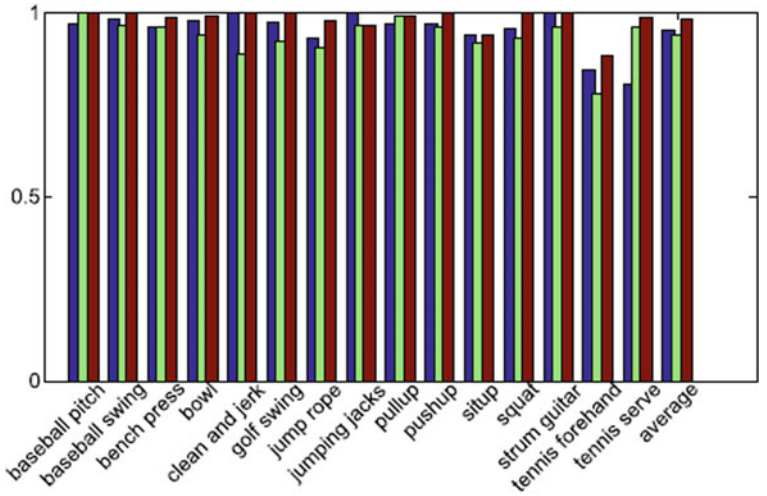

Fig. 15 Per class accuracy on the Penn action dataset for global features (blue), pose features (green), and combined features (red)

Layer (type)	Output Shape	Param #
conv2d_1 (Conv2D)	(None, 128, 128, 16)	448
conv2d_2 (Conv2D)	(None, 128, 128, 16)	2320
max_pooling2d_1 (MaxPooling2	(None, 63, 63, 16)	0
conv2d_3 (Conv2D)	(None, 63, 63, 64)	9280
conv2d_4 (Conv2D)	(None, 63, 63, 64)	36928
max_pooling2d_2 (MaxPooling2	(None, 31, 31, 64)	0
conv2d_5 (Conv2D)	(None, 31, 31, 64)	36928
conv2d_6 (Conv2D)	(None, 31, 31, 64)	36928
max_pooling2d_3 (MaxPooling2	(None, 15, 15, 64)	0
conv2d_7 (Conv2D)	(None, 15, 15, 128)	73856
conv2d_8 (Conv2D)	(None, 15, 15, 128)	147584
max_pooling2d_4 (MaxPooling2	(None, 7, 7, 128)	0
conv2d_9 (Conv2D)	(None, 7, 7, 128)	147584
conv2d_10 (Conv2D)	(None, 7, 7, 128)	147584
max_pooling2d_5 (MaxPooling2	(None, 3, 3, 128)	0
flatten_1 (Flatten)	(None, 1152)	0
dense_1 (Dense)	(None, 256)	295168
dense_2 (Dense)	(None, 1)	257

Total params: 934,865
Trainable params: 934,865
Non-trainable params: 0

Fig. 16 Model summary

```
In [6]: final_model=model.fit(x_train, y_train, batch_size=50, epochs=2)
   ...: final_val=model.predict(x_test)
   ...: final_val=np.round(final_val)
WARNING:tensorflow:From C:\Users\sriva\Anaconda3\lib\site-packages\tensorflow\python
\ops\math_ops.py:3066: to_int32 (from tensorflow.python.ops.math_ops) is deprecated and
will be removed in a future version.
Instructions for updating:
Use tf.cast instead.
Epoch 1/2
5777/5777 [==============================] - 77s 13ms/step - loss: 0.4119 - acc: 0.8482
Epoch 2/2
5777/5777 [==============================] - 22s 4ms/step - loss: 0.0486 - acc: 0.9855

In [7]: from sklearn.metrics import confusion_matrix
   ...: confusion_matrix(y_test, final_val)
Out[7]:
array([[501,   0],
       [  0, 944]], dtype=int64)
```

Fig. 17 Running the model and the confusion matrix for a small sample

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Evolution of Wireless Communications with 3G, 4G, 5G, and Next Generation Technologies in India

Pranay Yadav, Alok Upadhyay, V. B. Surya Prasath, Zakir Ali, and Bharat Bhooshan Khare

Abstract In the era of wireless communication, internet devices such as smart phones, hotspots, and Wi-Fi zone are important player of rapid growth of data usage. Internet connection devices are building new challenges for internet service providers such as higher bandwidth and indomitable increasing users day to day. This article gives an overview of existing different technologies of wireless communication as well as future enhancement of wireless services is explained. Different techniques during last decade are introduced for handling next generation techniques for ISPs. We provided a comparative analysis of different generations such as 3G, 4G, and 5G, and we focus on the next generation communication technologies 6G and 7G. Current research works are focused on 5G and next era generation of communication technologies. The development of internet infrastructure is essential for better mobile broadband experiences. In this work, we compared all the available generation communication systems, either wireless or wired, that are being deployed as well as future directions.

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Keywords Wireless communications · Fifth generation communication · Quality of service (QoS) · Hot spot · Internet service providers (ISPs) · Wi-fi

1 Introduction

The demand of internet in over world increase rapidly. In this way, last five year 2013–2017 India shows indomitable growth usage of internet. 4G technology plays as an important part, especially reliance JIO for increasing the usage of internet in India. For the growth, any country depends on three main things—road, communication, and illiterateness [1–5]. Internet plays an important role for the improvement of literacy in any country. In the below Fig. 1 shows the graph of usage of internet in our country (India). In the last 2–3 yr growth rate of internet and smart phone user in cases rapidly [6–11]. To maintain this growth of the internet required 5G communication system implement in India. This paper discusses the different communication technologies present in the current communication system and coming in future 2020. The next evolution in the communication industry is coming 5G communication system that will start in approx. 2020. Figure 1 shows the internet growth rate in India. Figure 2 shows the different generation communication system and data rate of different generation communication system.

These small sensing element nodes that contains detection, processing, and communication of parts, cash in on the thought of sensing element networks supported the cooperative effort of an oversized variety of nodes. A detector array consists of an outsized range of detector nodes that are densely deployed either at intervals or terribly near the development [12–18]. The position of the detector nodes should not be modified or planned. This enables for random readying inaccessible parcel or disaster relief operations (Table 1).

2 Comparison of Various Techniques

Table 2 described the comparison among 3G, 4G, 5G, and 6G technology. The highest data rate of 6G is 70 Gbps, whereas the lowest data rate of 3G is 400Kbps to 30Mbps.

Table 1 Comparisons of different generation communication 1G to 5G

Technology feature	1G	3G	4G	5G
Start/Deployment	1970–80	2004–2010	Now	Soon (Probably 2020)
Data Bandwidth	2 kbps	2 Mbps	1 Gbps	Higher than 1 Gbps
Multiplexing	FDMA	CDMA	CDMA	CDMA
Switching	Switching	Packet	All packet	All packet
Core N/W	PSTN	Packet N/W	Internet	Internet

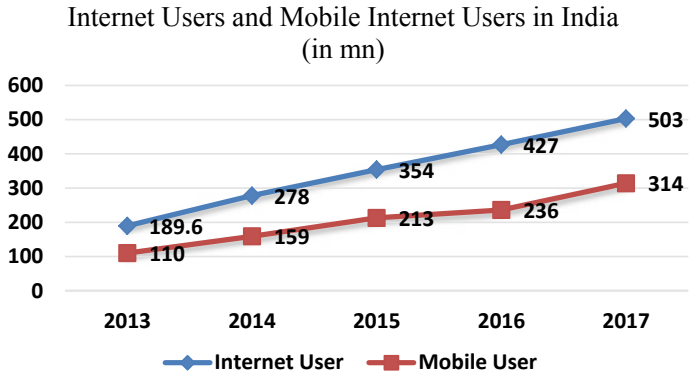

Fig. 1 Internet growth rate in India

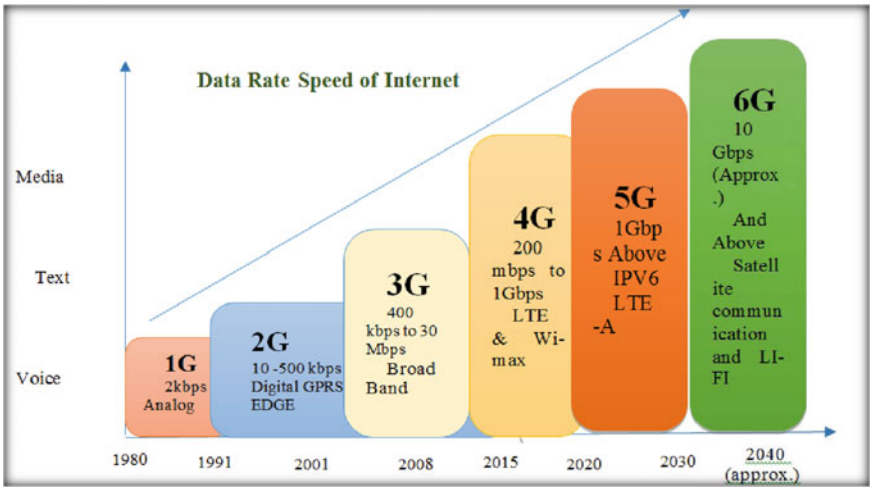

Fig. 2 Wireless mobile networks generation

Table 2 Compression between various technologies

Generation	3G	4G	5G	6G
Started at	2001	2008	Will start 2020	Will Start 2022
Technology	Broad Band IP Tech	LTE, Wi-max	IPv4	IPv6 satellite-based internet
Data rates	400 kbps to 30 Mbps	200 mbps to 1 Gbps	Higher than 1Gbps	70Gbps
Main network	Packet GSM, TDMA	Internet	Internet	Satellite-based connectivity
Sub generation	3.5G, 3.75G	4G only	5G till now	Currently not available

In the last decade, different researchers work on these three generations such as 3G, 4G, and 5G. Some researchers and telecom operators describe fourth generation (4G) mobile communication system as a new world better than 3G, which can provide many inconceivable applications and high performance multimedia contents. Also, few services such as 4G wireless instant connections are cheaper than 3G services.

3 Conclusion

In this comparative research analysis, it discusses the different generation of communication networks. This research analysis discusses mainly on three different generations 3G-4G, 5G, and future of 6G-7G. In the last decade, different researchers work on this three generation. This article shows the comparative study of different generation. 6G and 7G both are the future of communication technology thats why it discusses the different researcher's views and its comparison on it. 5G can want rethinking from the system and design levels right down to the physical layer. India got success in the satellite base internet services with the launch of three communication satellites. The implementation of 5G communication is done successfully in India, obtaining 10Mbps speed per second.

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Biogas Plant: Process & Parameter Monitoring

Pooja Agnihotri, Prabhas Kumar Gupta, and K. Ganpati Shrinivas Sharma

Abstract Green energy has led to an increase in biogas plants and consequently to an increased use of organic waste. Kitchen wastes are reliable because of their potential to yield methane. Biogas is a combustible mixture of bio-methane typically 50–75%, carbon (IV) oxide and also other trace gases. By monitoring the system with an indicator of digester behaviour and various parameter sensors, the plant can be operated successfully. For the increased performance, temperature is an important factor. Solar assisted biogas generation system offers several benefits. Thus, by increasing digester temperature using solar aided biogas is recommended to obtain higher amount of biogas yield. Reasonable pH moisture is vital for a fruitful anaerobic digestion course. Small particle sizes, suitable mixing of waste and water ratio are important factors too. This paper presents aspects of biogas plant with a smart system to monitor the system and enhance biogas production. It emphases on effective robust indicators, applicable monitoring methods. The details and facts presented here intend to boost and to foment biogas via anaerobic digestion. This is also beneficial for the development in research of biogas monitoring and management system.

Keywords Biogas · Biogas plant · Digester · Process monitoring · Parameter sensor

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1 Introduction

In compliance with international agreements to fight against climate change, government in many countries around the world are encouraging the increase of renewable energy, by providing subsidies to encourage the growth of renewable sector. Global power capacity is now based on renewable energy, much of which is provided by the solar and wind energy. Comparatively, more reliable and predictable source of renewable energy are generated from kitchen wastes and crops, i.e. biogas using household waste. Generation of biogas is not a novel process but its production efficiency is questionable. To contend with other forms of energy production, retain profit and to become sustainable in the long term process, optimisation is the prime focus for biogas sector. By process monitoring, biogas production and stability can be ensured. The process monitoring elucidates recent progress associated with effectual warning indicators, relevant parameters monitoring techniques to attain efficient and stable biogas production from anaerobic digestion process (AD).

2 Anaerobic Digestion Process for Biogas Generation

AD is a multi-step fermentation/biological method which includes chemical and biological reactions for breakdown and stabilisation of organic material by several groups of anaerobic micro-organisms in the non-existence of oxygen to convert a substrate to biogas. It comprises of four subdivisions—hydrolysis, acedogenesis, acetogenesis and methanogenesis (Fig. 1).

Information extracted from one step signify the pertinent status of the others as every level is closely linked to the other; thus, the metabolic product obtained from one level is the substratum for the next. Each level has distinct functional micro-organisms, and a fine balance between these micro-organisms having synergistic interaction has to be maintained. Therefore, to maintain stability, process monitoring has been the prime focus.

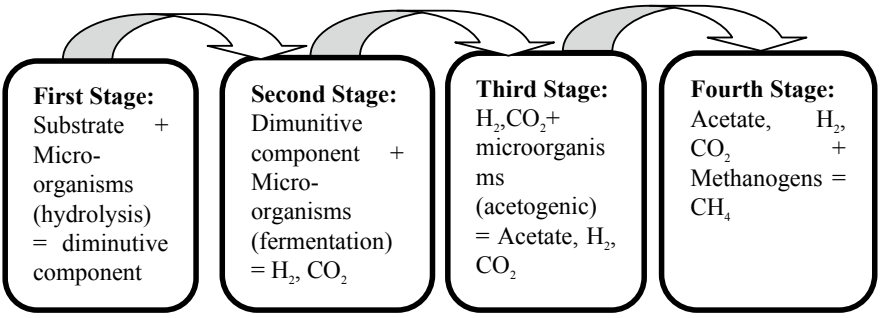

Fig. 1 Anaerobic digestion process [23]

3 Process Monitoring

Based on the amalgamation or separation of hydrolysis/acidogenesis phases and acetogenesis/methanogenesis phases, respectively, the AD progression can be executed in one or two stages. A favourable environment is required for the growth of micro-organisms on which the end-product highly depends. An optimal environment is vital for micro-organisms to live in for achieving a balanced procedure which necessitate suitable monitoring and control of different operational parameters such as particle size, volatile solid (VS), pH, temperature, carbon and nitrogen (C/N) proportion, retention time, toxic materials, etc. For effective biogas production, to understand what happens in AD and to achieve stability, process monitoring is essential. It comprises of two foremost steps, firstly explicating the mechanism underlying process instability related to monitoring parameters, thereby developing warning indicators to reflect the AD's operational status, hereafter the development of precise method and robust monitoring equipment for warning indicator.

For ensuring process monitoring, warning indicators are effective beginning. Warning indicators development have concentrated on evaluating the response of various parameters to intrusions caused by sundry functioning environment, validating and defining their threshold values for instance pH, temperature, alkalinity and biogas production. For a small group of parameters such as pH, temperature, pressure, level, inflow and biogas flow, real-time monitoring can be achieved by online monitoring systems. Surprisingly, for process monitoring at biogas plants, online monitoring infrastructure for indicators is inadequate and it calls for significant improvement in industrial sector.

4 Operational Parameters Monitoring

It is necessary to monitor and identify process characterising parameters, process imbalance indicators and variable process parameters for process monitoring and control that describes the state of the overall biogas process. In order to increase the efficiency, full-scale level monitoring of several parameters related to the structure providing power, temperature in digester, pH during AD process, gate valves and pumps is essential.

4.1 Pre-treatment of Organic Waste

For escalating the bio-digestibility of kitchen wastes and approachability of enzymes, pre-treatment is essential. Sometimes municipal waste is mixed with food waste. For many types of wastes, size reduction is a mandatory procedure thereby increasing the interfacial area resulting in higher food availability for micro-organisms leading

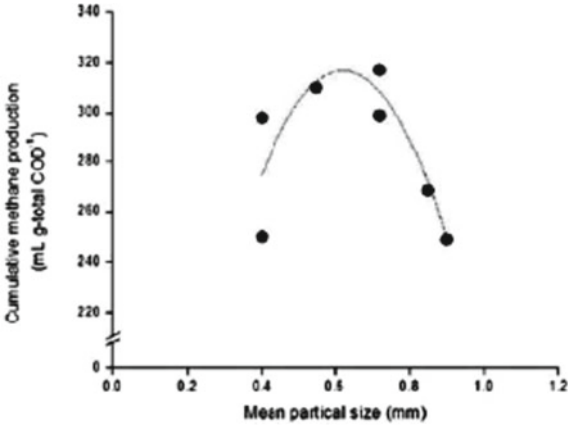

Fig. 2 Interrelation between methane and mean size of food waste

to rapid digestion. Grinder, blender, shredder are used to reduce the particle size. Further, reduction of particle size accelerates hydrolysis and acidogenes process resulting in the volatile fatty acids accumulation and drop in the rate of methane production [1, 2], as shown in Fig. 2 [3]. Therefore, optimal particle size ought to be maintained.

4.2 Carbon to Nitrogen Ratio

In an AD process carbon to nitrogen (C/N) ratio is another limiting factor. Carbon is the energy source for bacteria and nitrogen that helps in their growth. More nitrogen content leads to more substrate degradation time with slow increment in bacteria population, whereas high nitrogen percentage leads to ammonia generation inhibiting bacteria growth [4]. The digestion rate of carbon in anaerobic processes is 30–35 times more rapid than the alteration rate of nitrogen [5]. As a result, the carbon to nitrogen (C/N) proportion is as of 30:1 to 35:1 [5].

4.3 Temperature

The reaction temperature in digester will possibly influence the kinetics, the precise biogas production and on the whole, the efficiency. Under mesophilic (about 35 °C) retention time, is 15–50 days, under thermophilic (about 55 °C) retention time is 14–16 days, and the retention time is 60–120 days under psychrophilic conditions (below 20 °C) (rarely). At full-scale level as reported, the mesophilic process can be easily controlled; consequently, it is most prevailing [5]. Higher temperature increases the hydrolysis rate leading to more biogas production as shown in Table 1 [5, 7].

Table 1 Summary of methane yields from swine manure at various temperatures [5, 7]

Temperature (°C)	Feed loads (v/v %)	CH4 yields (L/g VS)	CH4 percentage in biogas (%)
25	5	0.317 ± 0.017	43.8
30	5	0.397 ± 0.010	54.8
35	5	0.437 ± 0.017	60.4

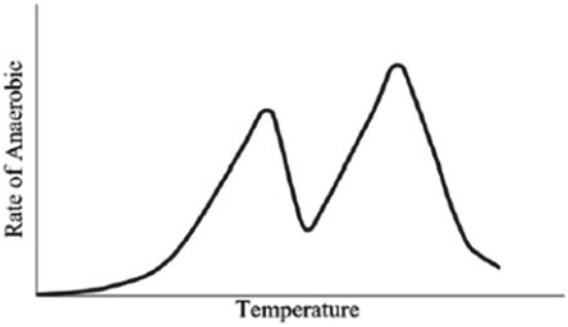

Fig. 3 Saw tooth pattern of AD process and temperature

In accordance with theoretical and practical reports, under different temperatures, rate of anaerobic digestion is similar to a saw tooth appearance as shown in Fig. 3 [8].

4.4 pH Value

Depending on the group of micro-organisms, optimum pH ranges are different. The optimum pH is around 6.0 for hydrolysis [9], pH is between 6.0 and 7.0 for aceto-genesis [10], and pH between 6.5 and 7.5 is for methanogenesis [11]. When there is a sharp pH drop, biogas production is totally inhibited [12].

4.5 Slurry Mixing

To achieve uniformity of organic waste concentration, temperature, etc. mixing is employed. It is done with the use of agitator (mechanical/electrical stirrer), slurry recirculation, etc. [5, 13]. In anaerobic digestion, mixing is a contentious factor. There are reported examples where higher methane yield is acquired in comparison with methane obtained by mixing as reported by Smith, Elliot and James [5] and Karim et al. [13].

A comprehensive review [14] illustrated the helpfulness of indicators for instance substrate conversion, transitional metabolites, alkalinity and end metabolic products,

i.e. methane yield rate. The threshold values have been explored extensively using warning indicators. However, for all plants, there are no standardised threshold value indicators that can be applied. Recent studies reported that the higher conversion efficiency in AD and improved process stability can be best achieved by process monitoring. At full-scale monitored biogas plants, significant challenges persists. Firstly, no universal indicators are valid, and secondly, process monitoring of the feeding substrates is seldom reported.

5 Conclusion

For biogas system stability and efficient biogas creation, continuous exploration of cost-effective process monitoring is the effectual approach. The development of broadly pertinent online observing methods is the key to guarantee stable production process. In the future, development of solar assisted system with biosensor technology and monitoring system for feeding substrate size and other parameters to achieve highly efficient and stable biogas production have great potential.

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Impact of Exogenous Electromagnetic Signals on Biological Entities

Rashmi Mishra, Arpita Shukla, and Dilip Tamboli

Abstract In this paper, the effect of exogenous electromagnetic fields is used to understand the behavior of biological entities. However, in some cases, endogenous signals could be preferred as it does not require external excitation. On the other hand, exogenous signal can be used for both internal as well as external electromagnetic excitation for studying the effects or presence of various biological entities. This study will lead to the understanding and development of non-invasive diagnosis techniques and non-medicated disease treatments. The method will be further extended by applying various feature extraction and machine learning algorithms to make the detection real time, without the need for additional processing of samples or chemicals.

Keywords Electromagnetic fields · Pathogenic bacteria · Sensor · Low noise amplifier · Spectrum analyzer

1 Introduction

After the detection of electromagnetic radiation (EMR), the biological effects of electromagnetic fields and waves have been the focus of scientific research. They have since acquired considerable information of its impacts on a single living cells as well as to humans [1].

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Table 1 Electromagnetic spectrum

Band	Frequency range	
	From	To
Extremely low Frequency (ELF)	3 Hz	30 Hz
Super low frequency (SLF)	30 Hz	300 Hz
Ultra low frequency (ULF)	300 Hz	3 kHz
Very low frequency (VLF)	3 kHz	30 kHz
Low frequency (LF)	30 kHz	300 kHz
Medium frequency (MF)	300 kHz	3 MHz
High frequency (HF)	3 MHz	30 MHz
Very high frequency (VHF)	30 MHz	300 MHz
Ultra high frequency (UHF)	300 MHz	3 GHz
Super high frequency (SHF)	3 GHz	30 GHz
Extra high frequency (EHF)	30 GHz30 GHz	300 GHz

The electromagnetic waves are the synchronized oscillations of orthogonal electric and magnetic field. The range of electromagnetic waves frequencies is from 0 Hz to 10^{25} Hz. The frequencies which are above ultraviolet band (3 PHz (Peta Hertz)) are considered as ionizing radiation as they contain sufficient energy to make electrons come out of an atom or molecule. This property of electromagnetic waves makes it very dangerous and sometimes harmful for living cells as it is able to break the chemical bonds and cause an unrepairable damage to the cell. Besides this, the ionizing character of radiation can also cause mutation or change in the properties of cells. However, in this work only up to microwave (300 MHz) band is considered. The frequency bands name along with frequency range within the 300 MHz is as shown in Table 1,

During the first decade of 20th century, the modern studies of electromagnetic radiation are started. A comprehensive review of development in the study of electromagnetic radiation during that period was done and presented by Burr et al. [2] in 1935.

The microwave is an electromagnetic wave which varies from 300 MHz to 300 GHz wavelengths. In a low-frequency range [3], microwaves are able to penetrate tissue with a thickness of millimeter. Microwave sensors generally have low costs and are relatively easy to manufacture [4].

Exogenous EM field interaction is basically the interaction between biological component, i.e., bacteria to be detected or microorganisms and the externally generated EM field [5, 6]. A large number of studies are presented either for the diagnosis or for the treatment method.

2 Formulation

In this technique, a method is developed for predicting the capabilities of the endogenous electromagnetic radiations for the detection and determination of various pathogenic bacteria in liquid media. The spectrum analysis of the endogenous radiations over a wider range (from kHz to 10 GHz) is used. This technique [6] is preferred because it is based on the knowledge that the macromolecules of bacterial DNA emit electromagnetic signals [2, 3], as each bacteria has unique type of DNA, it generates unique frequency or range of frequencies. As a result of this, a proper study as well as analysis of electromagnetic radiation can be used for determining the presence as well as identification of bacteria.

This testing technology can also be extended by using the feature of machine learning algorithms in order to make real-time detection possible so that the need of additional testing or processing of samples can be avoided.

Finally, the technique can be extended further:

1. For changing the lab testing setup to practical model which is portable and can be applied to fields.
2. For developing an android-based software for recording data on smart phones.
3. Also, for establishing a wireless communication link between the hardware setup and mobile phone (Fig. 1).

In this technique, a method is developed for predicting the capabilities of the exogenous electromagnetic radiations for the detection and determination of various pathogenic bacteria in liquid media. The aqueous solution is placed in an electromagnetic environment which is applied externally, and the reflection of microwave radiation is analyzed and measured in the presence of pathogenic bacteria. The technique is used for the analysis of microwave when it is placed in externally applied radiations [7, 9]. The test solution interacts differently with externally applied radiations, and thus, the presence of bacteria can be detected and analyzed; due to this radiation, the

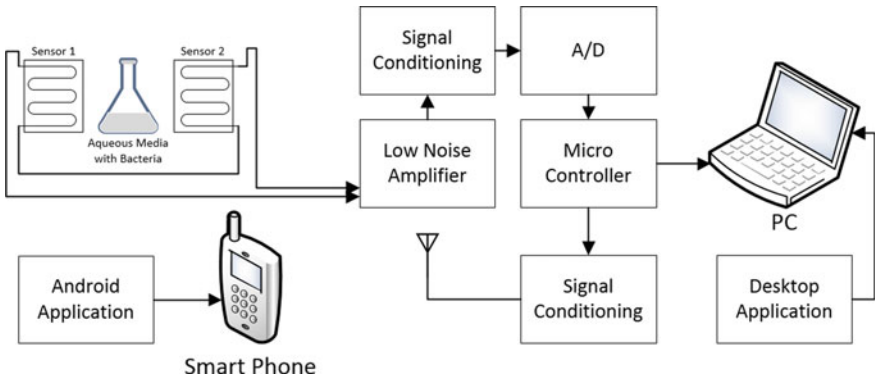

Fig. 1 Endogenous electromagnetic setup

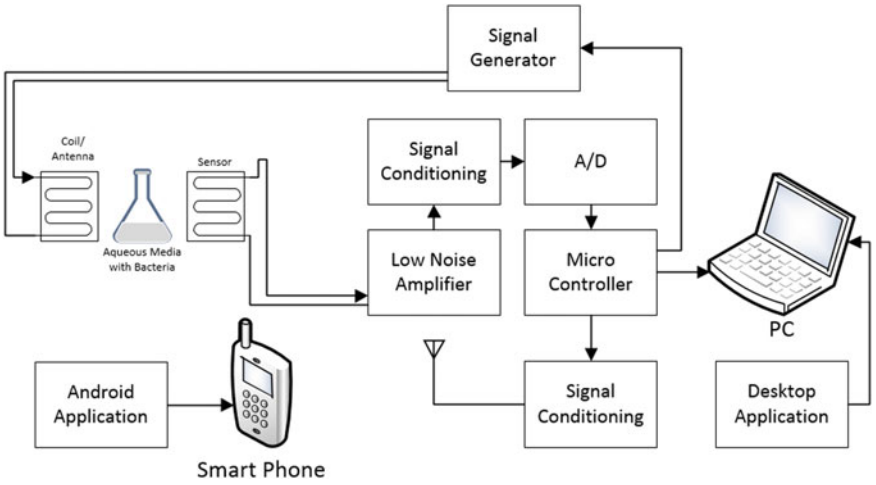

Fig. 2 Exogenous Electromagnetic setup

permittivity of material varies and the change in attenuated or phase shift or reflected amplitude can be recorded using various machine algorithms [8].This testing technology can also be extended by using the feature of machine learning algorithms in order to make real-time detection possible so that the need of additional testing or processing of samples can be avoided.

Finally, the technique can be extended further:

1. For changing the lab testing setup to practical model which is portable and can be applied to fields.
2. For developing an android-based software for recording data on smart phones.
3. Also, for establishing a wireless communication link between the hardware setup and mobile phone (Fig. 2).

Hence, the electromagnetic radiation is analyzed in the presence of pathogenic bacteria. As a result of application of electromagnetic radiations, the cell structure changes which leads to decrease or increase in the protein activity. Then, the effect on growth at different frequencies is analyzed.

The testing technique can further be extended by the application of various types of signal generation algorithms for controlling the growth rate of detected bacteria as soon as possible.

3 Conclusion

In this particular paper, application of both exogenous and endogenous electromagnetic field for medical diagnosis, systematic analysis, and treatment is presented. The study shows that the electromagnetic fields have a lot of potential for the diagnosis

and treatment of such medical applications. Moreover, the study also demonstrate that the potential of electromagnetic field is still in need of understanding with the living organisms since there is no practical or deterministic model exists for the explanation of such phenomenon. As a result of this, most of the studies about the effect of electromagnetic fields depends upon lab experiments and clinical data collection, and therefore, such trials cannot cover all the possibilities of microwave variations, the exploration, and research in this field is still very limited.

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Using Ad Hoc on Demand Distance Vector Technique for Identifying Sinkhole Attack in Wireless Sensor Network

Sana Tak and Ashish Trivedi

Abstract The wireless sensor network (WSN) consists of a large number of low-cost sensor nodes with limited resources. The limitations of the wireless sensor node are its features which include reduced memory, low computing power, are implemented in a hostile area and are left unattended, a small range of communication capabilities and low-power consumption capabilities. The basis of these characteristics makes this network vulnerable to numerous attacks, such as the sinkhole attack. The sinkhole attack is a type of attack in which the compromised node tries to attract network traffic by announcing its fake routing update. One of the impacts of the sinkhole attack is that it can be used to launch other attacks such as the selective forwarding attack, to recognize the phishing attack and the spills or modified routing information. It can also be used to send false information to the base station. This survey paper focuses on exploring and analyzing the existing solutions used to detect and identify the sinkhole attack in the wireless sensor network.

Keywords Wireless sensor network (WSN) · Sinkhole attack · Detection of sinkhole attack

1 Introduction

The wireless sensor network consists of small nodes with the ability to detect and send data to the base station [1]. The wireless sensor network is used in various applications, for example, in military activities, which monitored the movement of the enemy. It is also used in fire detection and healthy service to control heart beats [2–4]. Unfortunately, most wireless networks are implemented in a hostile area and are usually left unattended. Furthermore, most of its routing protocols do not consider

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the security aspect due to resource constraints which include low computing power, low memory, low power, and low communication range [5, 6]. This restriction creates the possibility that several attackers easily attack the wireless sensor network. An example of attack is the attack of the sinkhole. The sinkhole attack is implemented in the network layer where an opponent tries to attract a lot of traffic in order to prevent the base station receives complete detection information from nodes [7]. The opponent normally commits the node and that node will be used to launch an attack. The compromised node sends false information to neighboring nodes about its link quality, which is used in the routing metric to select the best path during data transmission. So, all the packs of his neighbors go through it before arriving at the base station [8]. The sink attack prevents the base station from acquiring complete and correct detection data from the nodes.

The purpose of this document is to study the existing solutions used to detect the sinkhole attack. Different solutions that have been used to detect and identify sinkhole attacks have been suggested by several researchers, such as Krontiris [9], Ngai et al. [10] and Sheela et al. [11]. Krontiris et al. [12] proposed a rule-based detection solution to detect sinkhole attack. All rules focused on the representation of the nodes and were implanted in the intrusion detection system. Hence, the intruder was easily detected when they violated one of the rules. Sheela et al. They proposed another centralized solution involving the base station in the detection process proposed by Ngai et al. [10]. The rest of this document is organized as follows. Section 2 discusses the sink attack and its attack mechanism in two different protocols. Section 3 presents challenges in detecting the sinkhole attack in the wireless sensor network. Section 4 presents several approaches proposed by several investigators to detect the sinkhole attack. Finally, Sect. 5 concludes this document and proposes some future work.

2 Sinkhole Attack

The attack of the cup is an internal attack in which an intruder commits a node within the network and starts a attack. So the commitment node tries to attract everything traffic from neighboring nodes based on the routing metric which is used in the routing protocol. When it succeeded reach him, will launch an attack. Because of wireless sensor network communication model multi-to-one communication in which each node sends data at the base station, it makes this WSN vulnerable to the sink attack [10].

2.1 Sinkhole Attack in MintRoute Protocol

The MintRoute protocol is a type of protocol that is commonly used in the wireless sensor network which has been designed specifically for the wireless sensor network, it is light and suitable for sensor nodes that have a minimum memory capacity, low

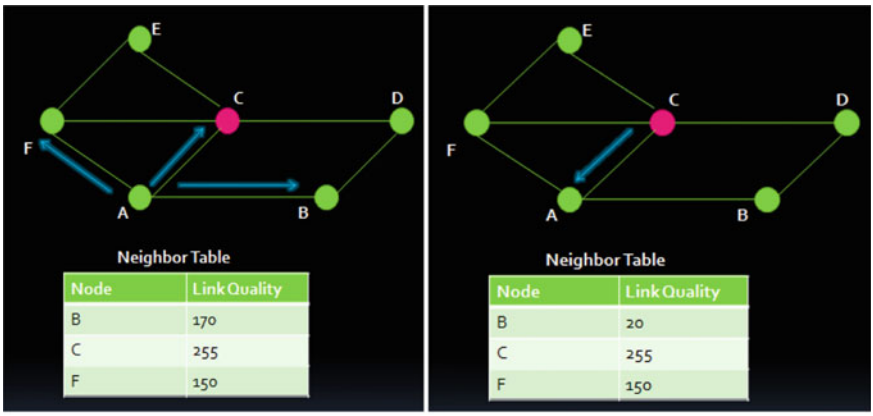

Fig. 1 Sinkhole attack in MintRoute protocol [12]

computing power and limited power. The MintRoute protocol uses link quality like metric to choose the best path to send the packets to the base station [12].

Figure 1 shows six sensor nodes A, B, C, D, E, and F. Node C is harmful and will throw a sinkhole attack. Figure 1a shows a routing table for node A with identifications of the neighbors with the related link quality. Initially, the parent node was node B but the node C announces its link quality with a value of 255 which is maximum value node A will not change its own main node until the connection quality of node B drops to 25 below the absolute value.

In Fig. 1b, the malicious node is sending a new update, the route packet linking the quality drops to 20 impersonate node B so that node A creates the package they come from node B. Node A will update its routing table and change the parent node to node C [12]. The attacker uses the representation of the node to start a attack.

2.2 Sinkhole Attack in TinyAODV Protocol

This is another explanation of the attack on the wireless sink sensor network and this time the attack begins below TinyAODV (Ad hoc On Demand Vector) protocol. The TinyAODV protocol is the same as AODV in MANET but this is lighter than AODV and it was specially modified for the wireless sensor network [13].

The number of jumps to the base station is the routing metric which is used in this protocol. Usually, the path from the origin to the destination is created when one of the nodes send a request, the source node sends an RREQ (Route request) package to your neighbors when you want to send package. Close to the destination is responded by sending the route (RREP) packet, if The packet is not forwarded to other nodes near that destination. Finally, the origin receives the RREP packet from

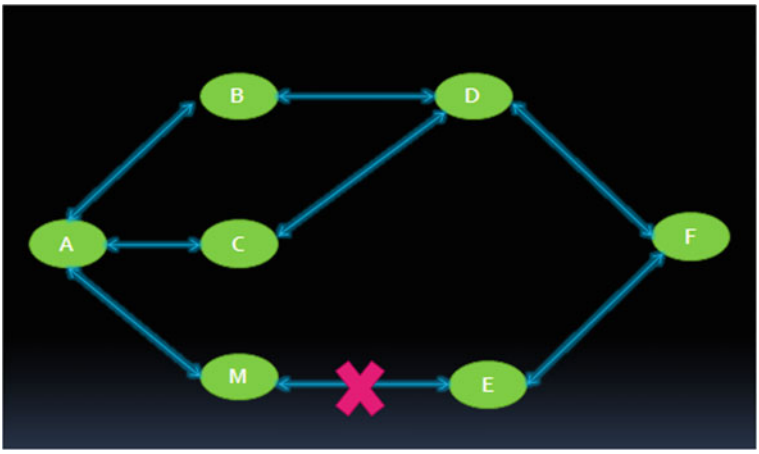

Fig. 2 Sinkhole in TinyAODV protocol [13]

the neighbor, then select a node with fewer numbers jump to your destination. The sink node or commit node is started at attack by sending RREP packet. In the RREP package give a small number of jumps indicating close proximity to the base station. So the source node decides to forward the package to the sink node. The committed node then performs the same technique for all its neighbors and tries to attract as much traffic as possible [13].

For example, Fig. 2 shows that node M launches sump attack on Tiny AODV. Node A sends RREQ to the nodes BCM. However, node M instead of transmitting to node E like nodes B and C to node D, it answers RREP to node A. So node A will reject nodes B and C, then forward the packet to M because nodes A and B are a lot far from F with respect to node M.

3 Challenges in Detection of Sinkhole

According to the literature review on the sinkhole attack in the wireless sensor network, the following are the main challenges to detect the sinkhole attack in the wireless sensor network

3.1 WSN Communication Model

All messages from the sensor nodes in the wireless sensor network are intended for the base station. This opportunity created to sink to launch an attack. “Sinkhole” attacks typically occur when the compromised node sends fake routing information

to other nodes on the network in order to attract as much traffic as possible. Based on that communication model, the intruder will only compromise nodes near the base station instead of targeting all nodes on the network. This is considered a challenge because the communication model itself offers the opportunity to attack.

3.2 The Attack of the Sinkhole Is Unpredictable

In the wireless sensor network, the packet is transmitted based on the routing metric used by different routing protocols [26]. The committed node has used its routing metric that uses the routing protocol to lie to yours neighbors to launch a sinkhole attack. So all the data from your neighbors to the base station will pass engaged node. For example, the techniques used by node engaged in the network used by TinyAODV. The protocol is different from the one used as another protocol MintRoute protocol. In MintRoute, they used the link quality as a route metric while in Tiny AODV, they used the number switches to the base station as a routing metric. Therefore, the sinkhole attachment techniques are modified according to the route metric routing protocol.

3.3 Internal Attack

The internal attack and the external attack are two categories of attack on wireless sensor network. The external attack is when intruder is not part of the network. In the internal attack, the intruder compromises one of the legitimate nodes through hardening of the node or weakness in the system the software then commits the node injects false information on the network after hearing secret information. Within the attack can break the network by changing the routing package. Through the sinkhole attack of the knot attract almost all traffic from a certain area afterwards making that compromised node attractive to other nodes. The fact is that the busy node has enough access privilege on the network and knowledge belonging to valuable information on the network. This topology created challenges in detection. Base a that situation, even the cryptocurrency cannot defend itself internal attack although it provides integrity, confidentiality, and authentication [12]. Therefore, the internal attack has a more serious impact on System of victims with respect to external attack.

3.4 Resource Limitations

Limited power supply, low communication range, low memory capacity, and low processing power are the main limitations of the wireless sensor network which make the implementation of a solid security mechanism difficult. For example, the

strong cryptographic method used in another network cannot be implemented in this network due to low computing power and low memory capacity. Therefore, they are considered less powerful keys compatible with the available resources.

3.5 Physical Attack

A wireless sensor network that is normally implemented in a hostile environment and left unattended. This provides an opportunity for an intruder to physically attack a node and gain access to all the necessary information [2].

4 Existing Approaches

Many researchers have worked in the field of wireless sensors to provide a security mechanism that adapts to limited resources due to the growing demand for applications in sensitive areas. Following are the identified approaches that different researchers use to detect and identify sink attacks in the wireless sensor network. These approaches are classified into rules, key management, anomalies, statistical, and hybrid methods. The following subsections describe each of these categories and provide examples of existing work that have used this approach.

Rassam et al. [14], they presented a document discussing the vulnerabilities of the Mintroute protocol for sinkhole attacks and the existing manual rules used for detection are examined using a different architectures. The first experimental results with the current WSN test stand show its ability to detect attacks on small WSN stern. Finally, the design of the sink detection scheme for WSN based on Mintroute is proposed (IEEE, 2012).

Gandhewar et al. [15], it mainly focuses on the sinkhole problem, its consequences, and presents a mechanism for its detection and prevention in the context of the AODV protocol. It also shows the performance of AODV without sinkhole attack, under attack and after applying their mechanism in the form of a simulation result obtained for a certain variation of nodes in the network, when considering performance metrics such as performance, PDR, delay, and packet loss. The simulation is performed using the widely used NS2 simulator. (IEEE, 2012)

Ahmad Salehi et al. [16], to detect the intruder in a sinkhole attack, his work suggests an algorithm that first finds a group of suspicious nodes that analyze data consistency. Then, the intruder is recognized effectively in the group by checking the network flow information. The performance of the proposed algorithm was evaluated by numerical analysis and simulations. Therefore, the accuracy and efficiency of the algorithm would be verified (IEEE, 2013).

Tomar et al. [17], the document presents a mechanism for detecting and isolating the sinkhole attack in MANET, replacing the routing protocol to improve network capacity after a serious attack. However, the shared open wireless medium and the

dynamic nature of MANET make its routing protocols vulnerable to attack. First, they analyzed an ad hoc on demand routing protocol for sinkhole attacks. Next, the use of the multi-route AODV routing protocol to the fully developed network from the sink attack is presented. The results and simulations show the effectiveness of the proposed work (IEEE, 2014).

Han et al. [18], proposed a new intrusion detection algorithm based on close information against sinkhole attack (IDASA). Unlike traditional intruder detection algorithms, IDASA takes full advantage of nearby sensor node information to detect well nodes. In addition, they evaluate IDASA in terms of detection accuracy of malicious nodes, packet loss rate, power consumption, and network performance in MATLAB. The simulation results show that IDASA's performance is better than other related algorithms (IEEE, 2015).

Cervantes et al. [19], they proposed an intruder detection system, called Intrusion Detection of SiNkhole Attacks in 6LoWPAN for InterneT of ThIngs (INTI), to identify sink attacks in IoT routing services. In addition, INTI aims to mitigate the negative effects found in IDSs that compromise their performance, such as false positives and negatives, as well as the high cost of resources. The system combines surveillance, reputation and trust strategies to detect attackers by analyzing device behavior. Results show INTI's performance and effectiveness in terms of attack detection rate, number of false positives, and false negatives (IEEE, 2015).

Kalnoor et al. [20], In WSN, security is the primary concern and a system that provides security is needed. The intrusion detection system is the system that plays a vital role in the security of a system. One of the main challenges of WSN is to provide a constant quality of service (QoS), such as reliability, congestion control, energy efficiency and end-to-end delay, through the application of safe routing protocols and the detection of a intruder that WSN QoS is not interested in. In research work, they discussed several QoS-based routing protocols to improve overall network performance (IEEE, 2016).

Saghar [21], proposed a new protocol, Robust formally Analyzed protocol for wirEless sEnsor networks Deployment (RAEED), which can address the problems of most DoS attacks. In this document, they formally demonstrated that RAEED can prevent the sinkhole attack. Finally, computer simulations and practical implementation on McaZ motorcycles confirmed their results of formal methods (IEEE, 2016).

Sasirekha et al. [22], an effective mechanism is proposed to prevent and detect sinkhole and wormhole attacks in MANET. The proposed work detects and punishes attacking nodes using different techniques, such as the node collusion technique, which classifies a node as an attacking node only with the agreement with neighboring nodes. When the node suspects the existence of an attacking node or sinks in the path, it joins the neighboring nodes to determine the sink node. In the prevention of routing attacks, the proposed system introduces a route booking method; the new routes learned are updated in the node routing table only after verifying that the route does not contain the attacking nodes. The proposed system effectively modifies the ad hoc distance vector on request (AODV) with the ability to detect and prevent wormhole and sinkhole attacks; therefore, the modified protocol is called Attack

Aware Alert (A3AODV). The experiments are performed in the NS2 simulator and the result shows the efficiency in terms of packet delivery ratio and general routing costs (IEEE, 2017).

Sejaphala et al. [23], software-defined wireless sensor cognitive radio networks (SD-WSCRNs) are sensor networks consisting of sensor nodes and a base station to which all detected data is sent. The network can be remotely reconfigured after deployment. The network is agile and adaptable to topological changes. It is also programmable, allowing you to easily manage the network. To address the challenges of the spectrum, the sensor nodes are equipped with cognitive rays. However, SD-WSCRNs are vulnerable to security attacks like sump, Sybil, and interference attacks. The cockpit attack can be used to launch other attacks, such as selective forwarding, wormholes and interference attacks. An attacker could commit a node closer to the base station or insert a node into the network that can be used to launch an attack. His work presented a theoretical analysis of the cup attack mitigation scheme in SD-WSCRNs (IEEE, 2017).

5 Conclusion and Future Work

According to existing work, most researchers are trying look for ICT solutions to detect, identify, and provide resistance to the attack of the sinkhole on the wireless sensor network. The researchers used the intrusion detection scheme based on the anomaly method, another based on rules and key management to detect and identify the sinkhole. Most investigations had security concerns, challenges corresponding to the availability of resources and mobility of wireless sensor nodes. Some provided only static solution and few in the mobile network. Very few researchers have managed to validate their safety system that uses a network of real wireless sensors. Even some of the results showed a low detection rate, a high network overheads, and high communication costs. The future the solution should focus on reducing the high network overload, computing power, faster detection speed and that system must be validated in a network of real sensors. Through this type of validation, it will be easy to verify it if your solutions meet the available WSN resources, like memory capacity.

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Application of Empirical Mode Decomposition and Support Vector Machine for the Classification of Arc Fault in Distribution Line

Himadri Lala and Subrata Karmakar

Abstract This paper presents a signal processing and machine learning-based approach to classify different types of arcs due to the interaction of a medium voltage distribution line and different surfaces. Different kind of arcing surfaces, i.e., concrete, wet-sand, grass, and leaning tree, are considered in a real-time environment to create different arcs. The similarity found in various arcing events is the low (in mA) current flowing during the arc. The voltage signals are taken as the basis of the whole analysis. The signal processing technique used in this study is empirical mode decomposition (EMD). The results obtained by the application of EMD along with different support vector machine (SVM) techniques on voltage signals successfully classifies various high impedance arc faults (HIAFs) for various arcing surfaces based on their harmonic footprints.

Keywords High impedance arc fault · Empirical mode decomposition · Support vector machine

1 Introduction

The fault detection equipment generally used in the power systems mostly works on the principle of over-current. In case of high impedance arc fault (HIAF), these equipments fail to detect the fault as the insignificant change in current profile due to high fault impedance [1, 2].

Over the years, several studies on high impedance fault (HIF) have been performed to understand the non-linear behavior of fault impedance and its impact on current profile. However, a lot of strategies [3–6] are used to detect the HIF. However, many techniques presented in [7–10] are also talks about different innovative approaches to

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detect HIF. Harmonic analysis techniques [11], on the other hand, are often used for HIF identification. Numerous scholars have introduced the "discrete wavelet transform (DWT)" along with machine learning techniques [12, 13], such as the "probabilistic neural network (PNN)," "artificial neural network (ANN)," "support vector machine," (SVM) etc. for the HIF detection. "Choi-Williams distribution (CWD)" is also used along with "time-frequency distribution (TFD)" for HIF detection [14]. Owing to the tree leaning on the power conductor, a DWT-based detection strategy is also suggested for an arc in [15]. The computational complexity in frequency domain analyzes nevertheless inspired a few researchers [16] to find the solution in the time-domain. Time-frequency domain-driven detection strategy for the arc is also suggested in [15, 16], owing to the tree leaning on the conductor. Moreover, a different type of arc fault can offer very different voltage or current characteristics and also have a very different impact on the surrounding environment. Therefore, it is necessary to discriminate different high impedance arc fault to take appropriate actions against those fault events. In this work, a different type of arcing surfaces, i.e., concrete, tree, wet-sand, grass which produces a different kind of arc are considered for further investigation and classification.

2 Arc in Distribution Systems

In modern day power distribution system, arcing phenomena can be seen mostly at the time of natural calamities. Natural calamities can cause a situation of a broken conductor of distribution lines. A broken conductor may create an arc of different types depending on the contact arcing surface or medium. In addition to that, arc is the consequence of loose contact made among a conductor and the ground (soil) or a grounding surface/object (concrete, tree, wet-sand, grass, etc.). Empirical mode decomposition and machine learning techniques are considered for HIAF classification based on their arcing surfaces.

2.1 Empirical Mode Decomposition (EMD)

The possibility of instantaneous frequency is the important rule of Huang's EMD method. The outcome of EMD is the intrinsic mode functions (IMF). Figure 1 describes the flowchart for calculating the IMF using EMD [17, 18].

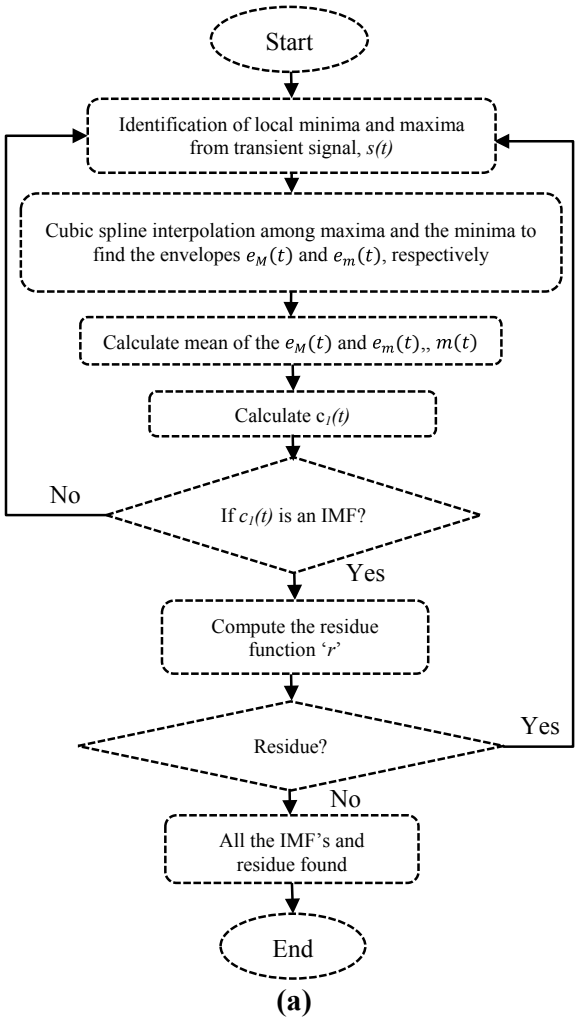

Fig. 1 Flowchart for calculating IMF using EMD

3 Machine Learning Using SVM's

Depending on the "types of boundaries (linear or non-linear) for a different type of scenarios, there are quadratic SVM (QSVM), cubic-SVM (CSVM), Gaussian-SVM, etc. [20]." In this work, linear SVM, QSVM, and CSVM are considered for the classification. Figure 2 describes the flowchart for HIAF classification using different SVMs along with IMFs as input features.

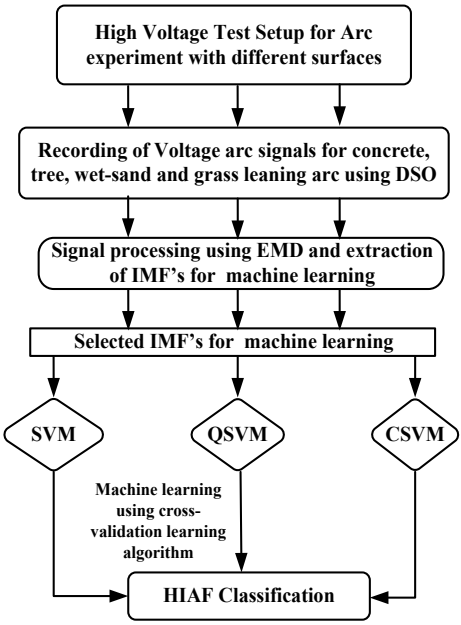

Fig. 2 Flowchart for HIAF classification

4 Experimental Arrangement for Arc Fault

All the experiments are performed in the "high voltage engineering laboratory at the National Institute of Technology, Rourkela, India" [21].

Figure 3a describes the graphical representation of various arcing investigational setup. The actual experimental setup at the HV laboratory is shown in Fig. 3b. In Fig. 3c, various type of arc during the experiments are shown. "The applied voltage to the conductor and different arcing surface is measured through a PT of 1000:1 ratio. The detailed specification and description are depicted in [22–24] ." In this whole experiment, the different arcing surface is considered, i.e., concrete, grass, tree, wet-sand. During the experiment, all the surfaces are solidly grounded to create the scenario for a broken conductor. When a conductor breaks apart, it creates HIF with severe arcing depending on the arcing surface. During this incident, these arcing surfaces play a very crucial role in the characteristics of HIF voltage or current. Moreover, these surfaces offer a very non-linear kind of high impedance which results in arcing. On the other hand, all of this is the same category of fault, and may not result in tripping of the circuit breaker.

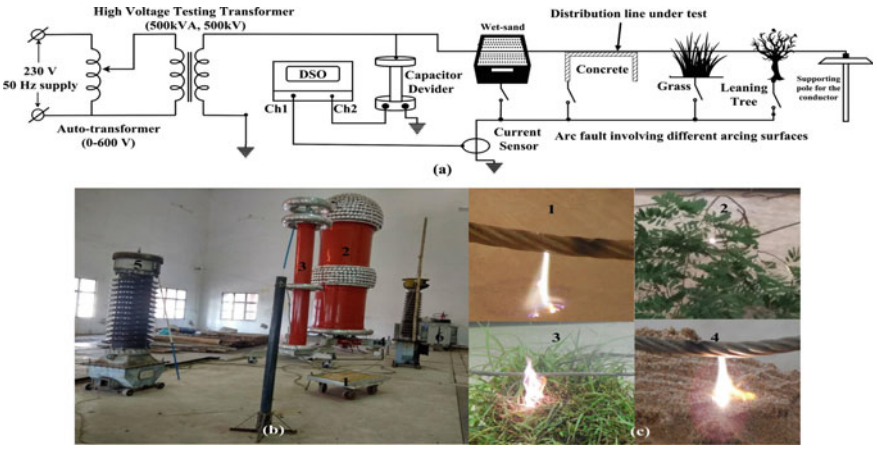

Fig. 3 Overall experimental setup and various arcing events **a** The graphical representation of experiment setup; **b** Actual laboratory setup (1. Arcing object, 2. Testing transformer, 3. Capacitor divider, 4. Conductor, 5. PT, 6. Auto-transformer); **c** Arc in different arcing surfaces and conditions (1. Concrete, 2. Tree, 3. Grass, 4. Wet sand)

5 Experimental Results and Analysis

In the present study, four types of arcing surface are considered for further investigation. In all the cases, the data used for analysis are voltage and current waveforms captured through potential transformer. Firstly, arc is simulated for concrete and leaning tree. In both the cases, influence of non-linear impedance is observed in form of arc. In concrete, the arc creates a conical pattern. However, arc in a leaning tree does not follow a perfect pattern, instead, discharges through the nearest leaf to the conductor. Moreover, the other two experiments involving wet-sand and grass bed as the arcing surfaces are also performed. However, the difference was with the current, due to the offered impedances of tree and grass.

On the contrary, arc in the grass can be most dangerous compared to arc in the tree as it catches fire very easily. The voltage waveform for each arc conditions is presented in Fig. 4b. Therefore, an extensive amount of data is captured after several rounds of experiments with different voltage level keeping in mind the voltage level below 40 kV. The total number of samples taken for analysis is 10,000 (2500 for each class, i.e., concrete, tree, wet-sand and grass). The description of various tests is depicted in Table 1. Complete five sets of experiments are performed, and very asymmetric test sets of arc voltage signals at different voltage levels are formed to check the classification results. The reason behind the random nature of the test set is to build a robust algorithm irrespective of voltage levels. The EMD is applied to each data sets belongs to either different voltage level or various arcing phenomena and IMFs are calculated for those corresponding signals. “The EMD decomposes the captured signals into several IMFs. Further, these IMFs can be used for the reconstruction of the original signal. In this study, the EMD is applied to the voltage signals [24]. ” On

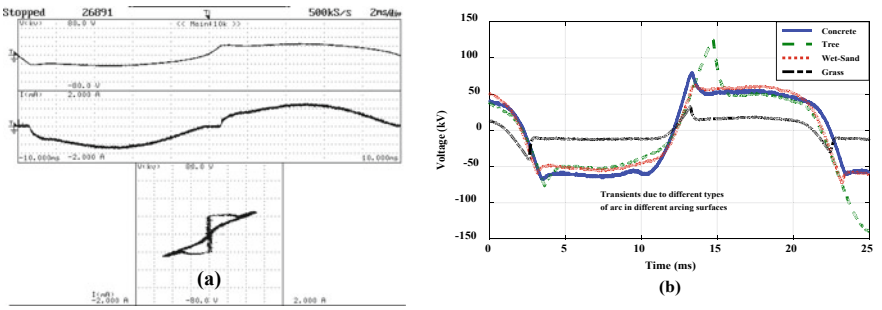

Fig. 4 Arc characteristic **a** V-I characteristics of arc in leaning tree, **b** Voltage characteristics of different arc faults

Table 1 Arc classification result for a different type of arc in various tests using machine learning algorithms

Different test sets	Type of arc surface	Voltage level (kV)	Primary current (A)	Number of IMF calculated using EMD	Number of selected IMF for classification	Classification accuracy using different classifiers (%)		
						SVM	QSVM	CSVM
Test 1	Concrete	20	82–85	8	8	91.1	99.3	100
	Grass	12	35–60	9				
	Tree	7	29–40	10				
	Wet-Sand	4	32–34	9				
Test 2	Concrete	10	45–48	8	8	89.8	98.6	100
	Grass	14	78–85	10				
	Tree	11	40–60	10				
	Wet-Sand	10	66–70	11				
Test 3	Concrete	14	70–75	9	9	80.6	100	100
	Grass	16	86–90	10				
	Tree	13	50–60	9				
	Wet-Sand	5	30–35	10				
Test 4	Concrete	16	92–94	10	9	85.8	100	100
	Grass	6	44–45	11				
	Tree	15	59–68	10				
	Wet-Sand	15	90–93	9				
Test 5	Concrete	20	105–107	10	9	84.9	100	100
	Grass	10	62–64	10				
	Tree	22	80–99	9				
	Wet-Sand	17	95–98	10				

the other hand, the total number of IMFs calculated from the EMD of arc voltage signals for concrete, tree, wet-sand, and grass are 10, 9, 9, 10, respectively. These calculated IMFs for different test sets presented in Table 1 for machine learning. As long as all the arcs considered here are HIAF, it is challenging to classify the various events. Therefore, in this study, different machine learning techniques are applied to get a comparative response between the learning tools. The classifiers or the machine learning tool used in this study are SVM, QSVM, and CSVM. The classification accuracy obtained from those learning algorithms is shown in Table 1. Apart from simple linear-SVM, all other classifiers are performing according to the requirement of successful classification. Moreover, the error in classification for QSVM and CSVM is marginal. A comparative view of all the classifier results is shown in Fig. 5. It is also evident from Fig. 5 that CSVM is found to be very consistent for HIAF classification. Further, Fig. 6a describes the full description of classified and unclassified instances of CSVM in test 1. However, the calculated

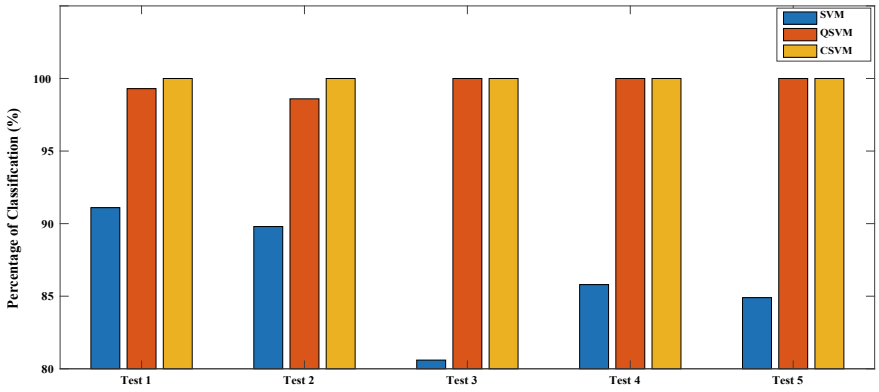

Fig. 5 Comparative analysis of different arc classification results based on SVM, QSVM, and CSVM

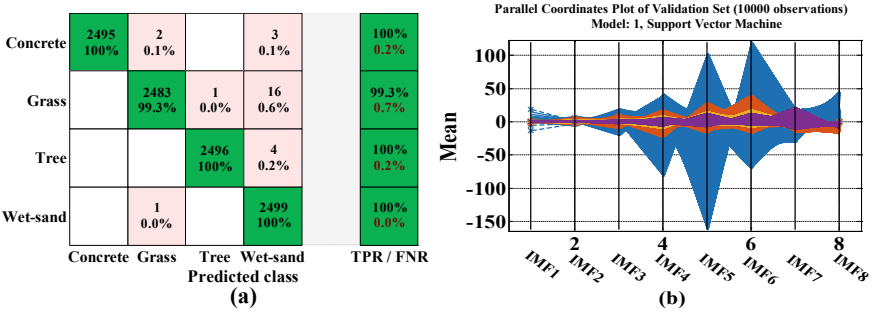

Fig. 6 Classification results of test 1 using cubic support vector machine (CSVM) as a machine learning tool; **a** Confusion matrix of the classification; **b** Parallel coordinates for the validation set

IMFs are mostly containing similar kind of frequency content, but their IMFs are very much different from each other. While applying the machine learning algorithms, the parallel coordinate plot of IMFs pinpoints that aspect. The parallel coordinate plot for CSVM is shown in Fig. 6b. Therefore, based on harmonic analysis with EMD, different HIAF can be successfully classified using machine learning techniques such as QSVM and CSVM.

6 Conclusions

The results acquired from all the tests of various arcing surfaces evidently shows the dissimilarities between HIAFs in the frequency domain. Apart from that, it also indicates that different arcing surfaces show a distinct behavior during experiments in terms of pattern and arcing path impedance and arcing voltage. The major conclusions from the work are the following:

- EMD, along with different SVMs successfully classifies the HIAF for concrete, tree, wet-sand, and grass arcing irrespective of voltage level.
- QSVM and CSVM are found very promising to classify different HIAF successfully.

The future work is planned involving other arcing scenarios in distribution system.

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A Stockwell Transform-Based Approach for the Detection and Classification of High-Impedance Arc in Leaning Tree and Sphere gap

Himadri Lala and Subrata Karmakar

Abstract In this study, an analysis of static and dynamic arc in sphere gaps and leaning tree is carried out. A Stockwell Transform (ST) or S-Transform-based approach is used for the detection and classification of the high-impedance arc signals. Conductance variations in this scenario are also observed for various voltage levels and sphere gap length for different arc. The findings obtained by applying the ST technique to arc voltage signals effectively identify and distinguish the high-impedance arc based on their frequency signatures due to leaning tree from sphere gap arc.

Keywords Arc discharges · Stockwell transform · Support vector machine

1 Introduction

According to the limited influence on the current profile, the traditional fault detectors struggle to identify high-impedance arc and almost all apparatus operates on over current principles [1, 2]. The electrical arc also can occur between two conductors due to equipment failure, contact separation in switchgears, etc.

Several studies on "high-impedance fault (HIF)" have been performed with a focus on the non-linearity of fault impedances and its impact on voltage and current response of the system. However, a lot of strategies [3–6] are used to detect the HIF. Several methods based on "power line carrier communication" [7] "mathematical morphology" [8, 9], "magnetic field signature-based analysis" [10] are opted to for HIF detection. "Harmonic analysis techniques" [11], on the other hand, are often used for HIF identification. Numerous scholars have suggested the "discrete wavelet transform (DWT)" and different artificial intelligence-based techniques [12, 13],

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for example, the "probabilistic neural network (PNN)," "artificial neural network (ANN)," "support vector machine (SVM)" for HIF detection. "Choi-Williams distribution (CWD)" is furthermore suggested beside "time-frequency distribution (TFD)" for HIF detection [14] in some studies. The HIF due to leaning tree has been detected by using DWT in some studies [15]. However, there is a huge complexity in the methods which involve time-frequency domain analysis. This further inspired few scholars [16] to find a way in time domain. Time-frequency domain driven detection strategy for arc is also suggested in [15–17] also talks about the arc in leaning tree. In fact, an arc fault of a particular form may give very specific voltage or current characteristics and can have a very particular effect on the surroundings. Therefore, specific high-impedance arc fault must be discriminated against in order to take sufficient measures against such fault cases. In this work, a different type of arcing events, i.e., leaning tree and sphere gap arcing, which produces a different kind of arc is considered for further investigation and classification.

2 Arcing Phenomena and the Detection Algorithm

Behaviors of arcing can be seen in a power distribution network notably in the time of natural catastrophes. Catastrophes may give rise to a damaged distribution line conductor scenario. The properties of the arc where impedance over time does not alter may be called static arc. In [18, 19] the dynamic characteristics due to the time-varying fault impedances are discussed. A "Stockwell Transform (ST)" and support vector machine based are designed to detect HIF in leaning tree (dynamic) and sphere gap (static).

2.1 S-Transform and Its Application as Signal Processing Tool

The mathematical expression of S-Transform used in this work for feature extraction is presented in Eq. (1)

$$S(f,\tau,\sigma) = \int_{-\infty}^{\infty} f(t)g(t-\tau)e^{-i2\pi ft}\mathrm{d}t \tag{1}$$

where $g(t) = \frac{|f|}{\sqrt{2\pi}}e^{-\frac{t^2f^2}{2}}$.

"Here, σ represents the width of the Gaussian function $g\ (t)$. The ST of a fault signal $f\ (t)$ is defined as a CWT with a specific mother wavelet multiplied by the phase factor $p1(t,\ f)$" [20].

$$p_1(t, f) = f(t)e^{-i2\pi ft} \tag{2}$$

Substituting in Eq. (8),

$$S(f, \tau, \sigma) = \int_{-\infty}^{\infty} p_1(t, f)g(t - \tau)\mathrm{d}t \tag{3}$$

$$= p_1(t, f) * g(t, \sigma) \tag{4}$$

2.2 *SVM's and Its Capabilities as Machine Learning Tool*

The basic principle of SVM is "decision planes and decision boundaries. SVM can be linear (LSVM) or non-linear based on kernel trick [21, 22]. These boundaries or planes separate different class of data from each other using support vectors." "Depending on the types of boundaries (linear or non-linear) for a different type of scenarios, there are quadratic SVM (QSVM), cubic SVM (CSVM), fine and medium Gaussian SVM (FGSVM and MGSVM), etc." Figure 1 describes the flowchart for HIAF classification using different SVMs along with ST coefficients as input features.

3 Arc Experiment Setup

Due to the expense of the equipment and the danger involved with it, simulating arcing in a real-time situation is difficult. In [23], the high-voltage engineering laboratory setup used in this work is explained elaborately. The description of the experiment setup and the ratings of different equipment are discussed in [19, 20].

Fig. 2a describes the configuration description for different testing frameworks for the arcing. The description of the test setup is given in [19, 20]. Fig. 2c reflects *V-I* characteristics and various arcing voltage signals in various arcing environments captured during the arc.

4 Detection and Classification Results

Depending on the form of arc, the arc V-I characteristics changes. The properties of V-I shall be calculated by an arc's time constant. Nevertheless, certain arc attributes may also alter, based on other parameters. Two aspects of the arc are seen in this research after various arc experiments. Firstly, arc is simulated in sphere gap with a

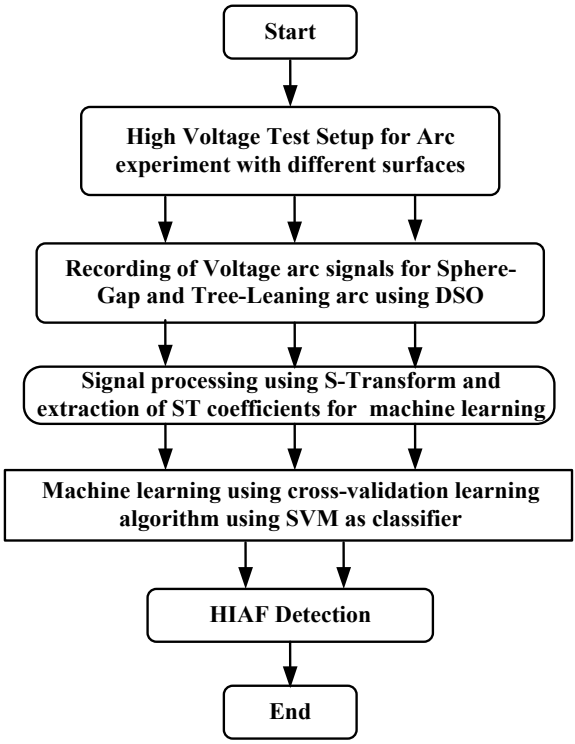

Fig. 1 Flowchart for the detection of HIAF

variation of gap length and arcing voltage. Later, the arcing phenomena are simulated between distribution line conductor and a leaning tree.

In all situations, voltage and current are measured and considered for further analysis. The oscilloscope is used to record the real-time voltage and current signals as well as the V-I patterns of both sphere gap arc and tree leaning cases. Fig. 2b along with Fig. 2c reflects the voltage, current, and the "*V-I* characteristics." Fig. 2b describes arc voltage and current transients for both the arcing events, respectively. While the *V-I* curves of both arcing incidents are identical, it is apparent from Fig. 2b whatever, they are different arcing events. The findings of the studies shown at Fig. 2b along with Fig. 2c, the voltage levels are 39 and 36 kV, accordingly. In both cases, the *V-I* curves are pretty nearly similar to the normal characteristics of the HIF. The arc for sphere gap and the leaning tree is depicted in Fig. 3a, b accordingly. However, the disparity between two arc forms is also notable from the non-linear conductance variance during the tree-leaning arc experiment depicted in Fig. 3c. However, the cumulative contrast and the importance between two separate tests are the grounding route for the arc. The grounding route for the sphere gap arc is a conductor while the grounding route for the arc is through the tree for the tree-leaning arc experiment. Where, the tree acts as a non-linear high-impedance path toward ground. Hence, the additional non-linear tree impedance will have an effect

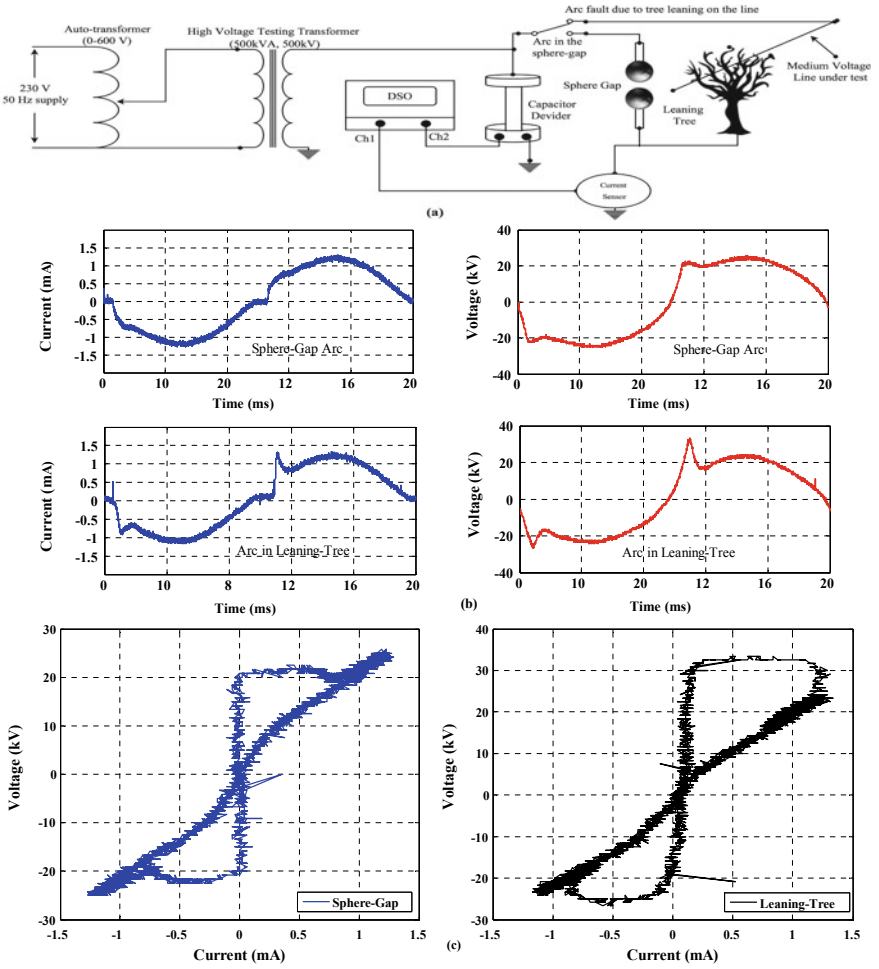

Fig. 2 Scheme of arc experiments and results **a** The scheme of arc experiments; **b** Voltage and current waveforms; **c** *V-I* characteristics

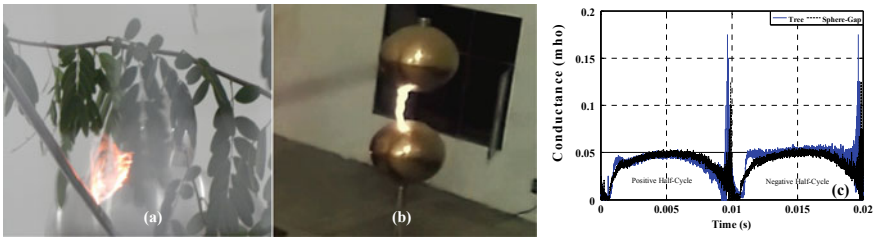

Fig. 3 Arcing phenomena **a** Arc in the leaning tree, **b** Arc in sphere gap; **c** Conductance variation plot for both experiments

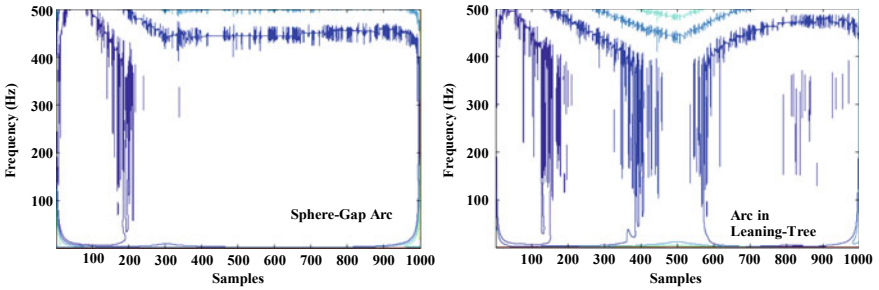

Fig. 4 Frequency spectrum contour plot for different arcing events

Table 1 Arc classification result using different SVMs

Machine learning tools	Number of samples	Number of features	Classification accuracy (CV)
LSVM	1000 for each class	501	100%
QSVM			100%
CSVM			99.3%
FGSVM			99.2%
MGSVM			100%

on the system's voltage and current profile. The "Stockwell Transform (ST)" is one of the most common signal transformation techniques. Instead of the time scale representation provided by the various wavelet-based algorithms, it provides a time-frequency representation. In fact, the ST coefficients are used to derive the numerous attributes from transient arcs. In this analysis, the ST is introduced to the arc signals to achieve a comparative view of the various SVM outputs. First, the ST is implemented, and it determines the related coefficients. Because the ST has much more precise coefficients, a range that requires 1000 samples of specific arc signals is used for analysis. Furthermore, the ST coefficients calculated are used to construct training sets for SVMs. The ST coefficients in this context are used as inputs for machine learning algorithms (i.e., "SVM, QSVM, CSVM, FGSVM, and MGSVM"). For the case of ST, the approximate number of attributes from the arc signal is 501. For both arcing situations the contour diagram of the ST coefficients is shown in Fig. 4. This explicitly indicates the disparity between all the arcing anomalies in time-frequency domain. Nonetheless, the findings determined using ST coefficients are considered to be rational for most SVM dependent techniques. The analyses reported using ST are illustrated in Table 1. Therefore, in this study different machine learning techniques are applied to get a comparative response between the learning tools. The classifiers or the machine learning tool used in this study are "SVM, QSVM, CSVM, FGSVM and MGSVM". The classification accuracy obtained from the SVM's is shown in Table 1. Apart from simple cubic and fine Gaussian SVM, all other classifiers are performing according to the requirement of successful classification. Moreover, the

error in classification for CSVM, and fine Gaussian SVM is marginal. Therefore, based on frequency analysis with ST, different arcs can be successfully classified using machine learning techniques such as "SVM, QSVM, CSVM, FGSVM, and MGSVM."

5 Conclusion

The findings from the arc detection classification algorithms clearly explain the differences in the time-frequency domain. Nevertheless, the "V-I characteristics" of both arcing events are similar, and show comparable attributes with HIF. However, a time-frequency domain representation using ST essentially classifies the two arcing events based on the time-frequency signature. The ST along with various SVMs successfully classifies two arcing events. However, the large number of input feature to the SVMs is a definite reason for the computational burden to the processors. The future work is planned for other arcing surfaces involving different arcing scenarios and the optimization of input features to the SVMs.

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Driver's Stress Analysis and Automated Emergency Call Using IOT and Data Analytics

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Abstract The level to which a driver worry affects the driving by causing numerous accident. In some cases, numerous lives are lost due to driver anxiety. Stress is something we can't ready to truly observe and recognize. Hence, various kinds of sensors like heartbeat, ECG, pupil dilation, pulse, breath rate, skin reaction are used to anticipate feeling of anxiety of the driver and driver behavior while driving. Also, in this system, we detect vehicle accidents using flux sensor. Flux sensor would be able to detect car hits and accidents by analyzing the pressure. If the accident is detected an alert message or call is sent to the respective bus authorities, police control room, and hospitals.

Keywords Flux sensor · Heart beat sensor · Eye blink sensor · K-means clustering · Naive Bayes classification

1 Introduction

Recent research shows that human behavior like thinking, making decision plays major role on road accidents [1, 2]. Due to heavy cognitive loads experienced by the driver cognitive demanding situations are high, and handling those situations are not appropriated [3, 4]. This leads to cognitive errors. To handle these situations effectively by the driver, it is important to identify the evolution of the cognitive load and stress level of driver by providing highly demanding situation [5, 6].

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2 Related Work

Accidents may occur due to many reasons but drowsiness of the driver is the significant reason among them [7]. Due to this, accident occurs which cause severe injuries and even leads to numerous death. Measurements show the process of detecting driver's drowsiness by alerting the driver should be initiated to prevent accidents. There are various measures like physiological, behavioral, and vehicle based to determine the drowsiness of driver [8, 9]. These measures are studied in detail to understand the existing system; the drawbacks in the system and the improvements to be made by finding solution for the drawback making the system strong and efficient. The different measures to determine the drowsiness and the sensors utilized for those measures are surveyed in this paper. The benefits, drawbacks along with limitations for every measures are examined. We finally recommend that it would be best to combine any of the measures with physiological measure to determine the drowsiness of driver accurately. Huge number of lives can be saved by sending alert if the person who is driving the vehicle feels sleepy [10].

It is revealed that the need to ensure safety for drivers related to business field is more at trucking summit gatherings [11]. This work prompted in introducing sensor for the loss of attention needed by the driver. It has been recognized as benchmark for global examination. Perclos is a method where observation is done manually by monitoring with the help of machine vision technology in the vehicle. The field test methodology and the answer to all the questions researchers try to find which is discussed in this paper.

In this paper, a glove is designed which is worn by driver to detect the stress of driver [12]. Using physiological signal, pressure of the driver is assessed, and the movement of steering is examined by how the driver moves his hand. The sensors are attached to the glove which reads the value from the tip of finger and the motion of the steering [13, 14]. The values are then passed through Bluetooth to the application where the stress of the driver is calculated. The stress can be detected in three different driving process. Support vector machine is used to classify the same type of data as a pattern. Here, the data are the values read by sensors in the glove. The sharpness of detecting the stress is greater than 95%.

It describes about sensors which are wearable to detect the stress of the driver [15]. The rate at which the heart beats is analyzed. Principal dynamic mode (PDM) is a method which is non-linear to find whether the stress or relax state is active by analyzing the nervous system. This technique is more efficient even though frequency-based method provides better execution on classification. The percentage of detecting the stress successful can be of 83% when both the PDM and frequency-based technique are combined together.

In today's Internet of Things (IoTs) world, wearable devices with sensors in it are becoming common [16, 17]. To analyze the physiological signal, physiological sensors play significant role. Various experiments have been conducted on using two or more physiological sensors at a time. In this paper, to reduce the amount of sensors or wearable devices ECG method is used to monitor the heart rate. This method is

best suitable for identifying the stress rates accurately by classifying into different class based on the range of heart beat rate.

2.1 Existing System

Driver's state like tilting of head, closing, and opening of eyelid is known by certain strategies [18]. It can be monitored by screening with the help of camera. There are certain issues in this strategy like driver wearing spectacles, environmental factor such as intensity of light and screening begins only after driver's face appears in front of camera which must be solved [19, 20].

2.2 Software Design

Embedded C is not a part of C programming language but it is an extension to C language. It helps in programming embedded devices effectively.

3 Proposed System

In this project, we propose collection of live data, sharing of data by IOT and analyze the collected data to overcome the challenge of detecting driver stress, driver drowsiness, fatigue. We coordinate heart beat and eye blink sensors, and it will be inserted in the driver's glass to identify the feeling of anxiety and tiredness. Also, in this system, we detect vehicle accidents using flux sensor. Flux sensor would be able to detect car hits and accidents by analyzing the pressure. If the accident is detected an alert message or call is sent to the respective bus authorities, police control room, and hospitals. If drowsiness is detected, then automatically song is played which conveys to the cleaner and co-driver stating the particular driver is falling sleepy [21, 22].

The collected data of the driver is transmitted to the microcontroller from sensors. The live data and the updated data which changes regularly on a certain period are transferred from the microcontroller to the system through RS232 cable. To ensure safety, by avoiding accidents vehicle service centers or nearby hospitals monitors if there is the presence of any abnormal symptoms.

The real-time data is transferred to the R programming studio from Netbeans. Data analysis is done on the data which is transferred by using R programming. Data of the driver are categorized on certain conditions like normal, abnormal, and critical using clustering and classification algorithms. The data are then stored in cloudme which is public cloud server for accessing anytime in future (Fig. 1).

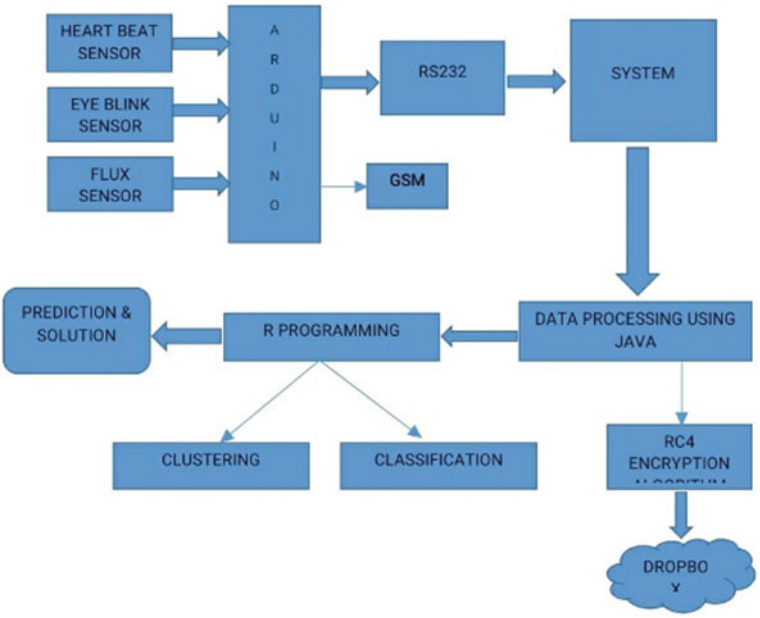

Fig. 1 Overview of the proposed system

3.1 Driver Stress Detection Using Sensors

Keeping in mind the impact caused by the stress levels and various cognitive load in physiological signal and also in the action of driver, current workload is calculated by the group of variables such as information about heart beat and eye blink of the driver.

3.1.1 Eye Blink Sensor

+5V power supply is given to an IR drive to enlighten the eye. IR photo diode records the reflected light. Infrared concept is used in eye blink sensor, and the values will change according to the state (closed or open) of driver's eye. To realize whether eye is closed or open, high and low are used as output, respectively. The result is then passed for logic circuit showing caution if needed to prevent accidents that occur through unconscious eye blink.

3.1.2 Heartbeat Sensor

A light emitting diode and a photo diode are attached to the heartbeat sensor. The rate of blood flow will differ across various regions of human body due to the heartbeat

pulse. The light absorbed by the tissue is transmitted or reflected. Blood absorbs some amount of light. The light, which is transmitted or reflected, is received by the light detector [23, 24]. The amount of blood in the tissue determines the amount of light which will be retained. The rate of the heartbeat depends upon the result given by the light detector.

4 Algorithm Implementation

4.1 Data Analytics

R is a programming language and programming condition for factual examination, designs portrayal, and detailing. A tremendous measures of multidimensional information have been gathered in different fields, for example, advertising, bio-medical and geo-spatial field.

Unsupervised machine learning or clustering is one of the significant information data mining techniques for finding information in multidimensional data.

4.2 Clustering

In this project, to classify the heartbeat rate into different cluster as normal, abnormal, and critical K-means algorithm is used, where the data are grouped under similarity [25].

In supervised learning, patterns that occur due to similarity in data are discovered, and there is no result to be determined. Here, the number of group is determined by us as three for the data to be classified into each group as normal, abnormal, and critical based on certain range or condition. Every observation is allocated to a group randomly, and the centroid of each group is found. At that point, the process is repeated by:

- Finding the nearest centroid and again assigning the data points to that cluster.
- Finding a new centroid for every group.

4.3 Classification

For machine learning, we use naive Bayes algorithm. We define conditions and solutions for the clusters. Like training the machines stating normal, abnormal, abnormal 1…*n* conditions, and solutions for each conditions. If the data is classified into two or more class, then there exist certain issues which can be solved by the naive Bayes

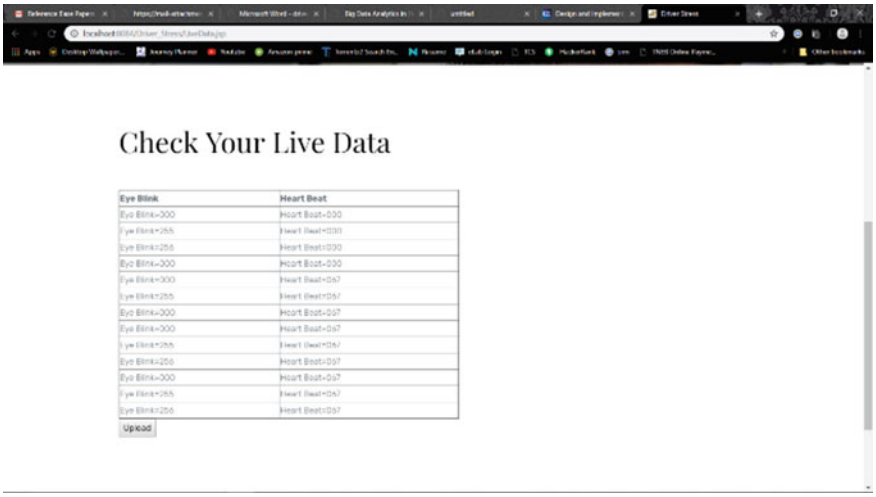

Fig. 2 Data collection from sensors

algorithm. Usage of binary input values simplifies the technique. The obtained model of naive Bayes consists of probabilities.

- Training dataset consists of many class, and each class has probability known as class probabilities.
- Every class value has input value with the probability of condition known as conditional probabilities.

5 Results and Discussion

See Figs. 2, 3, 4, 5, and 6.

6 Conclusion

In this project, the live data of driver's heart rate and stress level are shown while driving. Abnormalities are also detected at early stage using data analytics by sending alert call to the driver's family or friend's number.

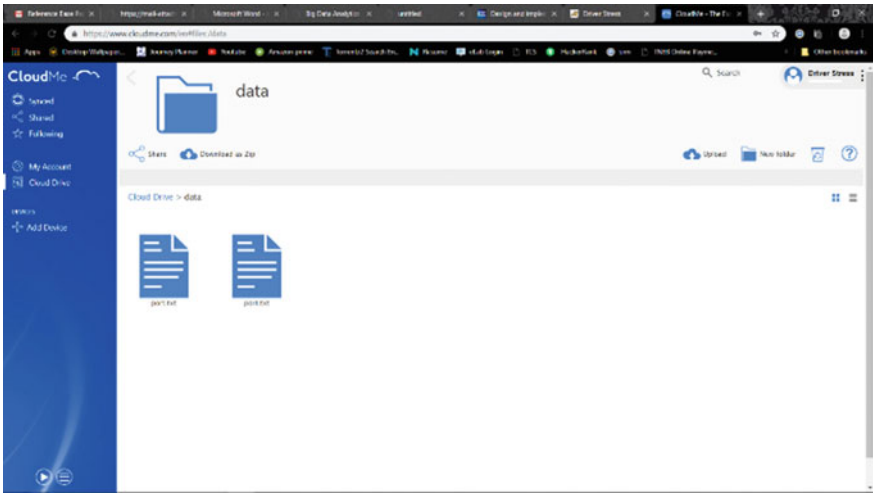

Fig. 3 Data sharing using public cloud

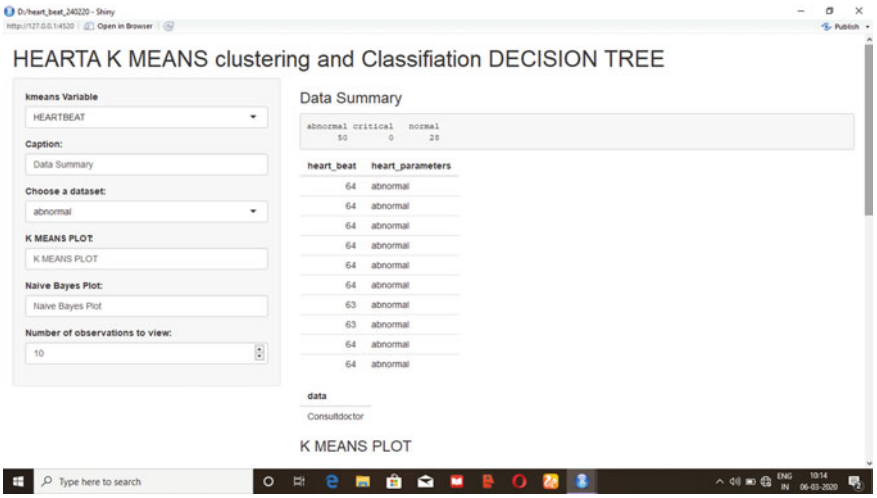

Fig. 4 Abnormal

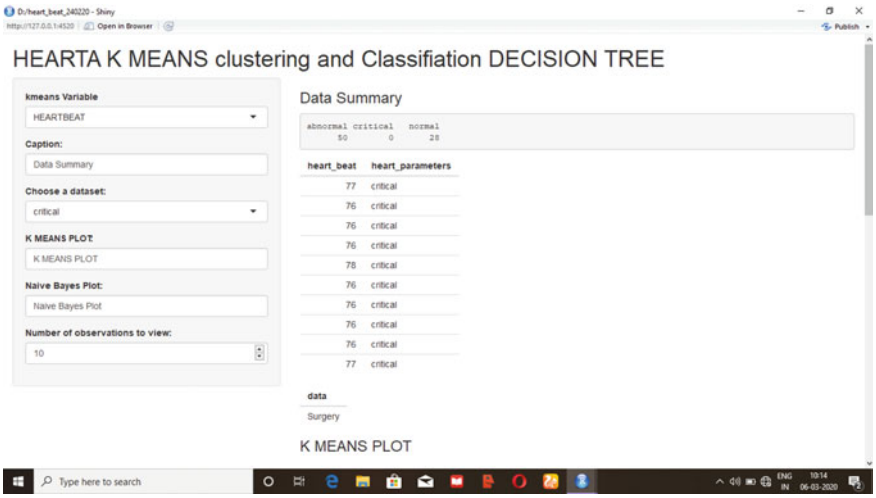

Fig. 5 Critical

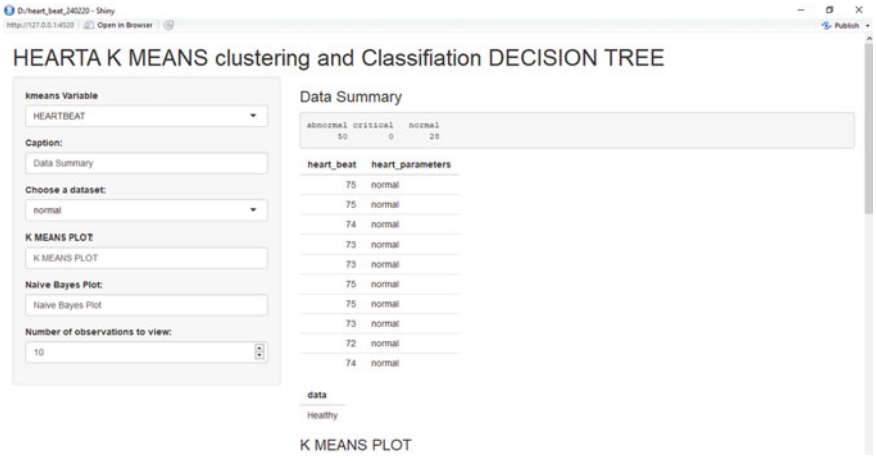

Fig. 6 Normal

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Air Prediction by Given Attribute Based on Supervised with Classification Machine Learning Approach

M. Gitson Nitheesh, R. Gokulakrishnan, and Prathima Devadas

Abstract All around, air sullying recommends the proximity of deadly substances into the air that is hindering human thriving and the planet considering. It is worth everything considered to be portrayed as one of the most dangerous perils that mankind at whatever point standing up to. It makes hurt creatures, harvests, timberlands, and so forth. To frustrate this issue in transport regions need to imagine air quality from harms utilizing AI structures. In this way, air quality appraisal and need have become an enormous research locale. The fact of the matter is to investigate AI-based frameworks for air quality assessing by need achieve the best precision. The appraisal of the dataset by directed AI strategy to get a couple of data resembles a variable explicit check, uni-variate assessment, bi-variate, and multi-variate examination, missing worth game plans and separate the information support, information cleaning/getting ready and information assertion will be finished everything considered given dataset. Our evaluation gives an extensive manual for the affectability examination of model parameters as to execution in line of air quality sullying by precision estimation. To propose an AI-based framework to effectively foresee the air quality index, the central purpose by need accomplishes the sort of best accuracy from looking at controlling solicitation AI calculations. In addition to that, different AI estimations are calculated from the given vehicle traffic office dataset with an appraisal of GUI-based UI air quality check properties.

Keywords Dataset · Machine learning classification technique · Python · GUI results · Naive based

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1 Introduction

In these days, it winds up being to a remarkable degree standard and perceived to find the opportunity to cloud benefits by utilizing cell phones. By a present report, cloud applications will address 90% of remarkable more diminutive information improvement by 2018. To offload the capacity to the cloud, there are differentiating current social event associations for PDAs, for example, Dropbox, Box, cloud, Google Drive, and Sky Drive [1, 2]. Since flexible disseminated choosing channels through more diminutive regulating and appropriated figuring, all the above security issues are passed on preparing are gotten in MCC with the additional asset obliged PDAs [3]. Since the information is guaranteed about and controlled in the cloud, the information security exceedingly relies on the IT relationship of the cloud affiliation's suppliers, and any security stipulation in the cloud structure may hurt the security of the clients' private data [4]. Giving frameworks have requests around each other's building choices; in any case, they are frustrated from checking these fundamentals considering how filtering through systems are routinely kept sifted through [5]. Spread zone organizing methodologies are routinely tended to by formal understandings, for example, peering and travel contracts, and the right utilization of this framework is key for interfacing with structures to achieve other truly obliging goals, for instance, keeping up activity degrees [6, 7].

2 Related Works

Hypothetically, a huge postponement could be utilized yet by and by, it is discovered that forecast outcomes drop if the deferral is excessively enormous [8]. While postponing the yield by certain casings has been utilized effectively to improve results for successive information, the ideal postponement is task-ward and should be gotten by the experimentation strategy [9]. Additionally, two separate frameworks, one for each bearing, could be set up on completely input information and a while later, the results could be combined using number shuffling or geometric averaging for clear desire [10]. Other than human activities, there is two or three irregular trademark cycles that also bring about the arrival of dangerous stuff. Close to human-made exercises, cataclysmic events, for example, volcanic ejections may bring about the pollution of air. Innovation is going around its wing in pretty much every stroll of human life exercises [11].

While the huge majority invests most of their energy inside, open air quality can influence indoor air quality to a huge degree [12]. Likewise numerous patients, for example, asthmatics, patients with hypersensitivities and concoction sensitivities, COPD patients, heart and stroke patients, diabetics, pregnant ladies, the older and kids are particularly vulnerable to poor outside and indoor air quality [13]. The modules are liable for getting and putting away the information, pre-handling and changing over the information into valuable data, estimating the toxins dependent

on recorded data, lastly introducing the obtained data through various channels, for example, versatile application, Web entry, and short message administration [14]. Adequate preliminaries on real data got by capable PM2.5 instruments show the suitability and efficiency of the proposed technique. Specifically, it is uncommonly consistent with real sensor gauges and requires low use time.

Both numerical and imagined results on genuine got information confirm the adequacy and intensity of the proposed framework in evaluation with the huge top-level methods [15]. To assess the level of the PM2.5 center is by organizing a photograph-based procedure [16, 17] . By recognition, it is found that the inundation map is tricky to air quality, demonstrating inside and out different appearances under high and low PM2.5 obsessions. Air pollution has become a general concerned issue, and thus, estimation of air quality can provide a positive guidance to both individual and mechanical practices [18, 19].

In specific, it loses structures and most pixel regards will, when all is said in done, be 0 under a high PM2.5 obsession [20]. Finally, the PM2.5 gathering of an image can be surveyed by methods for the mix of the recently referenced two features followed by a nonlinear mapping strategy. Specifically, the point likeness is removed to measure the fundamental information disaster with the idea that PM2.5 decreases the light shafts created from the articles and in like way mangles the structures of the formed photo [21–24]. Survey on, the stress caused on humans due to various reasons using wireless sensor technology is discussed in the paper, and the countermeasures for the same are suggested [25].

3 Proposed System

When photo practical-based technique is used as fundamental survey parameters, its taken data size is high. Different datasets from different sources would be solidified to shape a summarized dataset, and subsequently one of a kind AI figurings would be applied to remove plans and to get results with most outrageous accuracy.

The framework course of action is the applied model that portrays the structure, direct, and more perspectives on a structure. A game plan portrayal is a standard design and blueprint of a framework, made with an authoritative objective that supports thinking about the structures and practices of the framework.

A structure game plan can join framework detaches and the sub-frameworks made that will support executing the general framework. There have been attempting to formalize tongues to portray structure plan; everything considered these are called fabricating diagram vernaculars (Fig. 1).

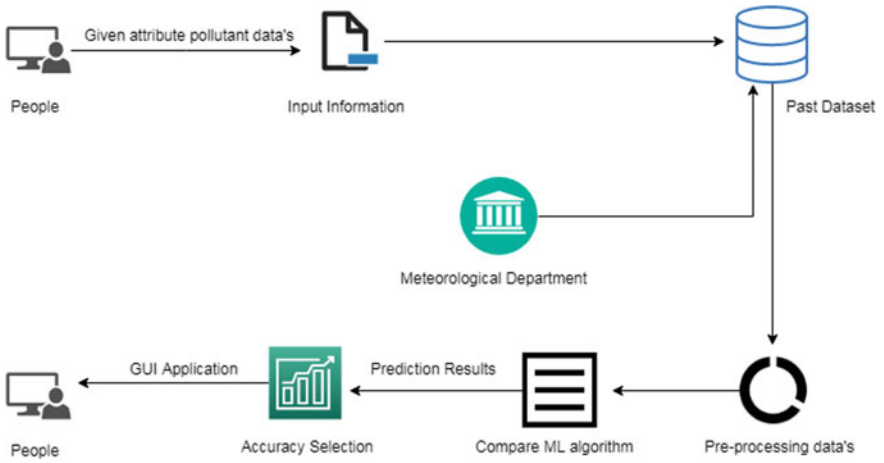

Fig. 1 System architecture

4 Modules Description

1. Variable identification process
2. Exploration data analysis of visualization
3. Outlier detection process
4. Comparing algorithm with prediction in the form of best accuracy result.

4.1 Variable Identification Process

Approval procedures in AI are utilized to get the mistake pace of the machine learning model, which can be considered as near the genuine blunder pace of the dataset. On the off chance that the information volume is sufficiently huge to be illustrative of the populace, you may not require the approval methods. The example of information used to give an impartial assessment of a model fits on the preparation dataset while tuning model hyperparameters. Various information cleaning assignments utilizing Python's Pandas library and explicitly, it center around most likely the greatest information cleaning task, missing qualities and it ready to all the more rapidly clean information. It needs to invest less energy cleaning information, and additional time investigating and displaying.

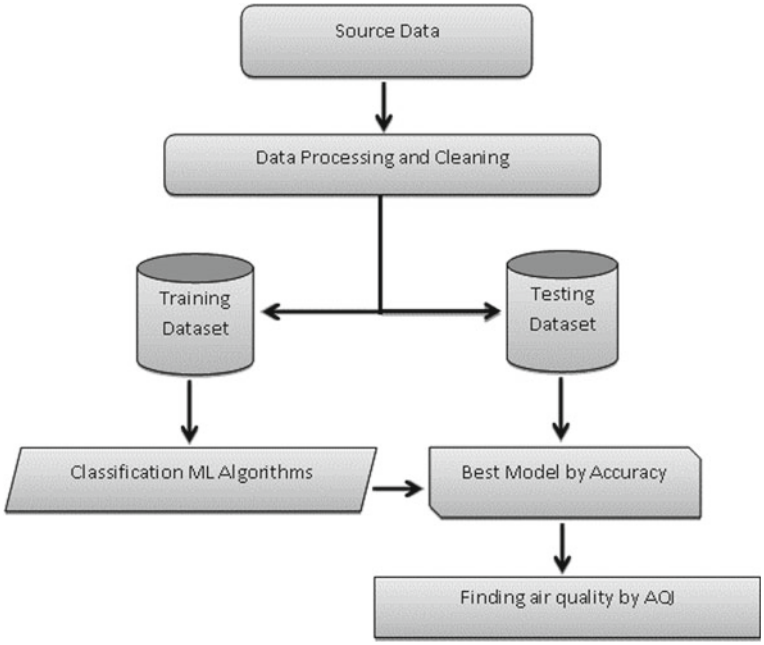

Fig. 2 Work flow diagram

4.2 Exploration Data Analysis of Visualization

Information depiction is a significant bowed in applied estimations and AI. Encounters oversee the purpose of reality spin around quantitative portrayals and estimations of information. Information acumen gives a gigantic suite of instruments for growing a dynamic comprehension. This can be important when investigating and finding a practical pace dataset and can help with perceiving structures, degenerate information, irregularities, and inside and out additional. With a little space data, data perceptions can be utilized to talk about and show a key relationship in plots and graphs that are more instinctual [2] and associates than degrees of association or hugeness (Fig. 2).

4.3 Outlier Detection Process

Various AI estimations are delicate to the range and task of trademark respects in the information. Irregularities in input information can slant and trick the game plan arrangement of AI tallies acknowledging longer preparing occasions, less exact models lastly progressively awful outcomes. Certainly, even before wise models are set up on arranging information, unique cases can understand deceiving delineations

and thusly overwhelming understandings of gathered information. Irregularities can slant the outline scattering of value characteristics in illustrative estimations like mean and standard deviation and in plots, for instance, histograms and scatterplots, pressing the body of the data.

4.4 Comparing Algorithm with Prediction in the Form of Best Accuracy Result

It is basic to take a gander at the introduction of different particular AI computations dependably and it will discover to make a test seat to consider various assorted AI estimations in Python with scikit-learn. It can use this test saddle as a configuration on your own AI issues and add more and different counts to consider. Each model will have differing execution traits. While having another dataset, it is a savvy thought to envision the data using different techniques to look at the data from exchange perspectives. A comparative idea applies to show assurance. A way to deal with do this is to use assorted portrayal methods to show the ordinary accuracy, change and various properties of the transport of model precision.

5 Future Enhancement

The weather prediction department and pollution control department can bring awareness to mankind about the existing air quality and predict future India with these challenges. To mechanize this framework by indicating the longing accomplishes Web application or work zone application.

6 Conclusion

The explanatory procedure began with information cleaning and preparing, missing worth, exploratory assessment in end model structure and assessment. The best precision on the open test set is high accuracy score which will be found. This application can help India meteorological division in anticipating the destiny of air quality and its status and depends on that they can make a move.

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Computer Vision-Based Approach for Indian Sign Language Character Recognition Using CNN and ROI Segmentation

Mercy Paul Selvan, Robert Bagio, Rithesh, and Viji Amutha Mary

Abstract Sign language is popular with hearing-impaired individuals around the globe. There are a pair of languages that employ predefined steps as well as motions to express a personal message. These languages are largely created to help deaf and verbally inhibited individuals. They normally use a precise and simultaneous mixture of motion of hands and wrists, the orientation of hands, hands styles, etc. Various areas have varying indication languages such as American Sign Language, Indian Sign Language. In this paper, we have concentrated on Indian sign words. This particular research work is designed to exhibit a simple strategy toward sign dialect to textual content transformation through personalized region of interest (ROI) segmentation as well as convolutional neural network (CNN). Multiple hint gestures are educated utilizing a customized picture dataset as well as applied by Python dialect. Making use of the ROI choice strategy, the task displays much better results compared to traditional methods within the terminology of real-time detection and accuracy level from video clip streaming by webcam.

Keywords Sign language · CNN · ROI · Detection · Classification

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1 Introduction

Not too long ago deep learning-based methods are used for indication of dialect recognition that carried out being amazingly effectively inside item detection various other computer system eyesight difficulties [1]. There are many cases where CNN is used for identification of the details of the signs that are assisted by the digital Web cameras [2, 3]. However, in the situation of scalability to sensible instances, they did not work nicely while they lack a necessarily substantial amount of pictures for every signal as education data. The instruction likewise has demanded a massive amount of time period to understand the picture that includes a result of the tips to a richer group of characteristics [4, 5]. After efforts, natural language processing (NLP)-based methods are observed that in fact make use of the HaarCascade classifier for indication determining as well as their CamShift algorithm for keeping track of the signal [6]. Text for respective symptoms is delivered to the POS tagger component and also by utilizing LALR parser significant phrase for the specific indication is produced [7]. This process offers nicely end up with 90% precision reported through the scientists though furthermore, it includes the disadvantage of inadequate detection as HaarCascade did not identify an item in lower luminosity quality [8, 9]. Moreover, a maximum of seven measures has to produce a phrase out of the video clip of indication that made up of a great deal of computationally major workflow entirely [10]. To alienate these aforesaid problems, a reverse engineering technique is used whereby abounding package is going to be existing on-screen prior to the category begins as well as an operator has to go that bounding with as package to that particular spot in which indication is created by listening to affected person. Just the area within the bounding package is delivered to the skilled CNN type for prediction [11, 12]. The primary edge of this procedure is CNN does not have to understand a lot of characteristics as well as identify the ROI. Just a little quantity of information it offers a lot of precision as well as quicker detection. In addition to that here, as hardware integration by using Raspberry Pi, it offers a lot of versatility as well as scalability for mute and deaf individuals who make use of Bangla sign language. In this paper, we have proposed a model that makes use of the convolution neural networks to detect the signs using the Web camera and segment the region of interest. Numerous parameters are involved to find out the efficiency of the proposed model [13, 14].

2 Related Work

Numerous research works are proposed by various researchers for segmenting or classifying a specific object or a certain is for detecting a sign language character. Paper [15] details a pair of concrete greatest methods which document evaluation scientists are able to utilize to obtain results that are good with neural networks. The most significant procedure is finding an instruction established as huge as possible:

we grow the instruction established by including an interesting type of distorted information [16, 17]. The other most significant procedure is the fact that convolutional neural networks are much better designed for visible paper duties compared to completely attached networks. Instant hint word recognition (ASLR) is a unique situation of automated speech recognition (ASR) and also laptop or computer eyesight (CV) and it is presently changing via utilizing man-made laboratory generated information to using 'real-life' information [18]. When it comes to [2], the writer has created an indication dialect recognition process for individuals that do not understand indication words, to talk effortlessly with hearing-impaired individuals and also designed to understand American sign language and in addition offers a total introduction to serious learning-based methodologies for indication language recognition. Indication gestures could be categorized as dynamic and static [19]. However, fixed gesture recognition is less complicated compared to powerful gesture recognition but all recognition methods are essential on the man society [20]. When it comes to [3], human–computer interaction moves ahead within the area of indication dialect interpretation. Indian sign language (ISL) interpretation product is a great way to assist the Indian hearing-impaired individuals to have interaction with regular individuals together with the assist of a laptop or computer. Research article in [6, 21, 22] details on an active program application that was created by using LABVIEW software program plus integrated right into a cell phone. The warning sign words gesture pictures are actually acquired utilizing the built-in digital camera of a movable phone; perspective evaluation capabilities are done and supply speech result with the built-in cd unit, therefore, reducing outlay of money as well as hardware needs. When it comes to [23, 24], the researcher has provided the complete analysis which contains the unit created (VS Virtual Sign Model) and also the encounters have done, with an instant bidirectional hint words translator, between created as well as indication language [25]. By surveying each paper, we have stated the issue of improving the device to accomplishment.

3 Proposed Approach

The proposed model is generated to understand the alphabet by utilizing convolutional neural networking as well as ROI segmentation on Raspberry Pi through webcam. Python language is utilized to perform the algorithm. Just before recognition, test gestures are caught within different orientations and also qualified straight into a unit made of kept in the root folder. While delivery pictures are taken in the bounding package and then changed into gray weighing machine pictures. Tips of the hands obtained from the switched into gray weighing machine pictures. The array of characteristics obtained from pictures in contrast to pre-trained details established utilizing a convolutional neural algorithm. If the shot impression coupled with virtually any of educated pictures, it presents the corresponding sales letter. Inside dataset creation, within this component, we build information established for every gesture. Each picture is so changed into the grayscale picture and then resized to 50 * 50. We

saved gestures in different folders with gesture id as well as rap for neighborhood data sources. Under the Python setting, access to video clip type in a motor magnetic generator is gained through digital camera.

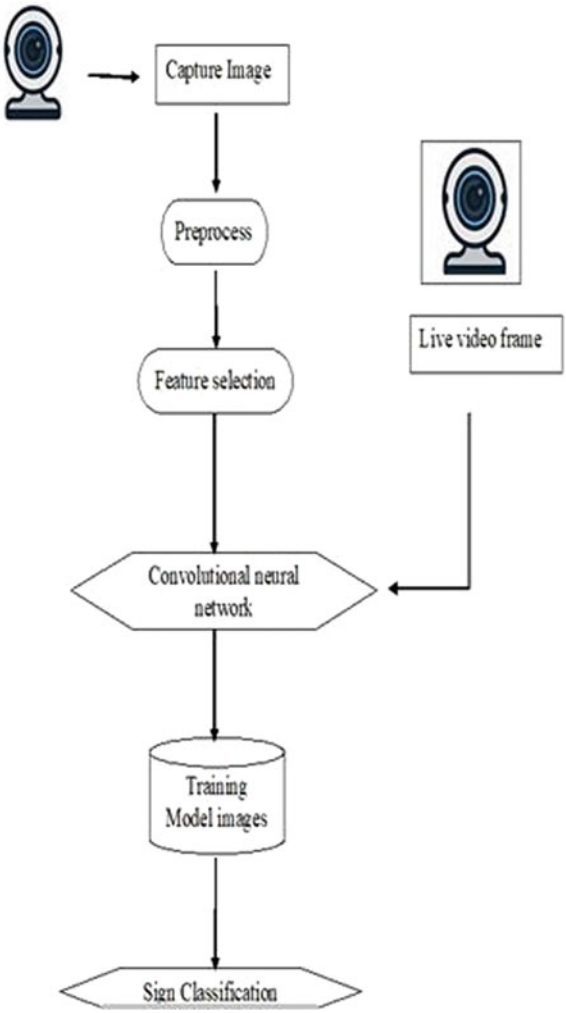
Pre-processing
The ultimate aim for any image pre-processing technique is to improve the quality of the image.

1. **Image Acquisition**. The primary stage of picture processing is picture acquisition. The pictures are gathered up possessing a very low racket in comparison with HD pictures. The primary benefits of the component are having pictures with much better lucidity, distortion, and low noise.
2. **Image Pre-processing**. It is among the kinds of picture processing, effort to generate analysis much more evident. Picture pre-processing is a means to enhance the caliber of the picture, such which the consequential impression is much better when compared with the initial body. With this task, imply filtration system and also median air filter are provided for the pre-processing of the choosing the pictures. The median air filter is a nonlinear device [19], and the typical air filter is a linear body.

Feature Extraction
The principle component analysis (PCA) statistical procedure is a method we utilize to carry out dimensionality minimization on the data of ours. PCA is a technique that cuts down on the dimensionality of multidimensional details inside a fashion that captures the heart of first information. It basically accomplishes the minimization by repetitively projecting n-dimensional vectors onto an $(n - 1)$-dimensional vector inside a fashion that maximizes variance. Figure 1 depicts the overall architecture of the proposed architecture.

CNN Algorithm
When a picture is considering the system, action areas are extracted and it is transferred onto the recognition system in which the characteristics are extracted and also the labeling of the measures is accomplished. The result of present coating functions as the feedback of the coming coating. The quantity of levels employed within the system completely is determined by performing on the Panasonic phone. The number of levels and also the activation performs may perhaps be transformed as well as noticed to understand the very best effective airer. Motion recognition is incredibly hard to do and therefore Sift includes removal is originally carried out on the picture to reach learn about the characteristics. A textual histogram is produced by using bag of visual words (BOVW) which reveals the patterns noticed by the steps. A dataset is utilized to instruct the system which comprises of different videos and images exactly where different steps are performed. The impression is initially scanned as well as hear as a result of the dataset. Subsequently, the picture is prepared to such a manner which the product quality on the image is elevated s which might include much more spatial as well as specification specifics. When the picture is

Fig. 1 Architecture diagram



switched into pixels, the characteristics are extracted by different levels within the system. When the instruction is completed, a brand new impression is provided to the system that reads the picture. When the picture is read through, the outline on the image is a recognized initially. Subsequently, the area segmentation system happens in which the activities within the picture are segmented individually. Then abounding package is bounded close to the excitement patterns which are determined with the system.

Segmentation
Image segmentation is a vital practice for many picture evaluation consequent responsibilities. Segmentation divides a picture into the constituent regions of its or even items. The objective of segmentation is making less complicated or even alters the representation of a picture into one thing which is easier and means more to evaluate. In Fig. 2, we can see the process flow chart from top to bottom.

4 Experimental Result

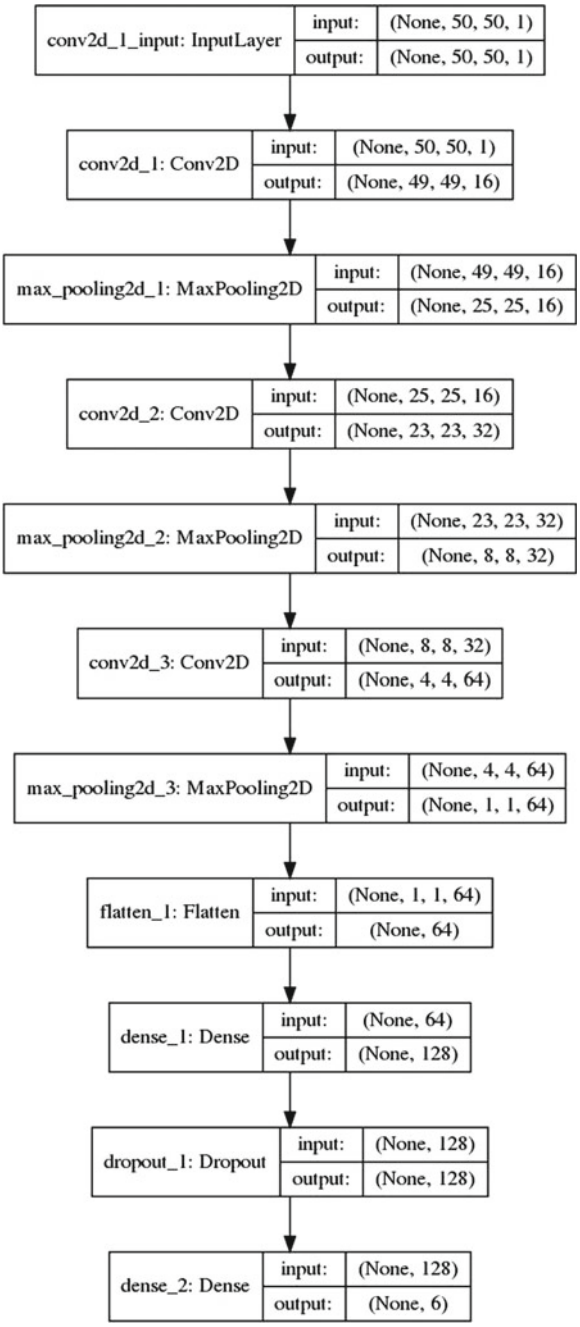
The experiments are performed using the Python 3 version. The computations are performed using the image Classification Learner Toolbox that is readily available in Python 3. First, the input image from the camera is given to the tool. In Fig. 3, the environment created using CNN Provider is depicted. Figure 4 is a result Screenshot image obtained from a webcam scanner. When this image is passed, the pre-processing takes place where all the images are extracted for character recognition.

In Fig. 5, there are many separation of signs was extracted and achieved the accuracy in good level. In Fig. 6, we can see the matrix values inside the image and generated as graph for clear view. Hence, we have achieved the accuracy level on comparing with existing model.

5 Conclusion

We have proposed an efficient method of producing a character using CNN and ROI segmentation scheme; these give more comfort to the sign language character recognition users as well as the backend management team. The images obtained from the camera are used for testing in such a way that they generate high image quality. Classification of the images is done using ROI. These images are then used for further extraction and segmentation. The techniques can be extensively used for detecting sign using CNN algorithm and has obtained an accuracy level of about 99.2%.

Fig. 2 Flow chart



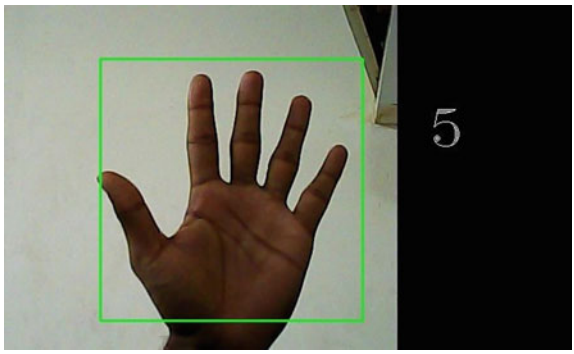


Fig. 3 Feature extraction

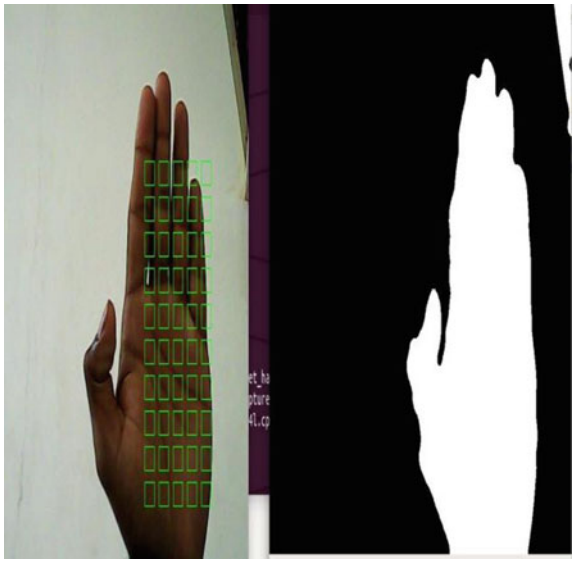


Fig. 4 Classification result

Fig. 5 Output screenshot

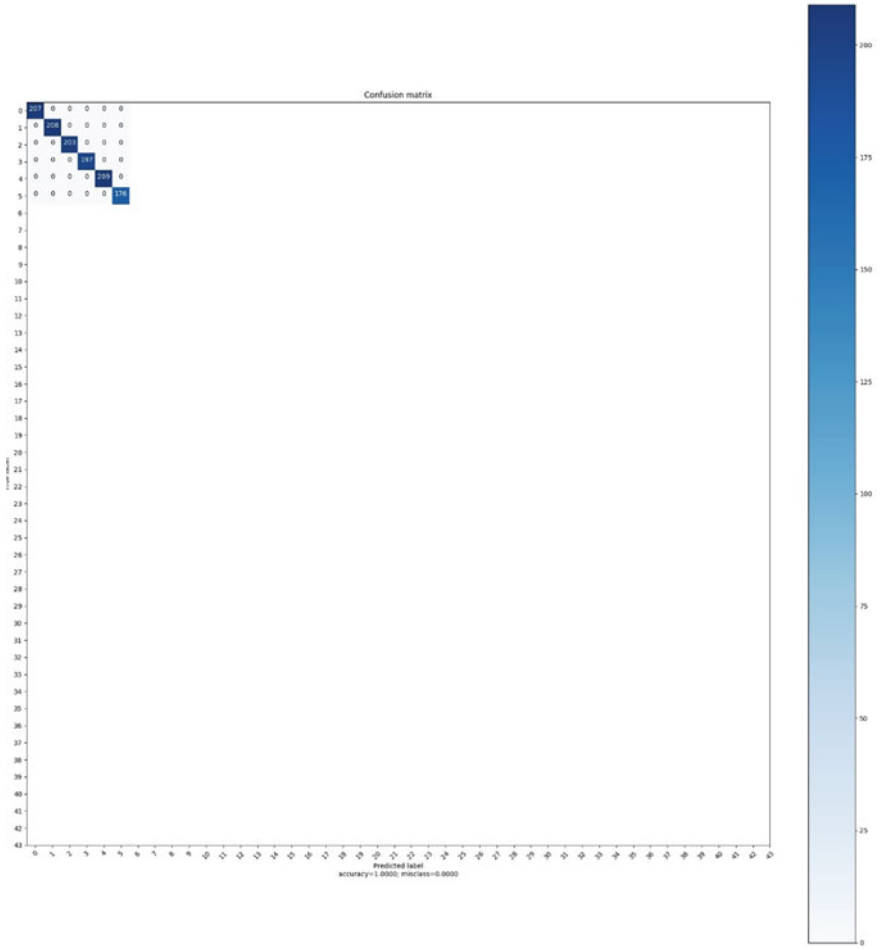


Fig. 6 Confusion matrix

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High Secured Data Access and Leakage Detection Using Attribute-Based Encryption

Mercy Paul Selvan, Repala Sai Sowmith, Puralasetti Dheeraj, and S. Jancy

Abstract Brilliant innovations within reach have encouraged age and assortment of immense volumes of information, on regular schedule. It includes exceptionally touchy and differing information like individual, authoritative, condition, vitality, report, and personal information. Information analytics give answer for different issues being looked by brilliant hospital information like emergency reaction, debacle versatility, rise the executives, doctors, the executives framework, and so on. It requires conveyance of delicate information among different elements inside or outside the hospital. Sharing of touchy information makes a requirement for effective utilization of brilliant hospital information to give savvy applications and useful to the end users in which are liable and experimental method. This mutual delicate information if gets pilled as an outcome can make harm and extreme hazard the hospital assets. Strong hold of basic information from informal exposure is greatest issue for accomplishment of any task. Information leakage perception gives a lot of instruments and innovation that can productively settle the worries identified with patient basic information. The principle goal of this task is to identify the guilty operator/individual who are indented to hack the information. We additionally send blockchain idea over this undertaking for high security. We give fake/copy record to those liable individual.

Keywords Big data · Blockchain · Data analytics · Data leakage · Hospital

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1 Introduction

Cloud computing offers an assorted scope of re-appropriating administrations, including capacity and calculation to serve people and endeavors. Essentially, redistributing administrations as a rule incorporate online installment and security issues. Be that as it may, most customary assistance arrangements need to depend on a trusted third party to acknowledge reasonableness to finish installments. For instance, Google cloud stage offers an assortment of processing administrations, for example, information stockpiling and calculation, and the client enrollment, and administration utilization needs a ledger made by an outsider budgetary foundation [1]. This can prompt major issues, for example, arrange interference when banking frameworks are out of administration or information spillage brought about by the cloud outsider. In this manner, the acknowledgment of secure and reasonable installment of re-appropriating administrations is of central significance for cloud-based applications. Right now has risen as a solid possibility to understand security issues of cloud administrations on account of its conveyed and unchanging natures. The works present a blockchain-based reasonable installment to the design for using redistributing administrations in cloud computing. The proposed framework guarantees to give adequacy and hearty decency capacities by utilizing an assistance the board convention run by blockchain. Reasonable installment can be accomplished among clients and re-appropriating specialist organizations on mists through exchanges which are put away and confirmed by blockchain without the contribution of any outsider. The development in the correspondence innovation has encouraged the associations to track about every single movement or occasion happened inside its premises. Enormous information essentially doesn't mean immense volume of information gathered through sensors; however, it is the information accessible to be examined utilizing propels apparatuses to bless savvy and to a hospital by deciding patterns, openings, and different dangers related [2]. A hospital owing canny framework as far as social, financial, and physical framework is considered as keenone [3, 4]. The most critical worry about the keen hospital private information at present is the issue of information rupturing which restricts the protection and safety of essential information. This huge volume of delicate key information is needed to be shielded from information leakages [5]. Previous situation of quick development requires the sharing of touchy information of element among assorted partners inside or outside the association (here hospital) premises for examining reason [6, 7]. However, the accepting substance may abuse this information and can spill it intentionally or unintentionally to some unapproved outsider [8, 9]. Information spillage is characterized as the thought or inadvertent dispersion of touchy data or information to an unapproved vindictive element [10]. Basic information in different associations as appeared in Fig. 1 [11] incorporate Intellectual Property (IP), segment data, foundation subtleties, open area information, monetary data, and different other data relying on the hospital [12]. Information spillage uncovered a major test and extraordinary danger to the association privacy in light of the fact that as the include of breaks increments in resultant the expense happened because of these spillages likewise

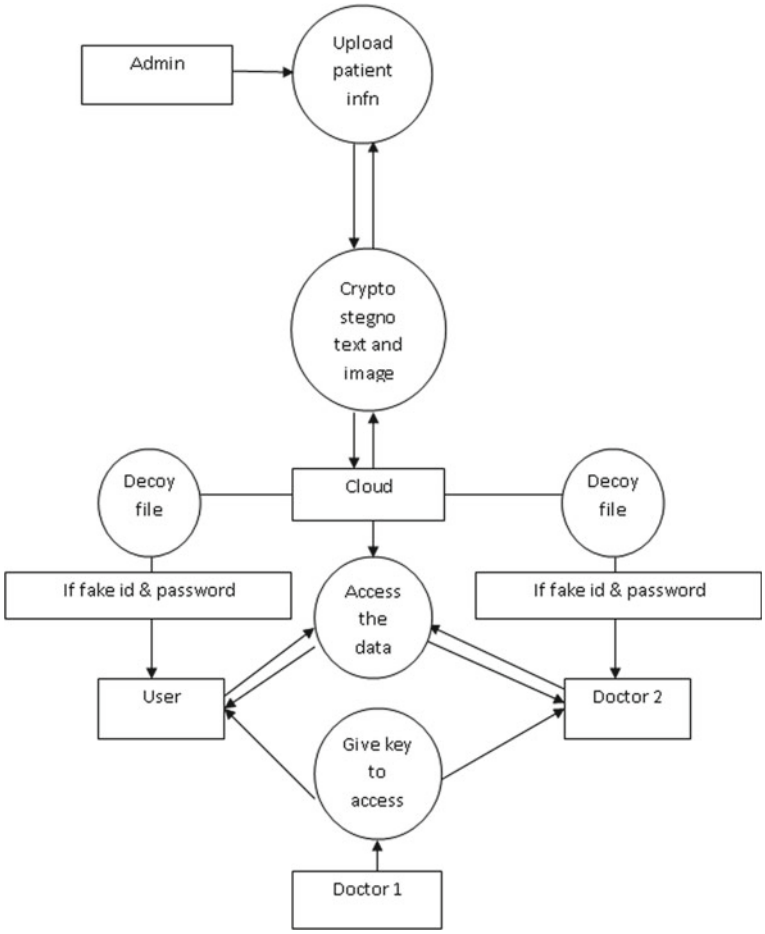

Fig. 1 Proposed system architecture

keep on expanding [13, 14]. It is fundamental to ensure the private data as it builds the danger of falling the touchy data in unapproved hands, and afterward, it tends to be abused by unapproved outsider [15, 16]. Accordingly, it has gotten basic for any association to identify and forestall such spillage [17]. Therefore, if limit the information sharing to control security and protection of delicate data may decrease the association's development [18]. The customary methodology like watermarking, steganography for the information spillage recognition includes alteration in the first information [19, 20] so while another, a model to distinguish the malignant guilty operator who caused spillage of basic data and gives security to shield the touchy data [21]. This representation visualizes the blameworthy operator by watching the example of information assignment among different specialists. In the model, wholesaler dispenses the mentioned information thing among different specialists, spoke

to through bi-graph. In the wake of accepting the pivotal information, if specialist uncovers this information to some noxious outsider, and at some point, later information is discovered be extant at some unapproved place; system to recognize spillage is utilized to disclose the dataspy.

2 Related Work

Numerous examinations in Cloud of Things, blockchainm, and related issues have been explored over the ongoing years in a wide scope of specialized angles. Numerous endeavors have been made to give survey articles on this examination territory in various degrees. The overview papers displayed the audit of late endeavors in the appropriation of blockchain innovation in different cloud situations and applications [22, 23]. They additionally dissected specialized parts of blockchain–cloud mixes, from definition, coordinated structures, empowering advancements to application situations and open issues. In the interim, the creators talked about research [24].

Issues, difficulties, and chances of mix among blockchain and cloud computing. They concentrated on the upsides of blockchain reception in cloud systems, including security, information the executives, and application areas with potential help stages. The work introduced a review on the utilization of the blockchain innovation to give security administrations, and its specialized properties to tackle related difficulties in different application spaces, including cloud processing. All the more as of late, the review on the incorporated model of blockchain and edge figuring, an all-inclusive cloud computing idea, was talked about in the study [25].

We propose an appropriated, versatile and fine-grained get to control conspire with proficient decoding for the big data in mists. Blockchain innovation is utilized to oversee personalities and give the validation, store, and execute a shrewd agreement that consolidates the relevant and nitty gritty access arrangement characterized by the information proprietor, which is activated by an entrance requester that gives information proprietors the sovereign right to successfully deal with their informational collections and deals with the strategy. We additionally utilized the ciphertext-policy attribute-based encryption plot for supporting the effective decoding re-appropriating as another security layer for dealing with the arrangement.

In a CP-ABE plot, every client's key is related with properties, and each ciphertext is identified with an entrance arrangement; therefore, information proprietors can decide the entrance approaches for their own information and control them straightforwardly. In the event that a client's (patient) traits fulfill the entrance arrangement in the cipher text, the client can decode the cipher text effectively. In addition, CP-ABE has an integral framework called key strategy Attribute-Based Encryption (KPABE) [14]; in which every client's key is related with an entrance arrangement, and each ciphertext is determined with traits [26]. The utilization of CP-ABE to the cloud condition can bring information spillage anticipation and gain control together, which are structural essentials for big data security and protection [2].

Most access control arrangements receive an incorporated engineering. They redistribute the control of information to confided in outsiders, which keep the client from controlling his own information. This can cause issues of morals and classification. Lamentably, when we share our data with outsiders, we promptly lose control and possession. Our new plan official breaks this custom and gives individuals what has a place with them in a reasonable manner. Truth be told, we accept that big data needs an other entrance control structure that meets its particular prerequisites and highlights, permitting clients to control their own protection. This "change" will require reexamining access control advances and making another arrangement that tends to the security and protection prerequisites of big data. Ideally, we are on the edge of another period of decentralization, which has brought another innovation, known as blockchain, that could change in a general sense our thoughts of incorporated position.

3 Existing System

There is no framework to distinguish the guilty specialist/individual; there is no security to keep away from information spillage of delicate data. Existing situation of quick development requires the sharing of delicate information of substance among assorted partners inside or outside the association (here hospital) premises for examining reason. Be that as it may, the accepting element may abuse this information and can spill it intentionally or accidentally to some unapproved outsider. Information spillage is characterized as the pondered or unintentional conveyance of touchy data or information to an unapproved malevolent substance.

4 Proposed System

It includes profoundly delicate and differing information like individual, authoritative, condition, vitality, transport, and financial information. Information analytics give answer for different issues being looked by savvy urban communities like emergency reaction, debacle versatility, development the executives, keen patients the board framework, and so on. It requires conveyance of touchy information among different elements inside or outside the hospital. Sharing of those delicate information is troublesome and hard. We embrace information spillage identification framework to distinguish the guilty operator/individual. In the proposed piece of work, we distinguish the guilty specialist/individual through wrong passwords based confirmation. When our framework recognizes the blameworthy individual at that point fake document/wrong record is disseminated to that programmer. All the information is put away utilizing blockchain innovation for high security reason. All the information is put away in cloud server for viable remote access.

4.1 User Registration

Right now/persistent need to enlist their own data like name, address, mail ID, portable number, address. What's more, those subtleties will be put away on database. After enlistment, client will get client ID and secret key to get to the application. This is an application to see their emergency clinic report from cloud. To get to the emergency clinic records, we are making client Id and secret word for confirmation.

4.2 Hospital Server

Server is the principle procedure for each application since it is the main path for correspondence it will build up the correspondence among customer and relating site. Right now are executing emergency clinic server to keep up both patient data, specialist data, and other medical clinic subtleties. All specialists need to enroll their assignment and different subtleties same like that other medical clinic need to enlist their subtleties on this server. Since patient may change their treatment starting with one medical clinic then onto the next that is the reason emergency clinic will like wise enroll their data. Server will keep up all the subtleties and give subtleties at whatever point client solicitation to the inquiry (Figs. 2 and 3).

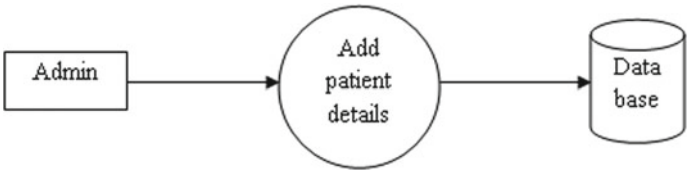

Fig. 2 User registration

Fig. 3 Hospital server

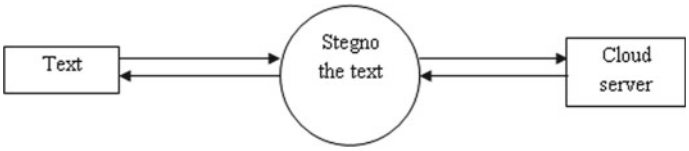

Fig. 4 Stegno analysis

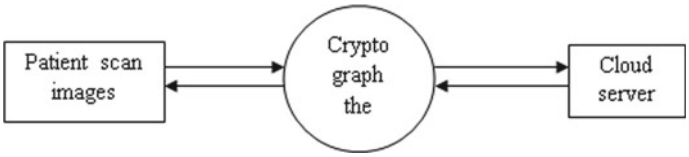

Fig. 5 Image cryptography

4.3 Stegno Analysis

Steganography is the method of concealing personal data (record, message, picture, or video) inside another document, message, picture, or video. We are concealing the patient's close to home data and their report about sickness. Each datum will be put away as a stegno position at the point when we put away the record as a stegno it won't hacked or burglary by any one (Fig. 4).

4.4 Image Cryptography

In our framework, we are putting away the patient filtering report like the irx-beam, ECG, and different pictures in scrambled structure utilizing ECC calculation. ECC produces keys through the properties of the elliptic bend condition rather than the customary strategy for age as the result of exceptionally enormous prime numbers. Utilizing ECC calculation, we are scrambling the picture document and store it in cloud server (Fig. 5).

4.5 Fog Computing

Haze figuring is a term made by Cisco that alludes for developing of cloud computing to the edge of an undertaking's system. Otherwise said the edge computing or misting, haze transforming boosts the activity of register, stockpiling, and systems administration benefits between end apparatus and cloud computing server warehouses. It is a different to keep up the distraction data. Here, we fake the patient data in secure

Fig. 6 Fog computing

manner that is the way to ward making aphony report of patient. For security, we are making this kind of record (Fig. 6).

4.6 Data Access

Right now are actualizing getting to process for client just as emergency clinic. Right now, tolerant detail will be kept up by a specialist who is the individual patient met from the outset time. He had just authorization to get to the patient data. On the off chance that it any case understanding change the emergency clinic or he/she needs to see his/her subtleties that they need some key to get to the information which is put away in cloud. In the event that the patient their clinic another specialist need to offer key to get to the patient subtleties. For the two individuals, they need one key to get to the document. That key will be given by specialist from emergency clinic. Both patient and specialist have client id and secret phrase to get the document. Framework will check their ID and secret expression on the off chance that it coordinate with past information nbase, and they will get key from specialist and view subtleties. In the event that it won't coordinate with past database server which will give distraction record, and ready will be send to the patient (Fig. 7).

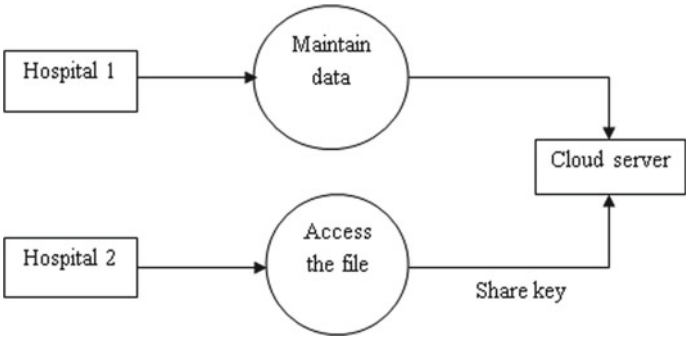

Fig. 7 Data access

4.7 ABE Implementation

Attribute-Based Encryption (ABE) may be used to encrypt files. Rather of encrypting each part of a log with the keys of all recipients, the log can only be authenticated with attributes that suit attributes of the recipients. This basic can also be used to encrypt transmissions and reduce the amount of keys used. The multiple applications can view all the patient data like doctors, technicians [27], and nurses depending on their consent to view them and their keys.

4.8 Blockchain Implementation

A square is a compartment information configuration. The normal size of a square is by all accounts 1MB (source). Here, each testament number will be made as a square. For each square, a hash code will process for security.

5 Result and Steps

Step 1 (Fig. 8):
Step 2 (Fig. 9):
Step 3 (Fig. 10):
Step 4 (Fig. 11):

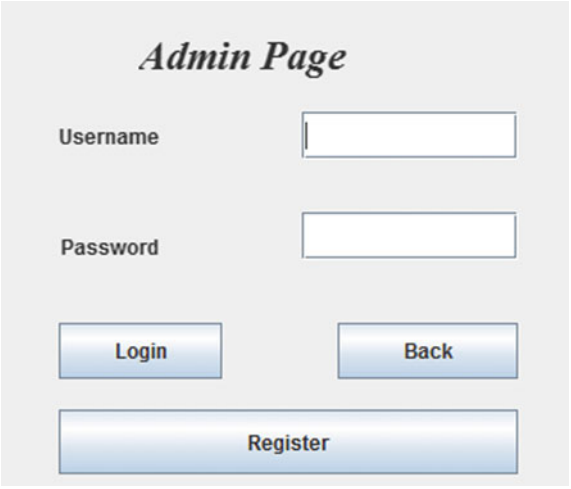

Fig. 8 Admin page

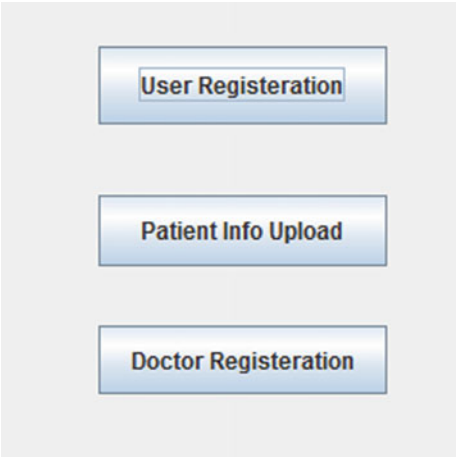

Fig. 9 User registration

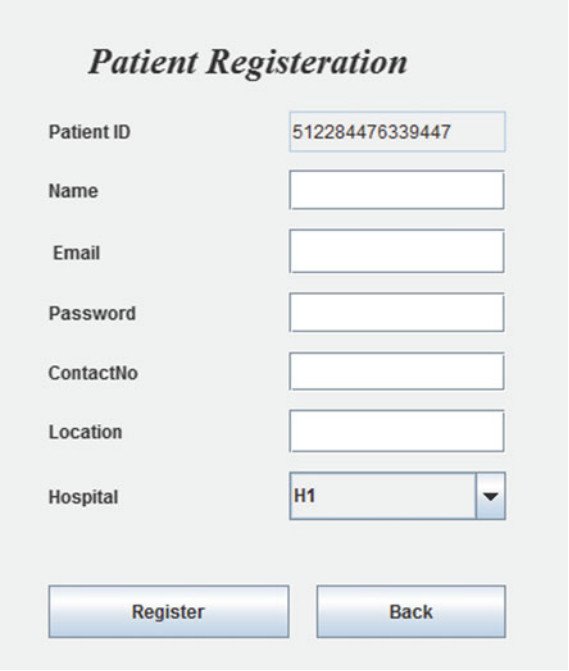

Fig. 10 Patient registration

Step 5 (Fig. 12):
Step 6 (Fig. 13):
Step 7 (Fig. 14):

Fig. 11 Patient details

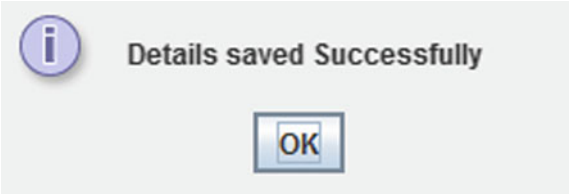

Fig. 12 Saving details

6 Conclusion

Brilliant hospital is information driven enormous information gathered by omnipresent shrewd things like different medicines, various medical report, and so forth change the lives of occupants by benefiting an a lot of savvy and clever applications and help in dynamic capacity. Effective execution of hospital idea relies upon the productive utilization and security of touchy information. Given model takes care of information spillage issue utilizing a blame operator distinguishing proof model to recognize the spillages that are caused deliberately or accidentally. It finds the odds of the operator for being blameworthy by processing likelihood relying upon the information dispensed among different specialists through bi-graph. Data leaker is recognized by contrasting the determined likelihood of releasing the information, and the classified data is safeguarded. Future endeavors could be made to improve the security of the most delicate data by means of considering the edge esteem.

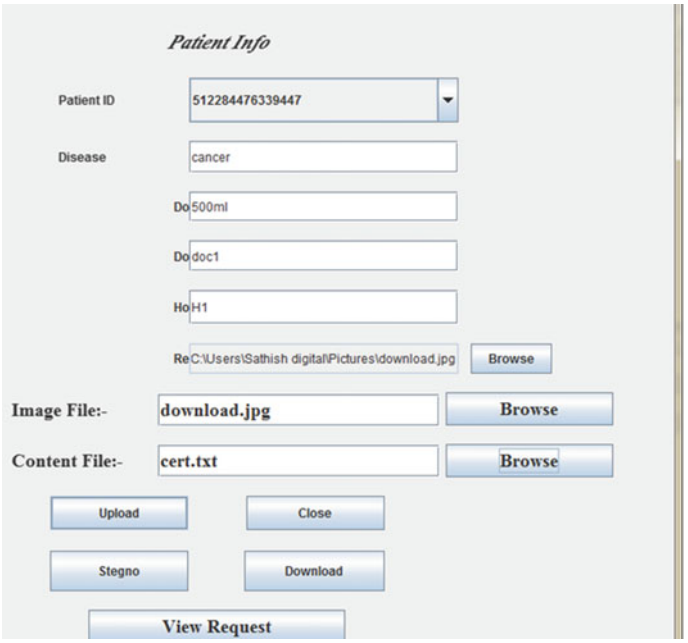

Fig. 13 Patient documents updation

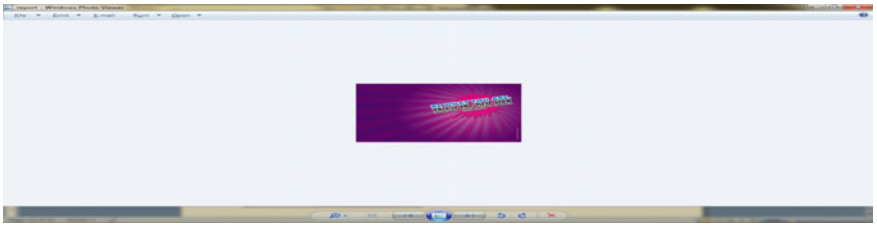

Fig. 14 Patient report

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Enabling Ternary Hash Tree-Based Integrity Verification for Secure Cloud Data Storage

Sadam Vamsi, Rachaputi Raviteja, Mercy Paul Selvan, and Mary Gladence

Abstract The primary point of this venture is to give a solid and secure cloud support and furthermore increment dependability of confirmations by continuous auditing. Cloud service certifications (CSC) are a decent way to address a more prominent degree of security. Keeping in view that, cloud administrations are a piece of persistently evolving condition; question unwavering quality of such confirmations may happen in multi-year legitimacy periods. To expand dependability of accreditations, it is must to guarantee consistently solid and secure cloud administrations. CA of cloud administrations is still in its juvenile state. In this manner, we directed an exhaustive workshops, interviews writing survey with professionals to finish engineering for nonstop cloud administration inspecting. However, outsider evaluating techniques are not accessible in existing strategies. In this way, we propose a potential methods for execution that demonstrates different advantages and changes that must be figured out how to diffuse the idea of persistent cloud administration inspecting. Evaluators and suppliers who are connected together in a calculated design that are getting advantage over pertinent inward and outsider reviewing approaches. The security examination of the proposed open inspecting system demonstrates the accomplishment of wanted properties, and execution has been assessed with the itemized try set. The outcomes show that the proposed secure cloud reviewing system which is exceptionally secure and productive away, correspondence and calculation costs.

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Keywords Security auditing · Certification · Cloud computing · Continuous · Ternary hash tree

1 Introduction

Numerous associations transfer their information, applications to the cloud, driving them to accomplish money related and specialized advantages. Associations are ambivalent to acknowledge cloud administrations in light of security, protection, and dependability concerns. CSC is acceptable intends to address these worries by setting up trust and expanding straightforwardness of the cloud showcase [1–5]. In this way, to give straightforward, consistently dependable, and secure cloud administrations continuous auditing (CA) of affirmation criteria is required. Past these unique reason techniques, investigate as of now comes up short on a far reaching design, empowering outsider inspectors to persistently review a wide assortment of CSC criteria. Before conceptualizing a design and characterizing how to perform CA, it must be dissected where CA is sensible [6, 7]. Accordingly, we examine which CSC criteria ought to be persistently reviewed to guarantee continuous adherence by performing workshops with cloud administration evaluators first. Be that as it may, associations are as yet reluctant to embrace cloud administrations due to security, protection, and unwavering quality concerns seeing provisioned cloud benefits just as questions about dependability of their cloud specialist co-op. Cloud administrations are a piece of an ever-evolving condition, coming about because of quick innovation life cycles and intrinsic distributed computing (CC) attributes, as on-request provisioning and ensnared sup-utilize chains. Subsequently, such long legitimacy periods may place in question unwavering quality of gave affirmations. CSC criteria may never again be met all through these periods, for in-position, because of setup changes or significant security episodes [8–12]. In this way, continuous auditing (CA) of accreditation criteria is required to guarantee straightforward, consistently solid, and secure cloud administrations, and to build up a reliable CSC, after the underlying confirmation process is practiced. Tending to the holes of the examination work, the inspecting of real information squares or reproductions of information squares is by all accounts need; yet these imitation information squares were just given to different clients who get to the information in the servers that are geo graphically situated close to the clients [13]. So as to guarantee information unwavering quality and accessibility, putting away different copies are a typical methodology followed in the cloud [14, 15]. For dynamic updates, single square update will prompt update different copies of the concerned square [16, 17]. With existing plans, checking the respectability of the copies is by all accounts correspondence and calculation overhead [18, 19]. Considering the enormous documents put away in CSP and asset limitations of DO, it is critical to build up a safe structure with proficient information examining procedures for periodical information respectability confirmation [20, 21]. Our commitment stretches out to offer the help of dynamic updates, blunder limitation, information rightness, block less confirmation, and imitation information inspecting [22].

2 Related Work

Right now, overview of the diverse security chances that represent a risk to the cloud which is introduced [23]. This paper is a review progressively explicit to the distinctive security gives that has exuded because of the idea of the administration conveyance models of a distributed computing framework. A unique review administration with the zero-information property for honesty check [24]. It additionally bolsters auspicious inconsistency recognition and dynamic information activities with index hash table (IHT), fragment, sampling structure. Liu et al. [9] explained a plan of open inspecting with irrefutable fine-grained refreshes. It uses positioned Merkle hash tree calculation to register the obvious metadata and authenticator esteems. Here, the reviewing procedure is made through a test reaction convention, which is confirmed by TPA. The open evaluating for the mutual information in the cloud is protected with client's information security through a ring mark plot described by Wang et al. [8]. It underpins dynamic information refreshes tasks through list hash tables that maintain a strategic distance from re-calculation of marks on squares, however, constrains open unquestionable status over the recently embedded or adjusted squares. Li et al. [25] describe a plan including disconnected and online labels that were utilized to confirm and check the trustworthiness of the information squares.

3 Proposed Methodology

Checking of remote data integrity is needed for securing clients data in cloud environment. Client used to send and upload their important document in cloud. By using the algorithm of dynamic block age, the uploaded file is splitted into small blocks. The blocks will be stored in ternary hash tree (THT) group. The squares have a guardian's hub and youngster hub. Record allocation table (FAT) file system has appropriate indexing and metadata's for the various chunks of the cloud storage. Here, the reviewer consents to investigate logs, which are routinely made during observing tasks by administrations suppliers to survey confirmation adherence. In the event that attacker taints information in multi-cloud, the continuous auditing process causes the verifier to perform block and file-level checking for remote information integrity checking utilizing verifiable data integrity checking algorithm. The evaluating forms have a stream, first the parent square checking. On the off chance that the parent square has any adulterated document, at that point the youngster hub evaluating. On the off chance that the kid hubs have any defiled record the file recuperation that is finished by the verifier, consequently if the information gets tainted during checking. Clients would complaint be able to cloud for document recuperation.

3.1 Advantages of Proposed System

- The proposed framework performs block-level, file-level, and replica-level auditing with tree block ordering.
- Our framework to support error localization with data correctness dynamic updates with block update, insert and delete operations in the cloud (Fig. 1).

Checking of remote data integrity is one of the most issues happening in cloud computing. Clients data will be outside of them control. Unauthorized changes will be corrupted the clients data to gain profits in cloud server. Quick innovation life cycles and intrinsic cloud computing qualities as on demand provisioning and supply chains are part of the cloud environment. Consequently, such long legitimacy periods may

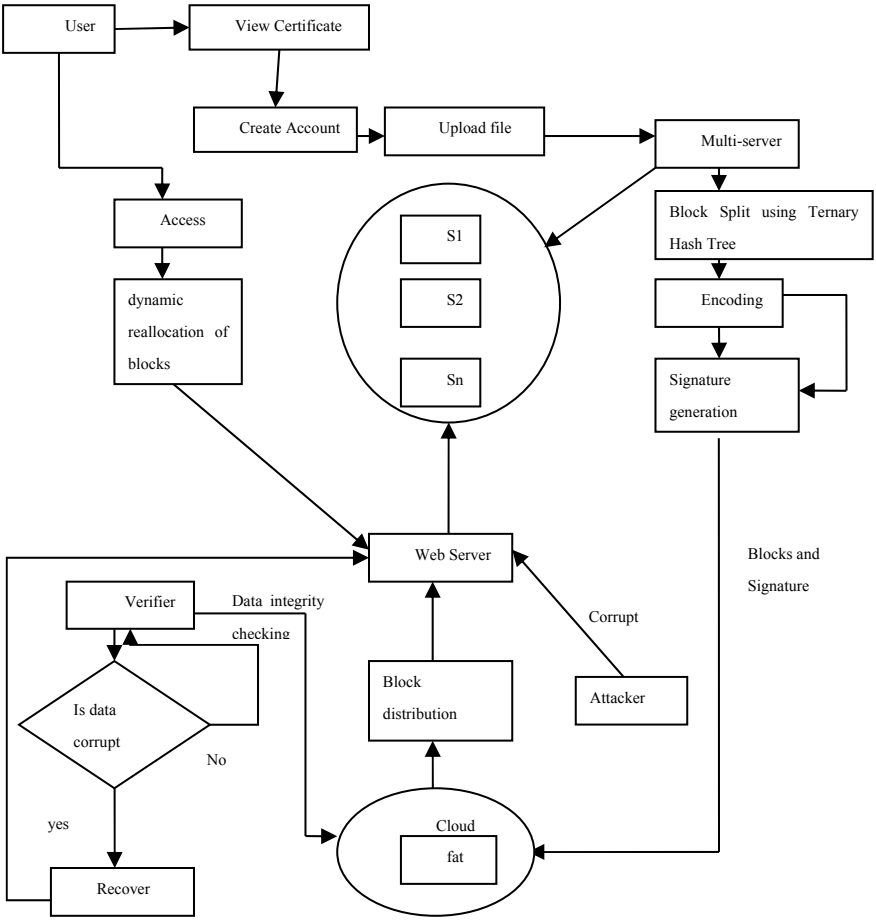

Fig. 1 Overview of the proposed system

place in question unwavering quality of gave confirmations. And furthermore cloud administration clients don't longer have their information locally, guaranteeing that their information is by and large effectively put away, and uprightness is kept up in cloud conditions which is of basic significance. Information trustworthiness might be undermined by, for instance, malignant insiders, information misfortune, specialized disappointments, and by outside assailants.

3.2 Block Split

Configuring multi-cloud server course of action setup will be done by admin. Server IP address and port number are given by the head for each cloud. By and by a server architecture is made for multi-cloud storage. In case, the overseer needs to reconfigure the old multi-cloud server course of action; it will in general be done. For old server plan, FAT report can be changed or remain same. Audit time will be set by the manager for data integrity checking process. Customer has a basic level registration process at the web end. The customers give their own one of kind information to this technique. The server along these lines stores the information in its database. After registration, customer can move reports to the server. Moved archives will be taken care of in a server. Exactly when the customer move the data to different cloud when it is splitted into different squares using dynamic square age algorithm, and each square will be attached with signatures before taking care of the data in FATFS. Imprint made using MD5 Algorithm. In like manner, the data gets encoded using for Base64 Algorithm.

3.3 Data Integrity Checking and Update

FATFS has fitting indexing and metadata's for the different chunks of the data that is being moved by user. Verifier performs remote integrity checking on cloud data. Cloud appoints self-assertive mix of the extensive number of squares to the verifier, as opposed to the whole report is recouped during trustworthiness checking. This is to shield customer security from an untouchable (Verifier). Clear data integrity checking algorithm is done in two phases: Block checking and file checking. In block checking step: Three imprints are made for block-level checking. A mark of a square recovered from a FATFS. A new mark is produced for square to be checked, and a signature is recovered from the square added with the mark which is put away in the cloud. The over three marks are cross checked for block-level integrity checking. What's more, the square substances are added to confirm with file-level integrity checking.

3.4 File Recovery and Certificate Generation

Attacker can decline data in any of the cloud servers. On Data integrity checking done by the verifier, verifier encourages corrupted squares to the cloud. Recovery process will be done by the verifier normally when data gets undermined. Customer can protesting to the cloud if the customer record get spoiled (Verifier doesn't perform watching out for this file). Whenever customer find a workable pace will be real-located logically to offer find a workable pace cloud, and FAT file system will get revived. Commentator will screen the cloud reliably, and they give the announcement subject to the cloud execution. Right when new customer partake in the cloud, they will examine the validation, and a while later they can make a record in the cloud.

4 Conclusion

The information reviewing in document level, square level, and imitation level are accomplished for confirming information respectability of the whole record. Barely any squares for visit review undertakings making it computationally proficient and copy level inspecting to guarantee information consistency over all the reproductions in the cloud separately. Further, the adulterated squares recognized during reviewing is limited and amended to suit the requirement for ongoing applications. Also, open examining jelly the protection of client information from TPA through the irregular requesting of the squares being obscure to TPA and CS. Further, information elements are performed keeping up open evidence on the equivalent with decreased multifaceted nature which was superior to the current plans.

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A Robust and Intelligent Machine Learning Algorithm for Software Testing

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Abstract In software engineering, the single point is to deliver top notch yield while enhancing the expense and the time expected to finish the application development. To accomplish this objective, software groups will play out the test on their application before live creation. For test automation documentation assumes a critical job. This paper center around mechanize experiment age dependent on accessible test assets, challenges which could be conveyed by methods for orderly practice improvement and characterizing test system for any software application. One noteworthy motivation is to ensure perceptibility among necessities and system experiments. Along these lines, the significance of experiments is dull and testing, especially under time objectives and when there are progressive changes to necessities. Right now, customized test age diminishes the cost of testing just as guarantees that experiments properly spread all necessities, a huge objective in prosperity essential systems and for the measures they need to come. This proposed application guarantees proficient test inclusion of software surrenders, where key usefulness won't be missed in the automatic test absconds expectation. Right now, experiments can be produced after application development completes a component or a lot of highlights.

Keywords Component · Automation · Deployment · Testing · Machine learning

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1 Introduction

With each new form of software, new highlights are included. As new highlights are included, the software turns out to be progressively perplexing, and when the software turns out to be increasingly unpredictable, without breaking anything. This is particularly obvious when there is strain to convey the new forms quickly and not contributing sufficient opportunity to design and to improve the nature of the code (as frequently occurs in a gravely actualized Scrum2 technique). In the end, this makes the pace of conveying new highlights decrease, which is the thing that we needed to maintain a strategic distance from in any case! A portion of this additional multifaceted nature is unavoidable [1, 2]. It would have existed regardless of whether we deliberately arranged and structured the whole software ahead [3–7]. This is called innate multifaceted nature [8]. Be that as it may, more often than not, the majority of the unpredictability in software exists since highlights was included rapidly without appropriate structure; the absence of correspondence inside the group; or because of the absence of information, either about the basic innovation or about the business needs [9]. Hypothetically, this multifaceted nature could be decreased if the software was painstakingly arranged ahead of time in general; however truly, it is a characteristic piece of each software venture [10, 11].

This sort of intricacy is frequently called coincidental unpredictability. Any unpredictability, be it innate or unintentional, accompanies an expense [12, 13]. This expense is obviously part of the general expense of building up a software, which is principally influenced by the quantity of designers and analyzers, increased when it takes for them to convey the software (duplicated by their compensations, as well, obviously) [14, 15]. As needs be, the point at which the multifaceted nature of a bit of software develops, its cost increments since it requires some investment to test everything, and furthermore, it sets aside more effort to fix (and retest) the discovered bugs [16, 17]. Coincidental multifaceted nature specifically likewise makes the software progressively delicate and harder to keep up and thusly requires considerably more opportunity to test and more opportunity to fix bugs [18].

2 Related Work

Programming testing is widely known for quality affirmation action that does functions like assessing the framework under test by observing the execution with the concern of uncovering disappointments [6]. A bigger concern is popped during the SUT. Outside, the conduct is not same as what it is expected from the SUT (as mentioned by its preliminaries or some other depiction of the usual conduct [5]). As this scenario needs the implementation of the SUT, it is mostly referred as a powerful examination [19, 20]. And also, to be mentioned, there are many quality affirmation exercises that do not require the execution of the SUT [7]. An important component of the testing is the experiment.

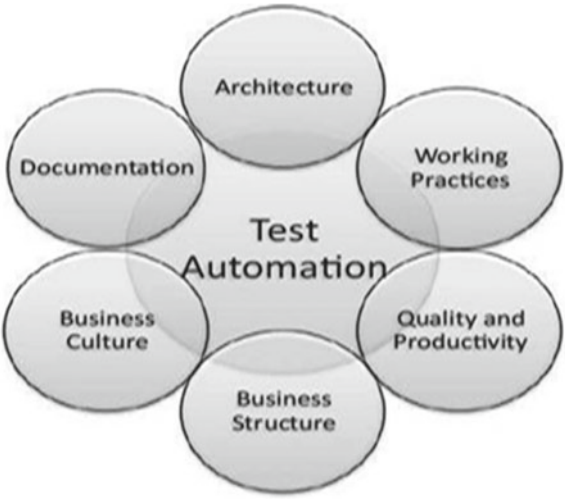

Fig. 1 Components for software testing

Usually, an experiment does the work of determining about the conditions an SUT must be done. It is for finding any occurrences of disappointment at any point. Figure 1 explains about the preliminaries required for software testing. When an experiment determines a disappointment, it is viewed as a success or mentioned to be fruitful (or powerful). An experiment signifies the information which esteems anticipated to implement the SUT.

In the proposed framework, each testing strategy has an explicit scenario to cover a specific module of the entire program, and every foundation characterizes diverse test preliminaries that ought to be achieved by a typical test suite. Preliminaries for the test can be generated from various parts of the product, for example, determination and implementation [21, 22].

As of now, SUT can be made with the goal of providing the information regarding implementation of a test suite to check how well the test suite achieves the test necessities. In the proposed framework, machine learning calculation can achieve from the accessible experiment information and expecting that the program under test didn't go as much from the rendition utilized during information assortment; it is conceived to make expectations rely on the consequences of the calculation [23]. Despite, the machine learning calculation will mostly be unable to recognize the entire experiment assessment process; it can even now distinguish some complex structures and examples [24, 25].

3 Proposed System

Imperfection evasion insinuates a system that perceives hidden drivers of deformities in a product life cycle and shields them from rehashing. It incorporates gathering

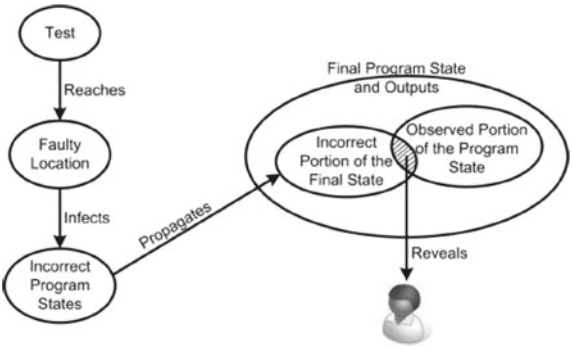

Fig. 2 Work flow of proposed system

imperfection data in a deformity storage facility, separating and recognizing the fundamental drivers of the most genuine deformities, and applying an effective way of thinking to improve the product advancement process in order to shield these deformities from rehashing.

Ilene Burstein distinguishes two orders of deformity assessment systems: Pareto outlines and Ishikawa (fishbone) chart. A Pareto layout is a visual graph speaking to the repeat of imperfection occasion. After examination of the Pareto diagram's data, it is endorsed to "center around basic few and not irrelevant many" deserts. For example, when a crucial deformity, for instance, a "dangling pointer" has been perceived in a code module, this imperfection ought to be balanced, and a method should be set up to prevent any future dangling pointers in the code. This should be possible via automatically checking with a static examination apparatus that all designers cling to the accompanying practice: "De-allocate the memory pointed by the pointer and set the pointer to invalid, when memory area is never again utilized (Fig. 2)."

3.1 JUnit Framework

JUnit contents can be run as remain solitary Java programs or inside an incorporated development condition (IDE, for example, Eclipse). JUnit can be utilized to test a whole class; some portion of an article, for example, a strategy or some associating techniques, or communication between a few items. That is, it is basically utilized for unit and combination testing, not framework testing. Test classes are composed utilizing the techniques in the JUnit.

Framework asserts class. Each test strategy checks a condition (assertion) and reports to the tests printer whether the test fizzled or succeeded. Assertions are the means by which expected outcomes, and the test prophet are encoded into JUnit tests.

The test sprinter reports the outcome to the client. In the event that in order line mode, the message is imprinted on screen. On the off chance that in an IDE, the

message is shown in a window on the showcase. All assert strategies bring void back. A couple of normal strategies are: assert true (Boolean): This is the least difficult assertion, and on a basic level, any assertion about program factors can at last be executed utilizing this assertion. Assert true (String, Boolean): This assert ion gives more data to the analyzer. On the off chance that the assertion is valid, the string is disregarded. On the off chance that the assertion isn't valid, the string is sent to the test engineer. It ought to give a succinct rundown of the disappointment. Come up short (String): This assertion puzzles numerous new test engineers, yet it is very valuable in circumstances where if a specific area of code is come to that implies the test has fizzled. As in the past, the string gives a synopsis to the test engineer.

3.2 Data Driven Test

The contrast between the way that manual analyzers handle startling conditions and the manner in which robotized tests do, vastly affects the way that computerization ought to be composed: Singular manual experiments are regularly to some degree protracted and will in general spread a total element with the entirety of its subtleties in a single experiment. It bodes well for manual experiments to confirm numerous littler things "en route" so as to spare time when executing the experiment. In the event that there is a minor bug or something changed that influenced these sideway checks, the manual analyzer can frequently skip it and proceed with the remainder of the experiment. In any case, on the off chance that you robotize such a long experiment as maybe, and it flops in one of the main confirmations; it doesn't have the intelligence to choose whether it bodes well to proceed or not. Some computerization systems permit you to report the disappointment and proceed with all things considered. Be that as it may, when a human analyzer experiences a disappointment, he for the most part chooses whether it bodes well to proceed, return a couple of steps (and precisely what number of) or totally prematurely end the test execution, in view of some comprehension of the idea of the issue. I locate that choosing at runtime exclusively upon the significance of the confirmation itself whether it bodes well to proceed or not (without intends to rehash or work around some last hardly any means) isn't entirely solid and thus has the capability [26] of harming the unwavering quality of the test computerization in general! Specifically, it is practically difficult to guarantee that the test carries on accurately in the entirety of the conceivable disappointment conditions. Different systems (counting most by far of the unit-testing structures) adopt the strategy that any startling condition that the test experiences causes the whole experiment to come up short and proceed with just to the following experiment (as opposed to the subsequent stage).

4 Results and Discussion

The result shows whether the software is defected or not.

As shown in Fig. 3. It correlates the terms that are used and present accuracy of success of software that is accuracy of defect. Bar graph represents the defects and success of software.

A graph as shown in Fig. 4 is created based on the accuracy of defects based on range in dataset that is used to train the algorithm. It also provides line range of code where more no. of defects are found.

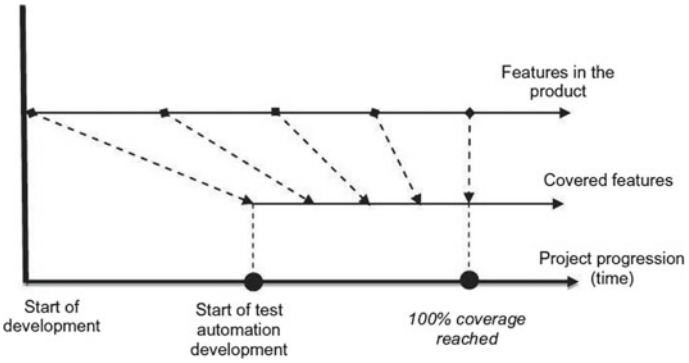

Fig. 3 Analysis of a plotted graph

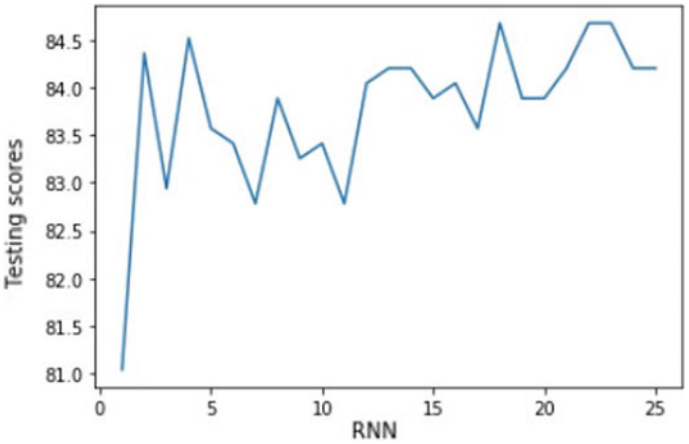

Fig. 4 Graph plotted between scores and RNN

5 Conclusion

Procedure that is leveled out, anyway doesn't meet its goal levels, would be seen as consistent yet not capable. More discussion of the system limit and trustworthy thoughts and the certainty factor. The certainty factor can be used to survey programming quality and help in choosing association decisions. In order to achieve the long stretch strength, the estimations of certainty factor (furthermore called certainty level) ought to stay inside a little range near the most noteworthy purpose of the scale. If the estimations of the certainty level are at the present time, then this suggests the code isn't being traversed incorporate increases; the tests are succeeding, and so forth. In this manner, the application can be released.

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A Novel Machine Learning-Based Ship Detection for Pre-annotated Ship Database

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Abstract Right now, present a novel machine learning-based ship detection for pre-explained transport database, which is intended for preparing and assessing transport object recognition calculations. Programmed object identification in the oceanic condition has gotten significant, with a wide cluster of utilizations in regions, for example, maritime fighting, vessel traffic administrations and fishery the board. The manual detection of items is not extremely effective due to the intense climatic conditions, for example, mist, downpour, storm and so forth. It might prompt flawed expectations and it is absolutely reliant on the ability of the individual. This adds to the usage of programmed object recognition component. The acknowledgment of inshore and toward the ocean ships is a major task for an enormous combination of employments in both military and non-military faculty fields.

Keywords False alarm suppression · Scene mask · Convolutional neural network · Ship detection · Categorization

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1 Introduction

ML is a use of man-made brain power that enables systems to take in and learn from experience naturally without overt alteration. ML revolves around the development of PC programs that can use it find themselves to find a good speed. For example, the way to learning begin with observations or knowledge, models, direct understanding, or bearing, so that we can test the knowledge structures and later choose better choices on the subject we offer. The key point is to allow the PCs to adjust the behaviors usually without human intercession or, likewise, support and change.

The recognition of inshore and seaward ships is a fundamental errand for an enormous assortment of uses in both military and non-military personnel fields. In the common sector, for example, the discovery of transport takes on a solid supervisory role in testing and supervising marine transactions, shipping, fishing waste dumping and unlawful carriage. In the military sector, by acquiring transport area, distance, route, speed and other data, one can determine if there is cross-border transport or other odd practices to guarantee coastal and ocean defence. In addition, because of the multifaceted nature of ocean condition, it is extremely trying for sea staffs to continue concentrating on the screen for quite a while. PC helped transport detection strategies incredibly free up HR and normally incorporate two stages: separating picture highlights and afterward utilizing classifiers for grouping and limitation. Zhu [1] separates ships dependent on nearby parallel examples, shape highlights and dim force highlights.

Yang [2] utilizes ocean surface element and a straight classifier to distinguish ships. Shen [3–5] initially removes transport recommendations and afterward utilizes a inclination highlight to recognize them.

These techniques can deliver stable outcomes under quiet ocean. In addition, manual determination of highlights is tedious and unequivocally reliant on the aptitude and qualities of the information itself. Along these lines, later investigations started to concentrate on the best way to coordinate more transport highlights into identification and how to distinguish sends all the more correctly and rapidly be that as it may, scarcely any investigations have tended to how to join the detection with the division errand to frame a start to finish framework, also the exploration on stifling coastal bogus alert by utilizing scene veil.

Expecting that DCNN-based semantic division is brought into the two-advance divulgence process, isolating the objective and the non-target districts adaptively, proportions of bogus alerts in the non-target zone can be decreased before the region affirmation of proposal targets. So as to cover the phony cautions in the non-target region in the near shore transport affirmation task, a novel framework, named as Scene Mask R-CNN, is proposed right now. This from start to finish structure contains four sub-systems with various cutoff points. The portion guide of the data picture is picked up by the segment extraction orchestrate first, and a brief timeframe later the scene front of target and non-target zone is ousted by the scene spread extraction sort out (SMEN). With the part blend between the yield of FEN and the surveyed scene spread, the fake alarm targets existing in non-target region are disposed of totally.

By then district recommendation orchestrate utilizes the joined fragment manual for produce the proposed skipping boxes, and these region proposals are brought into the request and backslide framework to get the last disclosure results. On a basic level, Scene Mask R-CNN is a practical reconsideration part applied for target exposure, and it gives satisfying affirmation achieves the between time reducing trick alerts in the non-target region.

To check the attainability and practicability of the system model, the Scene Mask R-CNN structure is made and its presentation is reviewed through the material assessments. Separating and the old style Faster R-CNN, our strategy appears at the accuracy of condition of workmanship standard [2], and the ocean side fake cautions are undeniably covered considering the impediment of the proposal bobbing limits the non-target zone. Along these lines, the basic duties of this paper are contracted: (1) Aiming at the camouflage of phony alert in the non-target zone, a novel system for DCNN-based vessel area task, called Scene Mask R-CNN, is proposed to overview the scene cover and see the objectives with a totally method. (2) The scene division and target affirmation are arranging synchronously, dependent upon a play out different tasks setback work. The objective distinguishing proof outcome and the division result of the eccentric scene are passed on simultaneously. (3) An edge likelihood weighted joining procedure is utilized to refresh the deduction framework [6, 7].

Significant convolutional neural framework can achieve transport revelation vital significant standards remote distinguishing pictures. The acknowledgment of inshore and toward the ocean ships is a crucial activity for the monumental organization of both military and regular resident of employment [8].

2 Related Work

This paper pervasively takes a gander at datasets and neural structures for transport disclosure; along these lines, we accumulate the related works for these two focuses. A. Stuff Detection Databases Mant data sets have made for multi-articles and express disclosure of items in the previous decade. ImageNet [9], PASCAL VOC [10] and COCO [11] are striking data sets for the clear declaration and acknowledgement of various static goals. Dismissing the way that these datasets in like way contain transport bases on the number is almost nothing and the groupings are not rich, if all else fails with just one engraving pontoon or vessel [12–14]. Caltech-USCD Birds 200 dataset [15] bundles flying creatures into 200 better requests and provides reasons for new element restriction, which makes multi-class solicitation and partial impediment possible. Introduction of these datasets along with others such as LFW [16], FDDB [17], KITTI [18], FSNS [19], LFIW fish dataset [20] and so forth can not only empower models organized on them to even more plausible outline to other test sets, yet additionally uncovers more difficulties, for example, obstructions, in this way unbelievably invigorates object revelation explores.

All things considered open datasets unequivocal for ocean transport affirmation stay inaccessible [13]. At this moment, adventure for immense vessel dataset has gotten logically genuine. B. Thing Detection Methods Consistent analysis on improving the presentation of article affirmation systems has been rotated across three regular branches in the light of massive learning point of view. Upon enhancing the convolution neural network itself, the critical other administrator attempts credit to Google's inception game plan [21, 22]. Considering the probability that logically critical structures ought to actuate higher thing recognizing evidence accuracy, two or three appraisals are made arrangements to develop the system layers. The administrator works right now VGGNet and ResNet. Moreover, Inception ResNet and ResNetXt join positive states of these two branches simultaneously, acknowledging better affirmation results. The subsequent division was focused on shifting vital learning-based exposure estimates and breaking away from faith-based acceptance figures.

District-based calculations start with the R-CNN, and a brief time span later aces has impelled a development of assortments like SPP-net Fast R-CNN, Faster, R-FCN and Mask R-CNN. This sort of figurings' tally whole is colossal paying little mind to how the conspicuous verification exactness is remarkably high. Completely article distinguishing proof estimations usually spread YOLO, SSD and YOLO v2. Clearly, they achieve the determination of place and representation by a solitary scheme.

The multiple branches both require inconceivable preparing information as help. It is commonly recognized that the nonstop accomplishment of thing pioneers is a delayed consequence of the receptiveness of more largescale preparing information. Thus, the third branch can be credited to utilizing the information itself, for example, the instructive records.

3 Existing System

PC helped transport detection techniques incredibly free up HR and commonly incorporate two stages: extricating picture highlights, and afterward utilizing classifiers for order and limitation. These strategies can deliver stable outcomes under quiet ocean conditions. Be that as it may, when unsettling influences, for example, waves, mists, downpour, haze and reflections occur, the extricated low-level highlights are not vigorous. In addition, manual choice of highlights is tedious and unequivocally reliant on the skill and attributes of the information itself.

3.1 Limitations of Existing System

A significant constraint of such methodologies is their adaptability to enormous amounts of preparing pictures. There is no right distinguishing proof of the specific ship.

4 Proposed System

A framework is proposed to computerize the identification of essence of ships in the given picture utilizing machine learning and deep learning algorithms. We are proposing alongside transport recognition, a ship grouping dependent on the sort and classification of the ships. The proposed framework would not just distinguish a transport yet additionally arrange as war transport, compartment transport and so forth.

The main layer in an exceedingly CNN is generally a convolutional layer. Absolute first thing to frame positive you remember is the thing that the contribution to the present convolutional layer is. Like we tend to referenced previously, the information might be a thirty two x thirty two x three cluster of part esteems. Presently, the best gratitude to legitimize a convolutional layer is to envision an electric light that is sparkling over the most elevated left of the picture.Suppose that during day time this electric light sparkles cover five by five space. What is more, presently, we should envision this electric light elusive over all the regions of the information picture. In AI terms, this electric light is named a channel (or by and large spoken as a vegetative cell or a piece), and furthermore, the area that it is sparkling over is named the open field.

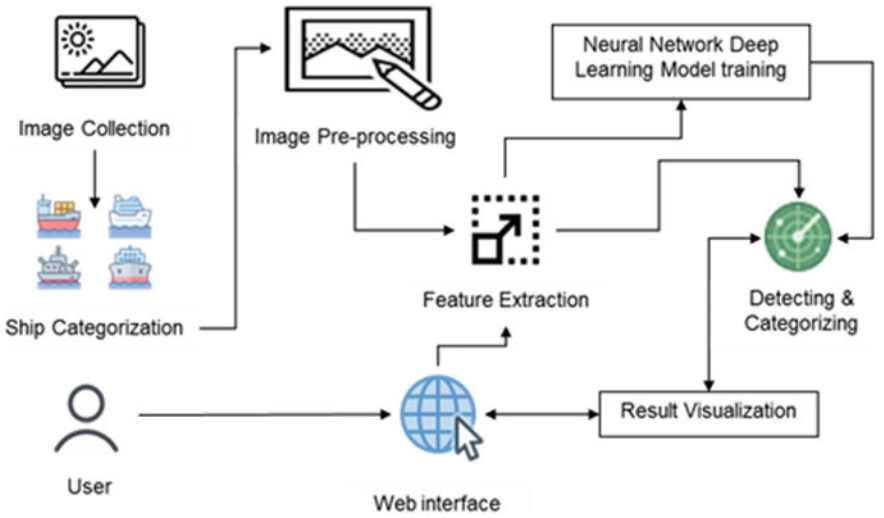

Fig. 1 Overview of the proposed system

5 System Architecture

5.1 Advantage of Proposed System

- Time interim is decreased.
- No requirement for watching the boat in human.
- Man power is decreased (Fig. 1).

6 Module Description

6.1 Data Categorizing, Collection and Pre-processing

A rough dataset was accumulated with kind of boats and pictures for every sort of boats. Since we did not have continuously number of boats pictures gathered reliant on the characterizations, we use Python to web crawl pictures from web. The web scratched pictures were taken care of in different coordinators. For this endeavor, we were using four classes. We have downloaded transport pictures for the going with classes, Accommodation, Container, War and Cruise. Python with enormous substance dealing with and frameworks organization libraries is the best gadget to limit one web scrapper.

6.2 Deep Learning Using CNN

Important learning is s subfield of AL stressed over figures convinced by the cortical structure and limit called falsified neural frameworks. Significant learning is a class of Al figurations that uses a course of different nonlinear layers of getting ready units to integrate extraction and shift. Each dynamic layer uses last-layer yields as data. We use convolutional neural network in our endeavor for getting ready and perceiving the boats in the given picture. We use multilayer neural framework and each layer yield is given as commitment to the accompanying layer.

6.3 Detecting and Categorizing Ships in Images

The CNN arranged model is used to distinguish the openness and the order of the boat in the given picture. The yield of the arrangement module is saved as a thing report using Python. Exactly when the customer inputs the photos [23] to for acknowledgment, the gauge system in the readied model is used to recognize the closeness of

the boat, and besides the class of the boat. Another image report is made with the class created over the certifiable picture.

7 Results and Discussions

Seashore ship prediction is based on many steps. They are as follows.

7.1 Scene Mask R-CNN

The purpose of our work is to obtain the scene mask of input RS image during the ship detection task, and to reduce then shore false alarms by the estimated mask, which improves the robustness of region proposals in the detection process. Therefore, the ship detection framework essentially contains two phases, the first phase is to obtain a scene mask via the scene mask extraction network (SMEN), and the second one is to detect the ships in the target area by using RPN, aided by the estimated scene mask.

- Onshore False Alarms Induced By RPN
- Feature extraction network
- Scene mask extraction network.

7.2 Prediction

See Figs. 2, 3 and 4.

8 Conclusion

As our endeavor is acquainted with finding the boat. Human clinical issue will be decreased in the boat acknowledgment strategy. By evaluating the findings, we shut down each discoverer's introduction and the difficulties of boat discovery. All kind of boat can be perceived in our boat acknowledgment technique, and therefore, it will in general be used as an enlightening assortment for transport distinguishing proof; we give preliminary results of three benchmark discoverers on the dataset. We moreover depicted the ordered structure of the dataset, including its obtainment framework, clarification methodology and the differing assortment.

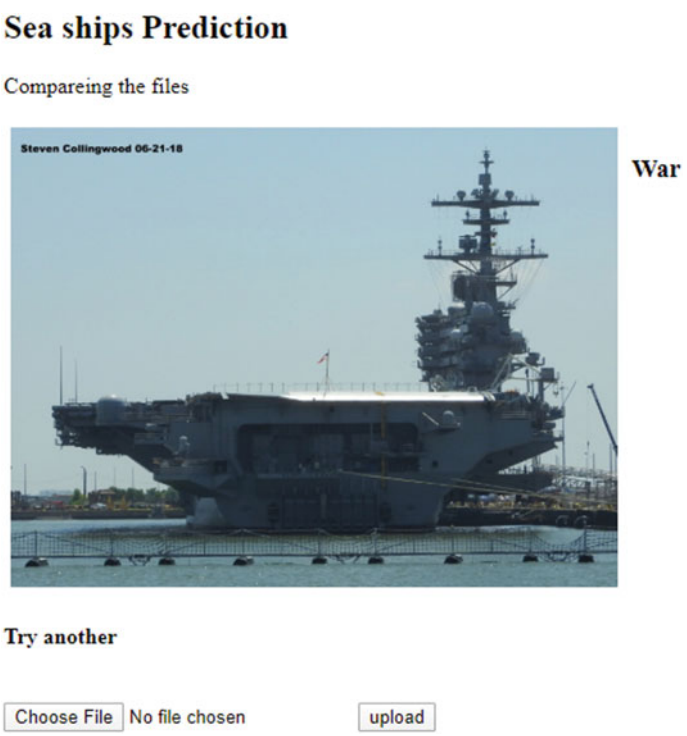

Fig. 2 Sea ship prediction

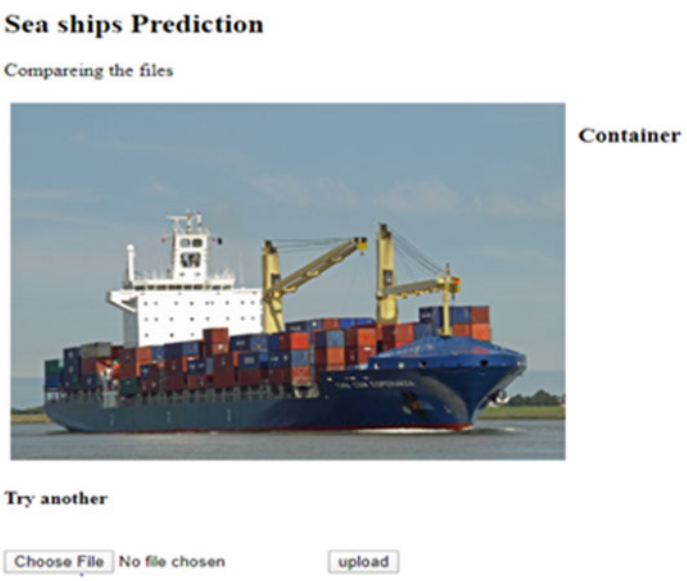

Fig. 3 Ship prediction

Fig. 4 Sea ship prediction with no result identified

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Attribute-Based Encryption in Multi-owner Setting

Betcy Thomas, Bertila Angelin, and B. Ankayarkanni

Abstract Measure structure framework attempt to apply based directory listing allows search questions and supports encoded information at a decent pace in the fine-grained cloud location. In any event, earlier CP-ABKS plans were used to support in reality, unexpressed tri-owner frameworks cannot be legally related to the tri-owner setting), in the absence of acknowledging higher computing cost and point of confinement value. What is more, because of security weights on find a workable pace, existing plans are vulnerable against isolated keyword guessing ambushes if the keyword range is of larger space. Likewise, it will be hard to see malevolent clients that releases riddle keys when many information client has a relative subset of chrematistics. At this moment, present a security saving CP-ABKS framework with camouflaged access approach in shared multi-owner setting (essential ABKS-SM structure), and show how it is improved to help hurtful client following (adjusted ABKS-SM framework). We can show that by ABKS-SM structures accomplish explicit certainty, negate isolated keyword hypothesizing snare in the standard bilinear party model. We moreover assess their introduction utilizing authentic world datasets.

Keywords Attribute-based encryption · Multi-owner · Health record

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1 Introduction

Distributed computing is generally utilized by the two people and associations (counting government an offices), for instance, to store and process huge volume of information (e.g., content and pdf) which are commonly scrambled before re-appropriating. Accessible encryption (SE) plans empower information clients to safely look and specifically recover records of enthusiasm over encoded information (re-appropriated to the cloud), as per client determined keywords. There are, be that as it may, other attractive properties when managing scrambled information out-sourced to the cloud [1, 2]. For instance, while encoding huge volume of information, traditional encryption approaches experience the ill effects of confinements due to having different duplicates of ciphertexts (e.g., out in the open key encryption plans) and mind boggling and costly key administration (e.g., in symmetric encryption plans) [3, 4].

Ciphertext policy attribute-based encryption (CP-ABE) plans [5] are intended to alleviate these two impediments, just as upgrading access authorizations in multi-client setting and encouraging one to numerous encryption. However, in standard CP-ABE plans, an entrance strategy in plaintext related with a figure content may bring about spillage of touchy data [6]. For instance, in an e-wellbeing frame work, emergency clinic An encodes a patient's electronic medicinal record (EMR) utilizing CP-ABE with an entrance approach [7] is discussed, for example, (—ID: 1788‖ AND —Hospital: Hospital A‖) OR (—Doctor: Cardiologist‖ AND —Hospital: Hospital B‖). Consequently, one can without much of a stretch gather from the client property set (—Cardiologist‖, —Hospital B‖) that patient (—ID: 1788‖) in Hospital A probable experiences a heart condition. Such protection spillage is unmistakably not fitting, especially if the ailment is increasingly delicate (e.g., explicitly transmitted ailments, for example, chlamydia, gonorrhea, and human papillomavirus contaminations). Moreover, therapeutic associations are liable to demanding administrative oversight in most created purviews [8]. Consequently, there have been endeavors to structure CP-ABE conspire with shrouded get to arrangements [9]. There have additionally been endeavors to configuration conspires that permit an information owner to appoint his/her pursuit capacity in a fine-grained way, which permits other information clients to look, recover, and decode scrambled information of intrigue. Models incorporate cipher content policy attribute-based keyword search (CP-ABKS) [10, 11].

2 Related Work

The primary symmetric SE plot and lopsided SE conspire were introduced. Consequent SE plans were intended to help a scope of highlights, for example, single keyword search multi-keyword search and positioned keyword search [12, 13]. CP-ABE was intended to permit fine-grained get to authority over figure writings, and

CP-ABKS was intended to support both fine-grained get to control and keyword search all the while. In any case, the computational expenses of these two plans develop straightly as the quantity of framework characteristics increments. This is not adaptable by and by Ramya et al. [14]. To limit computational expenses and figure content size required in such plans, a keyword search work in attribute-based encryption (ABE) conspire, by re-appropriating key-giving and decoding tasks, was executed [15, 16].

One genuine restriction of CP-ABE plans is that the entrance arrangement implanted in the figure writings may release delicate data to approved information clients, as talked about in the first segment [17, 18]. Likewise, a shrouded access arrangement plot, which supports AND-entryway with trump card by using inward item encryption, was introduced [19]. These earlier CP-ABE plans with mostly concealed access strategy have high computational expenses and do not bolster keyword search over encoded information [20, 21]. To oppose disconnected keyword speculating assaults, a proficient multi-keyword search plot with fine-grained get to control was developed [5, 7]. Should these plans be conveyed in a mutual multi-owner setting, they will require a similar irregular parameter for every individual information owner, which plainly is unfeasible by and by especially as the quantity of information owners increments [22].

Plans are defenseless against disconnected keyword speculating assaults if the keyword range is of larger size [23]. Besides, it is hard to recognize malevolent clients that release the secret key when there are many information client has a similar subset of traits CP-ABKS plans, it examine a common multiple owner where every record is co-possessed by a gathering of information [24, 25]. In earlier plans, the vulnerabilities of keyword speculating assault originate from that the trapdoors are generally produced by joining questioned keywords and DUs' mystery keys [26].

3 Proposed System

ABKS-SM frameworks accomplish particular security and oppose disconnected keyword speculating assault in the nonexclusive bilinear gathering model. We likewise assess their exhibition utilizing genuine world dataset. Initially, the solid development of the essential attribute-based keyword system in shared multiple owner setting framework is established, which helps finely with the grained keyword to search and shrouded. At that point, we clarify how the fundamental ABKS-SM framework is reached out to accomplish malignant client following in the altered ABKS-SM framework. Arrangement conspire helps AND entramsyway by a trump card using internal concealing the items. The modules are described as follows.

3.1 User Interface Design

The main task of our module is this. The significant job for the client is to move login window to client window. The particular module has been designed for the certainty cause. Firstly, we would have to login in with client's id and the password. It will cross examine the client's id and the password to find if the user is authorized. In case we enter any poorid or the password one cannot login window, an error will be displayed on the console. So that an unauthorized user cannot go to authorized person's account and modify the data pretending to be the one. This will provide a better certainty to the process. The server has all the authorized id and the password; it also looks up for the valid id's. This will improve the certainty and giving access to the unauthorized user to an authorized user account.

3.2 Hospitals Fill the Patient Details

Individual subtleties structure for the patient is given to the patient to fill when he wants the main meeting with the specialist. The motivation behind utilizing this structure is to gather all the data about the patient. Some restorative subtleties are likewise gotten from the patient which can be useful to the specialist for treatment. The patient individual subtleties structure contains the point by point data about the individual wellbeing history of the patient, individual contact subtleties. Other pertinent subtleties, for example, side effects of the medicinal issue of the patient [16] are additionally remembered for the structure.

3.3 Doctor Suggested Patient to Take Rest

Why some medicinal tests the specialist orders are important to help. Specialist checking proposed most of the therapeutic tests your primary care physician orders for you are a piece of the determination of your restorative issue, and they help decide your treatment. Utilize these inquiries regarding tests, determinations, solutions, and reactions. Before having a medicinal test, ask your primary care physician to clarify for what valid reason it is significant, what it will appear, and what it will test report.

3.4 Laboratory Generated Report

Results for all clinical laboratory tests (non-anatomical pathology/cytology) requested legitimately in mediates are accessible upon confirmation by laboratory

staff. Results may be accessible to the requesting doctor just as some other human services suppliers recorded on the patient report.

3.5 Doctor Provides the Solution

Wellbeing solutions utilize well-talented restorative experts that can analyze and treat physical indications you might be encountering. Our suppliers offer cautious physical assessments and completely talk about your restorative history to guarantee legitimate advances are taken to boost a full recuperation. Testing, x-beams, blood, etc. work and other therapeutic assessment devices might be utilized effectively to recognize the wellspring of the anxiety. When an analysis is resolved, we will counsel with you to offer you a well-considered treatment plan that gives you the best open door for mending achievement and recuperation. Physician recommended medication.

3.6 Patient Request the Report from Laboratory

Patients, similar to you, read wellbeing data missing patient strengthening; however, it additionally builds understanding solicitations for superfluous tests. Numerous patients demand explicit indicative tests and feel stressed over their own wellbeing on the off chance that they do not have the consolation of the test outcome. You may feel that you have paid for the privilege to get any test you demand, While a few specialists may set aside the effort to clarify why you might possibly require pointless tests, specialists' interests about being sued or inciting a negative web-based rating influence most to arrange the test (regardless of whether it is superfluous) to fulfill the patient.

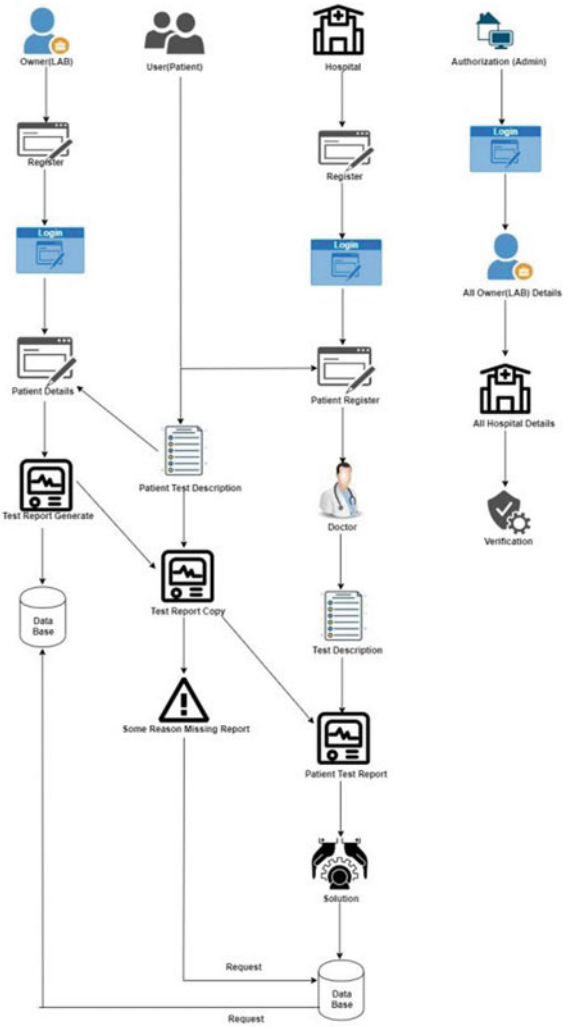
3.7 Doctor Gives Confirmation

A specialist reviewing clinical information tells a person that a register of practitioners has now been reserved on behalf of some other doctor or health or health information kept in the server.

4 System Architecture

Framework setup in Fig. 1 is the applied model that depicts the structure, lead and more perspectives on a framework.

Fig. 1 System architecture



A structure outline is a proper delineation and portrayal of a framework, shaped with the ultimate objective that supports considering the structures and practices of the structure. Framework planning can include structure parts and the sub-structures created that will take an interest to execute the general framework. There have been endeavor to formalize dialects to portray structure plan; everything considered these are called fabricating outline tongues. The admin verifies and clicks on the activate button if the hospital is genuine as shown in Fig. 2.

The efficiencies of the key generation and encryption algorithms are both fairly straightforward. The encryption algorithm would require two exponentiations for every leaf within the ciphertext's access tree. The ciphertext size will include two

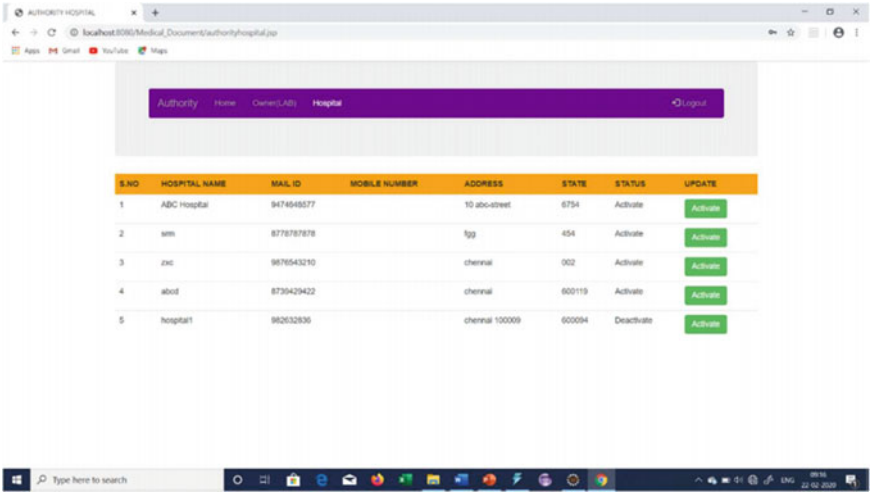


Fig. 2 Authority activation

group elements for every tree leaf. The key generation algorithm requires two exponentiations for each attribute given to the user, and therefore, the private key consists of two group elements for each attribute. In its simplest form, the decryption algorithm could require two pairings for every leaf of the access tree that's matched by a personal key attribute and (atmost 2) one exponentiation for each node along a path from such a leaf to the basis. However, there could be several ways to satisfy a policy, so a more intelligent algorithm might attempt to optimize along these lines.

5 Conclusion

We introduced a down to earth quality-based keyword search plot supporting concealed access arrangement in mutual multiple owner. Besides, this shows the essential attribute-based keyword system in shared multiple owner setting framework could be stretched out to help detectability in the changed framework, whenever wanted. The conventional certainty investigation demonstrated the fundamental and changed frameworks accomplish specific certainty and oppose disconnected keyword speculating assault in nonexclusive linear gathering model. Likewise exhibited the use of the suggested attribute-based keyword system in shared multiple owner setting frameworks by assessing the presentation utilizing three genuine terms datasets and with a proving ground which adds eleven portable ends and a superior server. Only confinement of the suggested attribute-based keyword system in shared multiple owner setting frameworks is the quantity of framework properties increments, so does the computation cost and capacity value. Along these lines, we mean to improve

proficiency of the attribute-based keyword system in shared multiple owner frameworks later on. Additionally, to encourage the effective situating of indexed lists and limiting the quantity of insignificant list items, we will work more on eloquent request in the subsequent work.

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Parkinson's Disease Detection Using Machine Learning Techniques

P. Anudeep, P. Mourya, and T. Anandhi

Abstract Parkinson disease (PD) is a progressive neuro degenerative disorder that impacts more than 6 Mio. People around the world. Nonetheless, non-specialist physicians still do not have a definitive test for PD, similarly in the early stage of the diseased person where the signs may be intermittent and badly characterized. It resulted in a high rate of misdiagnosis (up to 25% among non-specialists) and many years before treatment, patients can have the disorder. A more accurate, unbiased means of early detection is required, preferably one that individuals can use in their home setting. The proposed system for predictive analytics is a mixture of clustering of K-means and a decision tree used to gain insights from patients. The problem can be addressed with reduced error rate with the application of machine learning techniques. Our proposed system also produces accurate results by combining the spiral drawing inputs of patients impacted by common and Parkinson's. From these drawings, the principal component analysis algorithm (PCA) for extraction of the feature from the spiral drawings and support vector machine is used for classification. UCI machine learning platform voice data collection in Parkinson's disease is used as feedback. Thus, our study results will show early detection of the disorder can promote the therapeutic care of the elderly and increase the chances of their life span and healthier lifestyle living peaceful life.

Keywords Parkinson's disease · PCA · K-means clustering · Decision tree · Machine learning · Data mining

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1 Introduction

Parkinson's disease is a disorderliness in motion. This effect the nervous organization, and with time, signs become worse. Cerebral palsy, ataxia, and Tourette syndrome are other movement's conditions [1]. We come about when a disturbance in the nervous system influences the capacity of a person to shift or remain still [2, 3]. The National Institutes of Health (NIH) reports that about 60,000 people are identified with Parkinson's disease every year in the United States of America, and about half of the million people are living with the condition [4, 5]. Some signs grow with time, and certain patients may have dementia. Most of the symptoms arise from a reduction of brain dopamine levels [6, 7]. One study, located in France, showed in 2018 that men are 50% more prone to have Parkinson's disease than women in general, but women's risk tends to increase. Symptoms appear in most adults at or above age 60 [8, 9]. They occur sooner in 5–10% of instances, though [10, 11]. If Parkinson's disease progresses before age 50, this is considered Parkinson's disease with "early onset."

The paper is proceeded as follow, Sect. 2 describes the related works; Sect. 3 presents the proposed system; Sect. 4 covers the experimentation results and analysis; Sect. 5 expresses the conclusion [12, 13].

2 Related Work

- Aaswad Sawant et al. [14] studied on the various cancer detection strategies. The device can be used by surgeons and radiologists as a second decision for fast and effective identification of brain tumors.
- Gamal Saad Mohamed et al. [15] presented four forms of classification focused on Naive Bayes, SVM, MLP neural network, and decision trees are used in this paper to identify the PD dataset, and the output of these classification is analyzed when applied on the real PD dataset, distinct PD dataset, and chosen collection of PD dataset attributes. The data set used in this study includes a variety of speech signals from 32 people: 25 with PD and 9 healthy individuals.
- Enes Celik et al. [16, 17], in this analysis, to model Parkinson's disease, similar classification methodologies including logistic regressions, support vector machines, random trees, gradient boostings, and random forest are related. A total of 1200 speech data sets were used in the classification stage, comprising of 26 characteristics gathered from Parkinson's diseased patients and non-patients. Thanks to correlation maps, the features space of the dataset is extended. Such correlation of maps are developed with the features that are collected using the principal component analysis (PCA), information gain (IG), and all features, respectively [18, 19].

Monica Giuliano et al. [20, 21] proposed demographic details, and vocal phonation records/a/ from the accessible mPower database were examined in this study in order

to classify patients with PD. Then, a parsimonious model was identified that achieved a reduction from 62 to 5 characteristics of the phonation, which were considered in addition to sex and age. Neural networks multilayer perceptron (MLP) and logistic regression (LR) were used to achieve a model with strong predictive potential (area below the Receiver operating characteristic's curve, AUC-ROC, over 0.82) [22, 23]. This research leads to the tracking of patients with EP by capturing a few phoning information obtained through a mobile phone [24, 25].

3 Proposed System

We suggest a model and accurate results analyzing data from patients with both speech and spiral painting. Thus, the doctor will infer normality or deviation by comparing both the findings and recommending the drug dependent on the stage affected.

3.1 Voice Data Processing

UCI platform opens the audio file. We used RStudio for analysis of the data. The conceptual architecture for predictive analytics is a variation of the K-means clustering and the decision tree classification method that is used to obtain patient insights. The problem can be solved with reduced error rate by using the machine learning algorithms. The speech dataset of Parkinson's disorder from the UCI machine learning library is used as feedback. While our experimental results show early disease, diagnosis can promote therapeutic care of the elderly and increase the chances of their life span and better lifestyle contributing to peaceful life.

3.2 Spiral Drawing Analysis

We used PyCharm-based python language for data analyzes to process the spiral images. Our proposed system provides reliable results by combining spiral extracting feedback from the patients impacted by usual and Parkinson. From these drawings, the principal component analysis algorithm (PCA) for extraction of the function from the spiral drawings. From the sketches of the spiral: X; Y; Z; Pressure; GripAngle; Timestamp; values of the reference ID are removed. Using machine learning technique (Support vector machine), the extracted values are compared to the trained database and results are obtained (Fig. 1).

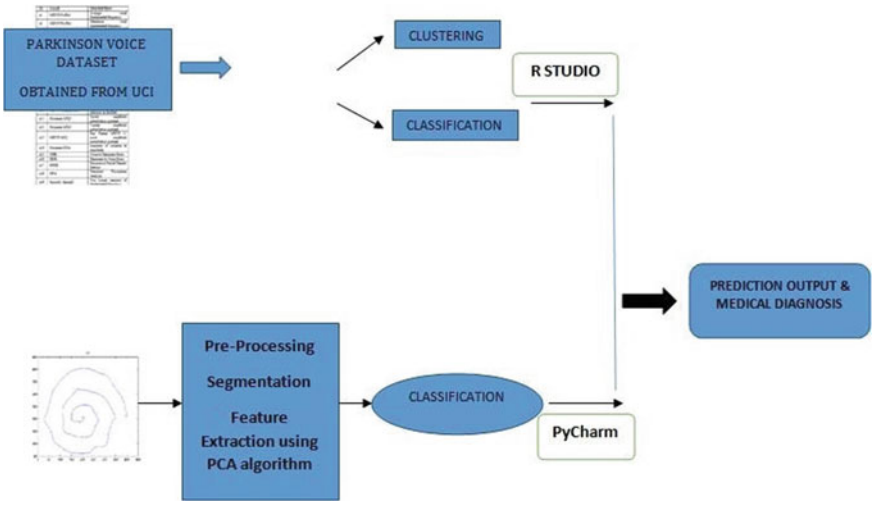

Fig. 1 Overall proposed

3.2.1 Parkinson's Disease Voice Dataset Analysis

1. ***Importing data into RStudio***

Step 1: Input and arrange the data in Excel.
Arrange the data in an Excel worksheet, so that the first row (Row 1) includes the column names and each following row contains all the information necessary for each data point in the experiment (i.e., Rates of description and measurements).

Step 2: Save your worksheet as a comma-separated file type (.csv).
Save your Excel spreadsheet as usual (default form of file: Excel Workbook); this will be your master file you can always revert to change stuff, add new details, etc. Then, press "Save As…" to create a version of your data to enter in R. A window should open where you can define the filename you want, as well as the sort of file you want.

Step 3: Import data to RStudio.

2. ***K-Means Clustering***

K-means clustering is an unsupervised machine learning algorithm that attempts to clustering data based on similarity between them. Unsupervised machine learning means that no outcomes can be predicted, and the algorithm is simply trying to find patterns in the data. In k-means clustering, the number of clusters we want to divide the data is defined. The algorithm allocates each discovery randomly to a cluster, and determines the centroid of each cluster. The algorithm then iterates through two steps:

- Reassigns data point to the cluster which is closest to the centroid.
- Calculate each cluster with centroid.

Such two measures are replicated until no further reduction of the variability within the cluster is feasible. The variance within the cluster is measured as a percentage of the Euclidean interval between the data points and the centroids concerned.

3.3 Decision Tree

A decision tree is also considered as prediction tree. A decision tree provides a framework to define judgment and result sequences. The aim is to predict an answer or output variable Y, provided the input $X = \{X1, X2, \ldots, Xn\}$. An input variable is named for every $\{X1, X2, \ldots, Xn\}$ part of the group. Creating a decision tree with test points and divisions will accomplish the predictions. At each check point, a decision may be taken to pick a single branch and navigate the decision trees in a number of disciplines, such as: on the basis of individual attributes determining whether or not to give a loan to an individual, predicting the rate of return to various investing strategies, predicting whether or not to deliver a direct mail to a prospective client, etc.

A decision tree consists of node, and thus, contains a rooted tree, which implies it is a guided tree with a core node. Root nodes does not have incoming edges, with all other nodes in a decision tree have exactly one incoming edges. An internal node is the node with an incoming edge and outgoing sides. Also known as the check node is an internal node. Nodes with no outgoing edges are classified as terminal nodes or leaves.

3.3.1 Parkinson's Disease Spiral Drawing Analysis

1. ***Preprocessing***

   (a) Image Acquisition
   Image acquisition is the principal phase of image processing. When opposed to HD images, the videos are obtained with minimal noise. Each package has the key advantages of having images of better clarity, low noise, and distortion.

   (b) Image Preprocessing
   Image pre-processing is one of the image processing types, an attempt to make identification more evident. Pre-processing of photographs is a way to improve image quality, so that the resulting image becomes better than original. The median filter is a non-linear method, whereas linear is the typical filter. Mean filtering is a fast, intuitive, and quick to apply smoothing images, that is to say reducing the amount of difference in strength between one pixel and the next.

The median filter is usually used in a picture to reduce the salt-and-pepper noise. It also does a better job of maintaining valuable information in the picture than the mean filter. The median is determined by first sorting all the pixel values in numerical order from the surrounding neighborhood, and then, replacing the pixel considered with the center pixel. If there are even numbers of pixels in the area under scrutiny, the sum of the two center pixel values is used. For the reduction of noise, both mean and median filters are used. This pre-processing image is used as the input for image segmentation.

(c) Image Segmentation

The segmentation of images is an important method for most subsequent tasks of image analysis. Segmentation divide an image into its region or artifacts which make up it. The aim of segmentation is to render the portrayal of an image clearer or more readily analyzable in something that is more relevant.

2. ***Prediction***

So, our hybrid model, combining image processing (spiral drawing analysis) utilizing image processing methodology and data analytics (values derived from speech dataset and spiral drawings) using R technology. Data analytics have a larger role to play in healthcare sectors, as these data are diverse and complex in nature, and the Parkinson disease dataset is large in scale, and new opportunities and demands are found, greater complexity is revealed, predictive capacity is improved, and time is productive to adapt to cost-effective measures.

More specifically, that integration helps healthcare organizations to quickly and efficiently evaluate their large data sets. Early detection of any type of disease is an important factor and this results in advance treatment of patients. This system detects the highest classifier precision, and multi-classifier consensus tests are taken to identify the disease sooner and increase PD people's lifespan.

4 Experimental Results

- In our work, we used UCI machine learning repository. The experiments are performed on R studio. The studio consists of enormous quantities of multidimensional details, that are gathered up within different areas including advertising, geo-spatial, and bio-medical areas. And with the help of python, I am generating a pressure graph for both the diseased and un-diseased. With these graphical representation of the data, we can get an idea of how differently both the diseased and non-diseased persons are identified and can be used for easily identification of the person those are effected (Fig. 2).

When this image is passed, the pre-processing takes place here all the features are extracted for further segmentation (Fig. 3).

The features are then trained with a decision tree classifier which is widely used for all classification and regression techniques. Then, as the next step, the RGB

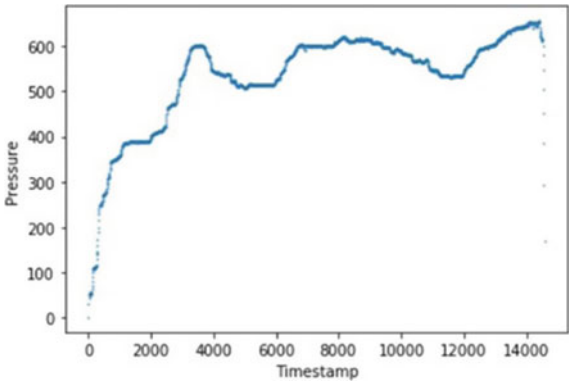

Fig. 2 The pressure graph for diseased person

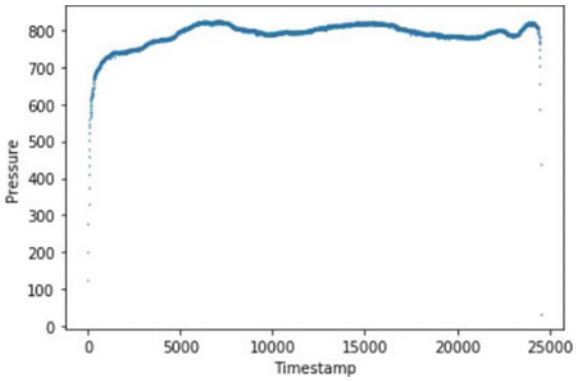

Fig. 3 The pressure graph for un-diseased person

components are extracted from the image and the analysis is done on the number of clusters obtained. Some images are kept for testing and training. The classifier learns [11] the features and successfully classifies when any new image is given to it. It identifies where the image is benign or malignant (Fig. 4).

- Figure 2 shows the efficiency of the proposed model. The accuracy of the classifier is observed with 86.66% whereas 99.9% specificity and 80.48% sensitivity. The segmentation of the prohibited item is extracted from the exact image which gives us various parameters for measuring such as its intensity, volume, and size. This helps in diagnosing and treating the disease more efficiently. In Fig. 3, the transmission speed of the system is depicted (Figs. 5 and 6).

Logistic regression is the technique that also used in the prediction of the diseased persons value as the reference and predict the approximate value for the diseased person (Fig. 7).

```
> summary(predict_seen)
 0  1
 9 21
> table_pred <- table(test_tree$status, predict_seen)
> table_pred
   predict_seen
     0  1
  0  7  2
  1  2 19
> accuracy_Test <- sum(diag(table_pred)) / sum(table_pred)
> print(accuracy_Test)
[1] 0.8666667
```

Fig. 4 Accuracy output

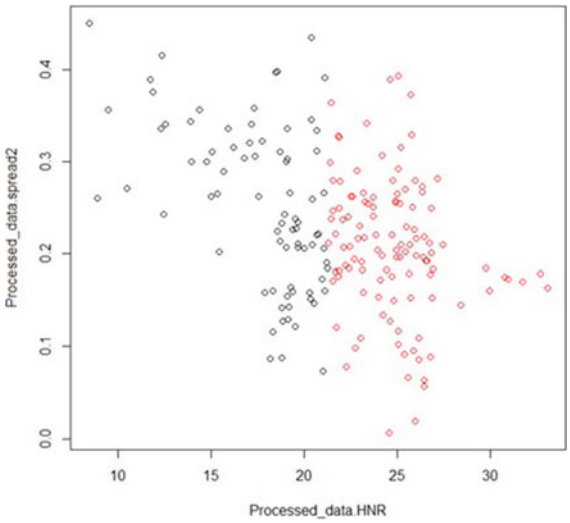

Fig. 5 Scatter plot matrix of Parkinsons's data

Logistic Regression

```
In [37]: clf=LogisticRegression()
clf.fit(train_x, train_y)
preds=clf.predict(test_x)
print('accuracy:',accuracy(test_y.tolist(), preds.tolist()), '%')
print(metrics(test_y.tolist(), preds.tolist()))

accuracy: 70.0 %
{'Precision': 0.5, 'Recall': 0.625, 'F1': 0.5555555555555556}

C:\anaconda\data\lib\site-packages\sklearn\linear_model\logistic.py:432: FutureWarning: Default solver will be changed to 'lbfg
s' in 0.22. Specify a solver to silence this warning.
  FutureWarning)
```

Fig. 6 Accuracy of logistic regression

Fig. 7 Accuracy of support vector machine

Fig. 8 Accuracy of decision tree

Support vector machines are also helpful in predicting because in these algorithm we generally identify the nearest points of the trained data and based on that we test the data (Fig. 8).

A decision tree is a tree like structure in which one node be the test data and other node will be trained data, and based on the nodes data, we will predict the outcomes (Fig. 9).

K-nearest neighbors, decision tree, SVM, k-means clustering we are going to get the accuracy of different algorithms and will help of all this algorithm we can identify the diseased person with some more accuracy and help the patient to move to the next process.

Fig. 9 K-nearest neighbor

5 Conclusion

Past analysis papers provide a comprehension survey for specific modalities in neuro imagination and related analytical techniques proposed for treatment of Parkinson's disease in recent years. Past research articles focused solely on a specific imaging modularity such as MRI or PET, or only on a particular type of dementia such as AD. This study sought to cover the wider range of imaging and machine learning algorithms for diagnosing of mental illness so that field researchers could readily identify the state of the arts in the area. We also emphasize the importance of early detection and prediction of Parkinson's disease, so that patients can be given treatment and support as soon as possible.

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My Device—Fog: Integrative Mapping, Tracking, and Identification of Device Id, Location, and User Info

Yashwanth Mandanapu, Mohan Krishna, Upputuri Tejo Gopinath, and D. Usha Nandini

Abstract In the current framework, the appropriated, dynamic attributes, and the cooperation prerequisite make it face numerous new security and protection give that can't be unraveled by the conventional open key or symmetric cryptosystem. The objective of the paper is to build a numerical model of fog registering and survey its relevance with regards to IoT, where it is significant to fulfill the needs of the idleness touchy applications running on the system board. The work further plays out a near presentation assessment of distributed computing with that of fog figuring for a situation with a high number of Internet-associated gadgets requesting ongoing administrations. In the proposed framework, the mist processing worldview to serve the requests of the inertness touchy applications with regards to IoT. By moving a data sensor, the IoT relies on a distributed calculation. This is a decentralized condition method to collect data from any place in the city. The system will test the vitality of every server and its region. Since at whatever point server transfers the subtleties of the sensor which will eventually weaken its vitality. We therefore need to transfer the information by allocating another server with the vitality to submit the information.

Keywords Access control · Authentication · Digital manufacturing · Fog computing

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1 Introduction

Internet of Things (IoT) is the system with physical gadgets, for example, advanced mobile phones, vehicles, wearable, and different things inserted with hardware, programming, and system network which empower gadgets to build up association among one another and trade information. IoT permits gadgets to be identified and sorted out remotely via the IoT organize [1], empowering direct power over the associated gadgets. Controlling various types of gadgets remotely, for example, social insurance-related gadgets is an amazing element of IoT; in this way, it is lead to progress in the effectiveness and dependability of such gadgets, notwithstanding the huge decrease of human connections and impedance with those gadgets [2, 3]. In the IoT region, the idea of Things alludes anything that can interact with the IoT system and be ready to exchange information about this system; hence, this could highlight an assorted variety of gadgets, vehicles, shrewd home apparatuses, installed frameworks, e.g., ATMs, etc. Cisco IBSG estimates that by 2020, there will be approximately 50 billion associated devices (that is, Things) [4, 5]. This huge number of associated Things will give a gigantic measure of information consistently; accordingly, information and communication technology (ICT) must empower its foundation to give fitting techniques to serve this information [6]. In this manner, giving secure change channels, quick preparing, and legitimate utilization of information. The ICT-based business models that associations receive are changing centralization to decentralization and the other way around [7]. The most recent turning toward centralization, it acquires the cloud register by making the planning, the phase, and foundation accessible to associations as administrations or utility as an end result of an expense. Be that as it may, the cloud may not be a doable answer for IoT information because of a few factors, for example, high inertness [8], organize data transmission, unwavering quality, and security [8, 9]. Another increase in fog call processing is creating ICT and becoming future models while leveraging research and development (R&D) people group. Mist is portrayed as an exceptionally virtualized stage that gives application administrations and arranges benefits between things hubs and server farms [10]. Fog registering is like cloud figuring; it offers a scope of use administrations, for example, information preparing and capacity to end clients. In any case, fog hubs are required to convey these administrations dependably, quicker, and in more secure design than Clouds [8, 11]. Notwithstanding administrations that would be hard for clouds all alone to give [12].

2 Related Work

The R and D people group found that the work of the fog centers at the edge of the system can provide low latency, care of the area, where QoS is improved [13, 14]. Be that as it may, there is the absence of solid arrangements supporting this processing

worldview. Even though fog processing is still in its theoretical phase, there are some related investigations, which must be respected. Bonomi et al. [11], one of the lead specialists right now, characterize the attributes of mist and contend that haze is a suitable stage for different applications, for example, associated vehicles (i.e., V2V) and brilliant urban areas [15, 16]. Along these lines, they present the potential advantages of haze as far as proficiency, unwavering quality, and diminished inactivity. Nonetheless, they didn't explore how haze can adjust with the various remaining task at hand (e.g., high information traffic) or what is the arrangement of the fog system. Beate et al. [17] propose an agreement and a movement strategy for foundation suppliers who join cloud and fog resources. Guarantees application is characterized, start to finish inactivity limitations and diminishes the system used by preparing of time. Be that as it may, the exhibited work doesn't improve the remaining task at hand versatility since the mist is likewise ready to perform computationally serious assignments. Hong et al. displayed a versatile mist in [18].

This versatile mist is an elevated level programming model geospatially dispersed, huge scope, and dormancy touchy speaking to future Web applications utilizing portable as haze. Versatile mist comprises a large number of handlers and occasional features that an application can call (e.g., in the call detection work while examining the new sensor). The versatile fog model is static; in this manner doesn't, however, present a non-exclusive model which is a model for a specific application while forgetting about capacities that manage specialized difficulties of preparing natives. I think utilizing versatile as the essential mist isn't a perfect arrangement, because of the untrustworthiness of portable accessibility (e.g., versatile sign dead), and the portable will be a force devouring. Bittencourt et al. [19] proposed an asset movement design, by concentrating on the transfer of virtual machines (VMs) between fog centers. The objective is to give the administration parts to the engage activity of fog. It mainly serves to make the VM accessible when the client moves to take care of the QoS. They accept that the VM contains customer information and application components. The movement is done such that clients don't see any debasement in their application's exhibition. Be that as it may, there is no support on how the fog can embrace with a few movements toward the same center of fog, which can cause a large load, where the benefits of fog are reduced.

Agarwal et al. [20] center around asset designation. The creators proposed a design comprising three layered; those are customers, mist, and cloud layers. Additionally, they execute a calculation that conveys the remaining task at hand among layers of clouds and fog. Responsible for the proposed form to check if there are enough computational calculations assets which are accessible on the mist hub. Given this, it either executes every single allocated task or executes barely any undertakings, while defers the performing others or even sending part of the activities to the cloud level. The impediment of this job is to make a presumption that each haze and cloud hubs will have a trough to deal with the coordinated effort and execution of the hub; along these lines, this methodology isn't all around talked about to demonstrate the correct execution of dispersed errands.

Kapsalis et al. [21], right now, engineering proposed for haze layer that is liable for designating and dealing with the undertakings and assets over member hubs. It uses a disseminated specialized technique dependent on production/membership design across framework layers. The proposed design has four strata IoT things, door, haze, and cloud. The passages don't play out any calculation; the main job is to change over the correspondence convention (e.g., Wi-Fi, Bluetooth, etc.) between things and a layer of fog. Even though creators take in thought heterogeneity of gadgets, the portability factor of IoT things likes well as the mist hubs aren't mulled over. Abedin et al. [22] proposed a calculation that helps asset share among the dangers. In their fog layer, they feature a utility measure for fog centers that counts the benefits of correspondence if they share their assets. Following this measurement, they initially decide a sorted out rundown of inclination blending mist hubs for every hub. At that point, every hub in the haze later will put a solicitation of blending to its favored matching hubs. On the gathering side, contingent upon the inclination and advantages of the recently gotten demands, an objective hub concludes either to acknowledge or dismiss the solicitation. The constraint of this work is that the center parameters whereupon mist hub takes choices are the cost of correspondence between centers that can be influenced by the time and area of the mix. Additionally, they don't take the QoS (such inertness, transfer speed, and so on.) in thought as a feature of the asset sharing choices.

Gao et al. [23] propose a cross-breed information spread system that applies programming characterized arrange and delay tolerable system (DTN) approaches the calculation of the fog. They try to avoid the haze cloud approach by presenting the idea that two different planes were clouds which is a control plane to process content, update inquiries, and arrange information streams, and the geometrically circulated mist servers from an information plane to spread information between fog servers with a DTN strategy. This mixture model incorporates the ordinary information spread, however, between cloud servers and haze servers; it incorporates many other structures that support delay information dispersals between cloud servers, versatile clients, and haze servers. To have the option to arrange information dispersals, the capacity of the cloud servers is changed in a control plan. This involves cloud servers decide the mist server that should have been refreshed with the necessary substance and control information scattering process. The fog servers and part of the cloud servers are treated as information points to offer assistance. The outcomes got shows that the use of this cross-pattern cannot be to press information when a large portion of a day of postponing is moderate; this half breed information spread is the best decision regarding financially and unwavering quality.

3 Existing System

The appropriated, dynamic attributes, and the cooperation necessity make it face numerous new security, and protection gives that can't be illuminated by the conventional open key or symmetric cryptosystem. Various divisions or partners and have

no earlier information about one another; a trust relationship ought to be set up before they team up to recognize malignant hubs. The trust is typically settled by validation, while conventional confirmation instruments can't address the verification between unusual elements.

Smart actuators must guarantee that the got guidelines do originate from genuine hubs with required qualities and keep new and respectability. What's more, the current verification component can't meet these security prerequisites well.

IoT gadgets need to dismiss the unapproved access to its information for keeping away from information spillage, and fog hubs need to decline the unapproved access to its administration for sparing assets. The two circumstances require a dispersed access control system as opposed to the current unified access control instrument.

Fog hubs are near IoT gadgets and can gather delicate information, for example, the client's personality, area, and so on. Since this information is straightforwardly connected with the clients in the neighborhood setting, the current protection safeguarding systems can't function admirably.

4 Proposed System

The fog calculation model to meet the needs of in latency-sensitive IoT applications. IoT relies on cloud computing when it passes information about sensors. This is a method of decentralization of collecting knowledge from every area of town. The program will check per server's power and position. Any each time the server loads the information of the sensor, it will degrade it's power each time. And we have to transfer the data by assigning another server with the energy to send the data (Fig. 1).

Advantages

Implement the server in a distributed way

- Collecting sensor values and update on the server
- Security for the data that we upload on cloud
- Migrate the job when any server loss their capacity.

5 Methodology

5.1 User Interface Design

In this way, user information is thus transmitted to the local server as all the sensor data. For each zone and each region, we introduce a local server from which the sensor information comes, such as temperature, atmospheric humidity, RFID-based sensor values, and also resources we have. The values of sensor stored on the local server. The local server is installed in the field. Your job is to collect all of the sensor

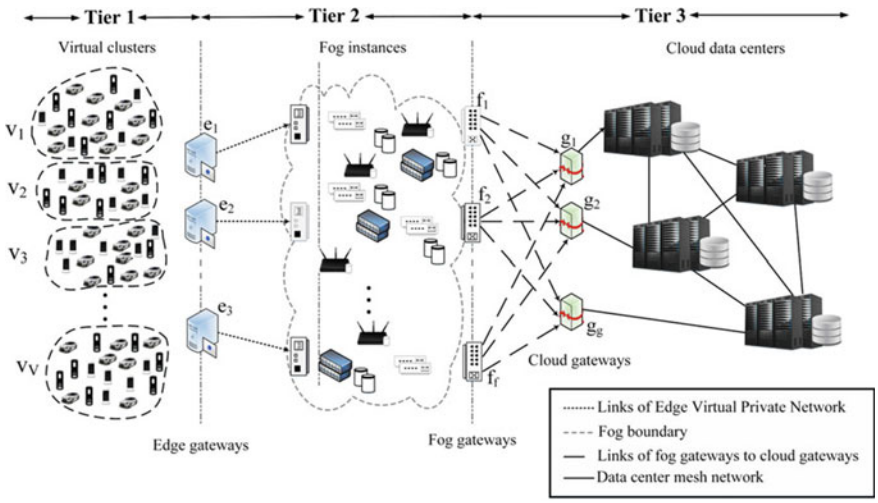

Fig. 1 Overview the present system

values to a specific high-level server. The UI architecture is to pass the maximum benefit of the sensor to the local server.

5.2 Centralized Server

The unified server is currently being used to collect all sensor esteems from the neighboring or regional node sent to each territory. The combined server gathers all the information and makes complete analysis of the information from the surrounding server. Specifically, what are the demonstrations the client should send to the nearby server. The server will dissect the surrounding server, and these complaints will be submitted to the concerned office if there are any objections. The single server now takes on a critical task.

5.3 Embedded Sensor Interface

Combined servers are currently being used to collect all sensor esteems from the neighborhood or regional node transmitted on each territory. The server installed that collects all the information, and the information investigation part applies a thorough analysis of the neighborhood data information. What's more, what are the grumbles the client gives to the neighborhood server. The server will investigate the surrounding server together, and such complaints will be reported to the concern

division if there are any protests. Incorporated server now takes on an imperative task.

5.4 Data Analysis

Right now, the data on whether the temperature is high or low or some fire was prepared happens dislikes all the data including contamination; additionally, we break down the information. So here, we actualize the framework to distinguish any common changes on the climate; it will send caution to that specific division. Through this, we get mindful of any adjustments in the climate.

5.5 Alert System

Specify the warning to the office in the final form for issues that rely on sensor alerts, and we will also send an alarm to the police division about the vehicle taken when you carefully read the RFID card.

6 Conclusion

Haze figuring will decrease delay with low traffic clog and low data transmission for time-sensitive IoT administration demands. Therefore, with a proposal to reduce the heap on cloud server farms, haze hubs are not a swap for cloud hubs, however, just expand the calculation and correspondence offices to edge of the IoT organize. While the nebula is a promising paradigm of the economic development of IoT structures, several open difficulties offer, for instance, the board issue assets. The work centers around breaking down the reasonableness of mist registering inside the structure of IoT. The goal of this paper is to establish a theoretical model of haziness and evaluate its relevance to IoT, where it is crucial to meet the needs of the idleness of delicate applications at the edge of the system. The work develops an evaluation of the close presentation of the distributed calculation with that of haze figuring for a domain with a high number of Internet-associated gadgets requesting constant administrations. Results delineate the improved exhibition of haze figuring both as far as the QoS provided and ecological disposal in such circumstances. In the end, we legitimize the haze worldview as an improved green registration phase that can strengthen IoT better contrasted with the currently distributed computing worldview.

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An Intuitive Extensible Framework for Implementing Cloud Broker Architectures

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Abstract Cloud computing is broadly received gratitude to the high business spryness; it assurances to its shoppers. Cloud administrations arrangement in the commercial center is an essential undertaking for both cloud customer and cloud supplier principally if the cloud buyer asks explicit properties for its applications. In this manner, this undertaking is designated to a third part which is the cloud intermediary. The proposed framework a cloud asset dealer is suggested that will administer the task of suppliers' assets to purchaser progressively. The proposed representative uses different prerequisites and imperatives determined by the shopper in the necessity depiction format as contribution, to figure amassed necessities, utilizing an accumulation calculation. Further, the administration planning calculation is characterized to discover a streamlined match between the accumulated necessities with the suppliers contributions. From that point, this calculation is executed regularly, in view of a procedure for dynamic planning to profit customers by virtue of presentation of new supplier or some great contributions. Results demonstrate that the arrangement gave by agent ends up being a success win circumstance for the customer concerning cost just as execution. We propose a monetarily roused pay way to deal with increment the granularity and utility of saved calculation and capacity administrations. The result is a profoundly virtualization of cloud asset intermediary. It comprises of a guardian asset administration commercial center and a shopper configurable virtual machine for asset sharing. The framework bolsters progressively settled virtualization with powerfully customizable asset limits for fine-grained auxiliary, worldly, and vertical–spatial versatility.

Keywords Cloud computing · Cloud broker architecture · Cloud engineering · Cloud framework · Virtualization

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1 Introduction

The principle target of each association is to augment its benefit and limit its expenses. Thus, associations are continually searching for new advances which can achieve this goal. Cloud processing, that became the prior structure for partnerships, is among the most motivating growing advances. Cloud processing payment more only is the cost model which emerges that empowers industries to decrease costs significantly by relocating their software equipment and programming to cloud conditions. An appearance to a few clouds anyway, the commitment of cloud administration by expert co-ops is a confused undertaking to the industries. Among them, the interesting answers for addressing to issue of cloud dealer utilization. Numerous cloud bodies such as Gartner and NIST have illustrated the cloud expert requirement [1]. Cloud broker takes on the middle-person job among the cloud client and the provider of the cloud; the fundamental skill is used to find the multifaceted cloud provider for free client. It provide administration along with cloud properties to be managed without illustrating the technical subtleties of the different cloud levels. This paper presents in the cloud engineering which contains a few segments, for example, get to administrator coordinating help, arrangement administration.

Our principle commitment is an arrangement system for cloud administration the executives, financier, and commercial center solutions that utilization some type of intermediation component which went Gartner, Forrester, and also NIST that plans to recognize available distinctions translations. Notwithstanding expert viding a thorough definition, our system permits us to characterize and think about intermediary arrangements. We take a gander at design pattern, i.e., programming-based interface arrangements which help financier through plan of action. We recognize an application and a stage perspective. Commercial centers, as application stores, are representative apps that gather which give user administrations. The merchant run the applications frequently on cloud stages to explicit brother key situated abilities.

This order that the system depends on a more detailed structure in terms of capacity and highlighting grades, building designs, and an increasingly sophisticated graphic design that specifically represents infrastructure, language, and functionality to specialist angles. The emphasis here is on an efficient guarantee to arrangement classes regarding on various information kinds of cloud and programming. We are talking about selected cloud administration of the board and agent age responses for reflecting and assessing the program, as well as having trends and difficulties from this comparison. The determination of subjects is again organized, pointing to the fact that it recognizes propelled arrangements that exhaustively distribute the cloud administration dealer space to ensure sufficiency and completion. The program is evaluated correctly. Designs for administration business solutions, we examine difficulties.

Such a devoted system doesn't exist for cloud merchants and goes past existing assistance scientific classifications, for example, [2]. Grozev and Buyya [3] go past this and present a scientific categorization and analyze arrangements. Be that as it

may, their exertion is focused on a scientific classification for between cloud structures. Their correlation plot utilizes five essential angles (type/association, engineering, handling consulting, application type, mindfulness). The description gave by Gartner, Forrester, and NIST [4, 5] are additionally elevated stages and not appropriate to a point by point characterization and examination. In [6], the multi-dimensional arrangement requirement is interpreted, and an important multi-facetted structure is proposed. Be that as it may, it doesn't unmistakably recognize application and stage dimensions, comes up short on a point by point jargon at idea occasion level, nor does it give a methodical distinguishing proof, extraction, demonstrating, and assessment of the system.

2 Related Work

To guarantee the portion of properties, the developers implemented a cloud computing system based on SLA in [2]. Two criteria are being considered right now: the remaining geological area of the burden and the server farms. This program presents SLA arrangement component to assist with SLA planning which fulfills preconditions for customers and suppliers. This structure can in any case be strengthened by including various properties as support for asset allocation, for example, expense, accessibility, etc., [6]; a further heuristic planning was suggested depending on different SLA properties for the applications of the cloud customer. This heuristic proposal can skillfully circulate applications on cloud properties, whatever it concentrates on satisfaction practical administrative properties, such as useful CPU and power, and it will not reinforce non-utilitarian functions.

In the developers suggested estimates of asset classification enabling the fulfillment of customers while reducing the amount and SLA spoils and increasing the profit of SaaS suppliers by improving the occupying of assets. Those calculations do not care about asset assignment consumer profile. This issue have been resolved in [7] by asking a detailed rendering of those calculations which goal to assist SaaS suppliers with customers. The another form of these calculations makes a consideration the QoS criteria the two customers and SaaS suppliers need. The approached estimates, however, does not help the SLA exchange mechanism that can maximize the satisfaction of the shopper and improve its usefulness. In [8], the developers implemented an architecture that allows for a QoS-mindful arrangement of uses on the most appropriate cloud specialist coop. A philosophy-based cloud management transparency is proposed to make choosing the best cloud provider simple for clients. This innovation will meet clients' prerequisites (programming and equipment necessities) in this way. This methodology is supported by a systematic analysis that confirms its knowledge and appropriateness.

Hsu [4] implemented a cloud administration selection model called cloud eval to satisfy client prerequisites for specified rates of administration based on the applicant administration's non-useful property evaluation. This model relies on a

complex multi-property strategy to promote customer choice of the ideal assistance. A framework for relocation is implemented at [9].

The proposed assessment of the most suitable cloud supplier right now depends on pre-characterized prerequisites clearly defined with SMEs. This errand is done in the stage of option which is part of this system. The proposed structure lacks adaptability because it is dependent on predefined requirements and conditions. In, the developers introduced a computerized solution that enables the client to pick the advantages of cloud storage that suit its needs. The developers have thus defined an XML specification that includes a representation of the capabilities of each cloud storage system. This approach allows the fulfillment of the preconditions of the client and the measurement of the presentation and expense. In any event, the XML template manual update is tedious and can cause some blunders. This dilemma can be fathomed by natural refreshment of the XML portrayals. The developers in [5] suggested a dynamic structure oriented to the fluffy scientific chain of command mechanism (AHP) allowing clients of organizations to choose the appropriate supplier of IaaS that meets their goals. Co-ops of cloud experts are evaluated using specific exam requirements. Right now, IaaS suppliers' commitment depends solely on the organization's priorities, and the predetermined amount of assistance is disregarded. A blueprint for testing cloud administration is implemented at [3].

This model proposed total cloud administration emotional and aim requirements, based on a fluffy clear weighting system for added substance. This model requires help from the client in the process of evaluation. In [2], the developers produced precise connection called Cloudcmp to help customers pick the cloud provider that fulfills for generating and ordering as far as execution and cost. The findings presented in [2] show that choosing one supplier is still challenging, as each supplier has its qualities. Through applying this model to specific applications, it can give better performance. In [7], a bit by bit alternative procedure known cloud step is suggested. That technique which required profiles based on layouts representing to identity of the industry, the end client along with the cloud supplier. The movement of the application profile exceeds its useful and needless validity, and the inventions use this program. A movement of the provider of the cloud profile enables that the assessment for each provider's of the cloud qualities and confirm that is acceptable for programs and profiles of partnerships. The method cannot be taken by any cloud supplier that touches the recognized by the client along with profiles associated with that.

3 Existing System

The agent design must divide the layers into two dealer stage along with representative application: Execution of the merchant application is done on the usage stage. The stage may be given "as an administration." That stage gives scope for administrations for building the application by intervention procedures. Though application gives a solid agent perhaps focusing on a particular vertical area or a particular help type. The dealer application is built utilizing the stage administrations, giving highlights,

for example, SLA the board, a help inventory, administration provisioning, including self-administration access, just as client verification and approval. Supports the structure, arrangement, furnishing for observing the assets of cloud, e.g., by an administration entries. The expansion of the center wheel of life the executives (LCM), including checking highlights of association. Simple highlights to the reconciliation for perfect administrations can be given.

The board agents could likewise be called inside intermediaries as their primary reason for existing is frequently dealing with an inner help inventory. Then again, old style representatives regularly intervene among clients and remotely offered types of assistance. This viewpoint is correlative to the dealer stage capacities, which center around the agent development just, however, not the goal implanted in the design.

3.1 Disadvantages of the Existing System

- Requires computational ways to deal with investigate and comment on the enormous volumes of pieces of information.
- Discriminative models are more strong than generative ones.
- Slow procedure of institutionalization.
- Users with various ability requiring their applications to be conveyed across contrast land areas.

4 Proposed System

The cloud broker architecture for dependability is made out of five modules that work together to guarantee cloud agent works fundamentally adjacent to trustworthiness properties. The three principle modules (e.g., administration revelation, administration structure, and administration conveyance) are expected to satisfy the ordinarily asked jobs from the cloud specialist. Every module can work autonomously. The three modules can likewise team up to empower movement toward another cloud supplier in the event of ineffective recuperation of the present cloud supplier. The two different modules (e.g., SLA consistence and history storehouse) are transverse modules that are counseled or took care of by the three principle modules for explicit data. These two modules are added to our design so as to give a total and intelligent cloud representative engineering ready to bear the cost of steadfastness. In addition, through these modules, we can improve reaction delay (Fig. 1).

The service discovery module: This module gets the cloud buyer demands. The cloud dealer attempts to contrast the prerequisites and limitations and past experience of conveyance cases put away in the history store. The service composition module: Service creation happens when the necessary help is too mind boggling to even think about being offered by a cloud supplier. Thus, an arrangement between basic administrations is important to give this intricate assistance.

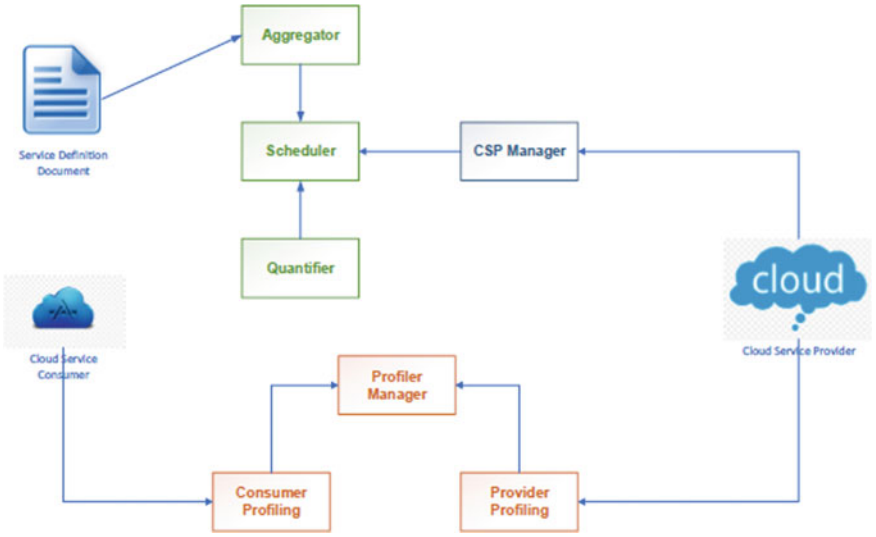

Fig. 1 Perspective of the suggested system

4.1 Advantages of the Proposed System

- Limit the chance of mistake inclined human design.
- High exactness and produce an outfit system.
- Most reduced expense and best-quality PaaS/IaaS layer.
- Better comprehension of order and grouping in the field of metagenomics.
- Optimized arrangement time and cost.

5 Conclusion

We present a facilitating design for cloud computing condition, which offers opportunity to cloud purchaser to modify the prerequisite further to fine level. This is finished with the acquaintance of weight trait relating with nonfunctional necessities and thought of suppliers' presentation in the task. This prompts suitable choice of supplier for shopper based on limitations and space necessity. Having these highlights, without having definite information on cloud suppliers, shopper can focus on the application part abandoning the specialized parts of cloud framework to the merchant. In addition, the task ends up being practical for cloud buyer, and then again, merchant is going about as a major customer for cloud supplier. Fuse of migratability list gages the degree to which adaptability of cloud suppliers can be accomplished. At long last, assets in accumulated structure will help in haggling with the cloud suppliers.

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Consumer Intension of Purchase from Online and Social Media Data

A. Pasupathi Nadh, V. Ram Kumar, and T. Anandhi

Abstract Advanced advertising is viewed as the favored strategy contrasting with conventional showcasing. It is valuable to the two professionals and scholastics of web-based social networking promoting and buy expectation. The exploration gives some underlying bits of knowledge into shopper points of view of web-based life advertisements and online buy conduct. Business, academician, specialists all are share their notices, data on web so they can be associated with individuals quick and effectively to study on accessible item sites by web scrap. Web scratching is a robotized technique used to remove a lot of information from sites, and the information on the sites are unstructured. To forestall this issue, web scratching helps gather these unstructured information and store it in an organized structure. Consequently, client cost and rating of item assessment and forecast have become a significant research region. The point is to examine given dataset utilizing AI-based procedures for item appraising determining by expectation brings about best precision. The investigation of dataset by support vector classifier (SVM) to catch a few data resembles variable recognizable proof, univariable examination, bivariable and multivariable investigation, missing worth medicines, and dissects the information approval, information cleaning/getting ready, and information perception will be done on the whole given dataset. Our examination gives a far reaching manual for affectability investigation of model parameters concerning execution in forecast of item appraisals with value subtleties by discovering precision estimation.

Keywords Co-creation · Consumer unification · Customer orientation · Review of the literature · Creating new product

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1 Introduction

Consumer intentions about new product development and details of the product are the main point of the topic [1–3]. Consumer plays the vital role in the new product development because they are the one who uses the product, and it should be in favorite of them [4, 5]. Consumer will give the main information about his requirements. If the customer satisfy with the product, then they are likely to sell [6–9]. The consumer collaboration is accepted in all parts in the new product development [10, 11]. Some practitioners state that consumers are too conservative [12, 13]. If the lack the necessary skills and knowledge about the rapid product development, then we can't sell it [14]. Consumer plays the main role in rapid product development if didn't like the product, then we have no use of it [15, 16]. If take an example of a mobile manufacture company if they release more number of models to the market but if the people don't like the product, then there is no use of releasing more no. of products into the market so we need to release the products what the customer likes and maintain a company if we take Motorola and Samsung as examples, where Samsung is company playing a vital role in the industry by releasing customer needed models with less cost and high cost giving space to think in benefit of both but Motorola can't sustain the competition by releasing unnecessary models which make it to loose in the completion [17]. These examples represent about the costumer integration with the rapid new product development [18]. Our approach is different and taking in consider to the previous literature reviews so we don't make any type mistakes what they have done, and we collaborate the ideas of customer integration and the organizational view so we can make up with a strategy [19].

2 Related Work

2.1 Determining the Effects of Marketing Mix on Customers' Purchase Decision Using the Gray Model GM (O, N)—Case Study of the Western style Coffeehouse Chains in Vietnam, Yu-Chien Chai, Ying-Fang Huang, and Hoang-Sa Dang, 2017

Café chain is blasting in Vietnam, the challenge between espresso drink providers right now additionally solid at present. Be that as it may, the Vietnamese market is assessed as an extraordinary potential market, consequently, so as to satisfy espresso consumer need just as extend the piece of the pie, providers of the café chain ought to be taken more thought on advancements exercises and the flavor of espresso drinks. Besides, results of espresso drinks with great taste and sensible cost can cause customers to have a significant level fulfillment and certainty to buy. Western style of café chain shows another market pattern for drinking business industry with more

chances and difficulties in Vietnam. This examination found that Vietnamese buyers take more contemplation on advancements exercises and the flavor of espresso drinks when acquiring espresso refreshments in western style of café chains. Regardless of that results of espresso drinks with great taste and sensible cost can cause customers to have an elevated level fulfillment and certainty to buy.

2.2 Cognitive Resource Limitation on the Decision to Buy Products from Consumers: A Prospect for Event Potential, Weiwei Han, HuaBai, 2018

Considering the neural effect of dispute between personality and performance when purchaser choice is limited to qualitative assets. Hanetal. And comparison is higher for shoppers' reckoning of share and response time in our estimation, and this means that they have much more flexibility to choose and are easier to make "purchase" decisions while buyers' discretionary assets are limited. The purchase rate of requirements 1 and 2 was greater than that of both other causes but there was no critical distinction between conditions 1 and 2. Constrained cognitive assets were determined on clients, based more on attractiveness than results. This research explores the influence of neural conflict between attractiveness and efficiency on shopper preference if subjective resources of consumers are limited. 20 individuals were propositioned to retain a 20-digit number in 20s in order to control its philosophical assets. Updates of items with attractiveness and assassination data have been capriciously displayed at that juncture. The boosts were divided into four conditions, according to the consistency of appearance and execution (claim 1): progressively appealing and predominant execution; claim 2: increasingly attractive and incompatible execution; claim 3: fewer appeal and unrivaled execution; claim 4: fewer appeal and seco. Researchers found that situations 1 and 2 were higher than that of the other two, but the contrast between situations 1 and 2 was not significant. The results showed that conditions 1. Although the two situations 2 and 3 have collision evidence, situation 3 evoked the most significant amount of N270 conflict than specific prefrontal settings. The P2 design was also influenced by back anterior cingulate districts in all systems, although the P2 sufficiency was substantially greater than the various conditions. The scientific advances have shown that buyers have to gradually call normative funds to include a few bits of piece data if the item appears clash. In general, they would use programmed models, full of felting, over informative, intelligent ones, which contributed to a high buy rate, a littler N270 and a bigger P2 for the more appealing, but, execution pieces. P2 and N270 could thus serve as valuable neural endogenous indicators that reflect the way to deal with purchaser-elective disputes.

2.3 Analysis of Factors that Influence Purchase Intention on Omni-Channel Services, Herio Susanto, Yudho Giri Sucahyo, Yova Ruldeviyani, Arfive Gandhi, 2018

Such research demonstrated the way in which digitalization preserves the digital business for companies. It has identified influences effectively affecting the desire of consumers to buy omnibus services through different channels. Three factors, including social influence, performance expectations, and perceived security, are influenced by the results. The cultural influence is the most important variable. It discusses the way in which a person can use the omni-channel (for example, family, colleagues, and other trusted individuals). The rapid development of digital and electronic media including mobile applications and social networking sites has altered the marketing strategy of department stores as well as the activity of the buyer. Such developments present new problems in handling complex platforms for businesses and retailers. Readiness and complicated maintenance are needed because each channel which has different features. It is important for customers to ensure accuracy and trustworthiness in their purchases. The purpose of this analysis is to examine the factors affecting the use of omnibus services by customers. The quantitative approach is proven with 168 respondents using PLS-SEM. As the results, variable social influence in omni-channel services becomes the most influential factor in buying intention, followed by performance expectations and perception of security. When an organization formulates plans for its omni-channel, those considerations become a priority.

2.4 Consumers' Intention to Purchase Re-manufactured Electronic Products: An Empirical Study in China, Lijun Ma, XiaoyiSu, Can Wang, Kangqing Lin, Meiyan Lin1, 2016

A statistical model and analysis analyzing the factors affecting the purchasing preferences of customers for new electronic goods in China. Their work expands the explicative capacity of TPB, applying perceived quality to the original model, advantages and perceived information. The thesis will support researchers through a detailed analysis of the re-manufactured goods' adoption by consumers. Restoring was defined as a critical part of the circular economy and a closed loop motor supply chain. Nonetheless, few studies focus on consumers' desire to buy reconstructed products. They suggest a comprehensive theory of expected conduct (TPB) to improve studies into this by incorporating more explanatory variables to explore the factors that influence customer purchasing intentions on revived electronics. We

gathered information and used it to check our concept through an online questionnaire poll. The empirical evidence shows that the client precedes acquisitions of remanufactured electronic products, social mores, guessed regulations of wrongdoing, and industry expertise. However, the potential risk affects both the buying behavior and the purchasing goal. Amazingly, portrayed quality and perceived advantages influence the acquisition intent good but insignificantly, While also inherent advantages are linked to purchasing attitude negatively and insignificantly. The possible explanation can be that customers are concerned about the quality of reproduced products and are not prepared to pay a premium for reproduced products.

2.5 How Perceived Factors of Review Contents Influence Consumers' Purchase Decision, Kang Miao, Qinghong Yang, Xing Wei, Xiaoping Du, Jianwei Zhang, 2016

The review place an positive or negative influence on purchase decision. If we have a positive review about the product, then it will help us in the marketing, and selling the product when if we have a negative review will get a bad impression about the product; then we can't market the product, and customer don't like the product; nowadays, online shopping is increasing so we need to keep in mind about the reviews because most of the people see the reviews, and then, only they like to buy it so review place an important role in the product marketing. Different type of algorithms shows the risk in the rapid product development and purchase decision; quality of the product and all come to question mark is the product which is a legit or not service risk, and the price marking of a product is also depends up on it where if a product is a nice but its price is high; then we can't do anything that nobody will buy it. Online product review system place a vital role in the customer influence to by the product or not varies type of reviews will cause different impact on the product so we need to overcome all this to market our product. The data we got from the different type of algorithms; by analyzing the data, we can come to know the risk in the product and impact of it if it shows negative tendency, then we will be in problem but if we get positive tendency, then there we can improve it more. The conclusion of the online review system is by using the reviews we can change it accordingly to it requirements.

3 System Analysis

Review makes important contributions to rapid new product development and the customer integration where there should be no gap in between their knowledge so they will be in one path which makes it easy to create a new product with less time, and by taking the reviews into the consideration, we can make change the so it will be helpful to clear with the requirements of the customer and create it with his needs;

by doing this, we can save the time, and the rapid new product development will be success because it was liked by the customers and where it will show the importance of the collaboration customer integration and the organizational integration [20, 21].

4 System Architecture

System architecture is the conceptual model which defines a system's structure, behavior, and more views. A description of an architecture is a systematic description and representation of a system, structured in a manner that facilitates thinking about mechanisms and attitudes in software [22]. A system architecture will consist of system components and established sub-systems that will work together for the overall system implementation. To order to explain system architecture, efforts have been made to formalize languages; collectively these are called languages of description of architecture (Fig. 1).

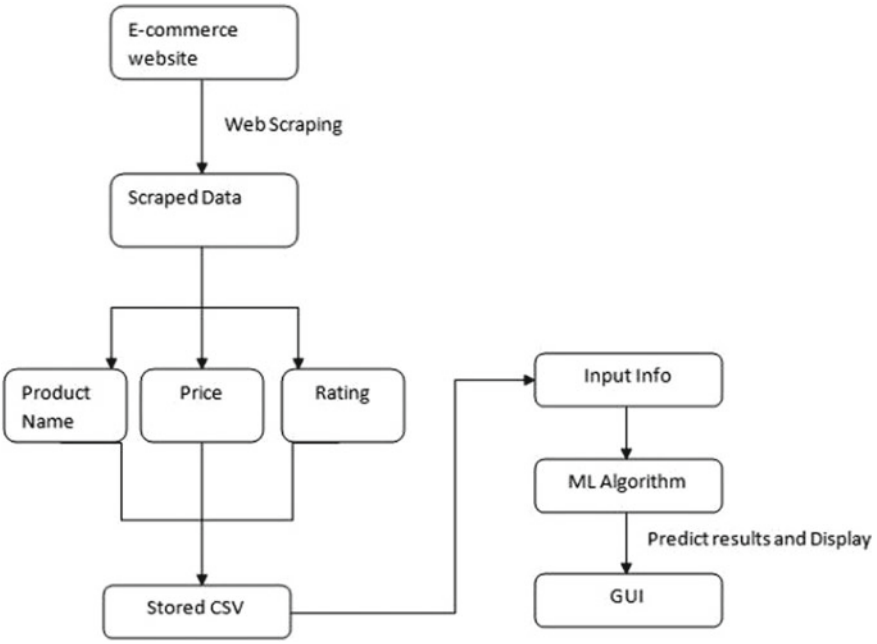

Fig. 1 System architecture

4.1 Scraping Data for Consumer Intension (Module-01)

We have to scrape Flipkart website using data miner extension to extract price, name, laptop ranking, and so on. So, we are inspecting the page to see where the data under which we want to scrape is embedded. To inspect the page, extract the size, name, and rating that is nested, respectively, in the ID tag. You should save it in a file after the data has been collected. The extracted data will be stored in comma separated value (CSV) format.

4.2 Data Validation and Preprocessing Technique (Module-02)

Importing the library packages with loading given dataset. To analyze the variable identification by data shape, data type and evaluating the missing values, duplicate values. A validation dataset is a collection of data held back from your model training, used to provide an overview of model competencies while tuning models and procedures that can be used to make the best use of validation and test datasets when testing your models. In order to analyze the uni-variate, bi-variate, and multi-variate method, data cleaning/preparation by renaming the given dataset and dropping the column, etc. Data cleaning is primarily aimed at identifying and eliminating errors and anomalies to increase the value of data in analytics and decision making.

4.3 To Train a Model by Given Attribute with Visualization (Module-03)

Data visualization is an important skill in applied statistics and machine learning. Statistics actually concentrates on objective data explanations and forecasts. Visualization of data provides a significant suite of tools to achieve a contextual understanding. This can be useful when researching and studying a dataset and can aid in detecting patterns, corrupting results, outliers, and more. Data visualizations can be used with a small amount of domain [10] knowledge to convey and explain key relationships in plots and charts that are more interactive and stakeholder than association or significance tests.

4.4 Performance Support Vector Classifier Measurements (Module-04)

A classifier that categorizes the set of data by setting an optimum hyper plane between the data. I chose this classifier because the number of different kerneling functions that can be implemented is incredibly versatile, and this model can provide a high predictability rate. Support vector machines are perhaps one of the most common and talked about the algorithms in machine learning.

4.5 Web-Based Application of Customer Intension by Php (Module-05)

Consumers intention is a type of sentiment analysis. Where we use support vector machine to automate the algorithm, and it will help us to analyze the date and classify the data into three different ways positive, negative, and neutral; by this information, we can state that he like the product or not we can show the data by using php. By this, they will know about the product and what is the review given. Whoever the consumer be, they can understand the analysis, and they can get the product with their requirements.

5 Results

See Figs. 2, 3, 4, 5, 6, and 7.

```
1 data.head()
```

	name	Price	ratings	reviews	rom	display	camera	Processor	Warranty
0	Realme [Upgrade to see in full]	₹8,999	4.5	23,148 [Upgrade to see in full]	4 GB RA [Upgrade to see in full]	16.56 c [Upgrade to see in full]	12MP + [Upgrade to see in full]	5000 mA [Upgrade to see in full]	Brand W [Upgrade to see in full]
1	Realme [Upgrade to see in full]	₹8,999	4.5	23,148 [Upgrade to see in full]	4 GB RA [Upgrade to see in full]	16.56 c [Upgrade to see in full]	12MP + [Upgrade to see in full]	5000 mA [Upgrade to see in full]	Brand W [Upgrade to see in full]
2	Redmi 8 [Upgrade to see in full]	₹7,999	4.4	3,11,34 [Upgrade to see in full]	4 GB RA [Upgrade to see in full]	15.8 cm [Upgrade to see in full]	12MP + [Upgrade to see in full]	5000 mA [Upgrade to see in full]	Brand W [Upgrade to see in full]
3	Redmi 8 [Upgrade to see in full]	₹6,499	4.4	81,400 [Upgrade to see in full]	2 GB RA [Upgrade to see in full]	15.8 cm [Upgrade to see in full]	12MP Re [Upgrade to see in full]	5000 mA [Upgrade to see in full]	Brand W [Upgrade to see in full]
to expand output; double click to hide output				81,400 [Upgrade to see in full]	2 GB RA [Upgrade to see in full]	15.8 cm [Upgrade to see in full]	12MP Re [Upgrade to see in full]	5000 mA [Upgrade to see in full]	Brand W [Upgrade to see in full]

Fig. 2 Training data

```
Classification report of Support Vector Machines Results:

              precision    recall  f1-score   support

           0       1.00      0.38      0.55        98
           1       0.79      1.00      0.89       235

    accuracy                           0.82       333
   macro avg       0.90      0.69      0.72       333
weighted avg       0.85      0.82      0.79       333

Accuracy result of Support Vector Machines is: 81.68168168168168

Confusion Matrix result of Support Vector Machines is:
 [[ 37  61]
 [  0 235]]

Sensitivity :  0.37755102040816324

Specificity :  1.0
```

Fig. 3 Confusion matrix result

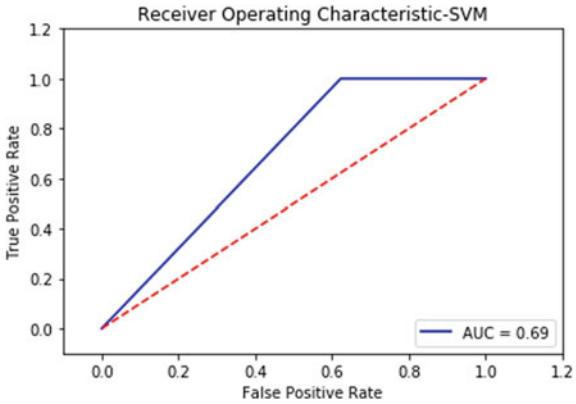

Fig. 4 Acceptance graph

6 Conclusion

This systematic review of the literature makes three major contributions to the theory of customer integration. First, it removes the difference in user type definitions, customer view of perspectives explaining the drawbacks, and requirements of the consumer in the rapid new product development at early stage so we can change it. Second, it represents the important of the consumer integration by showing the imperial findings about the new product development. Third, it indicates gap between the knowledge of the consumer intention and the rapid new product development,

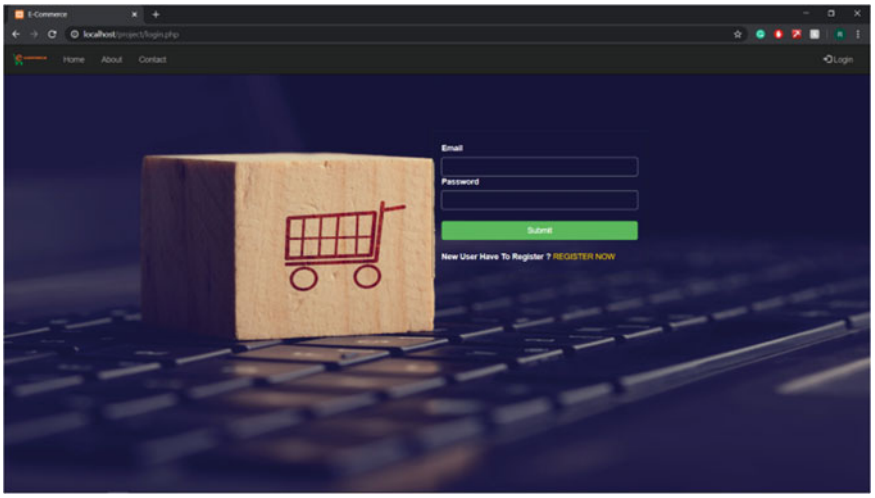

Fig. 5 Login page

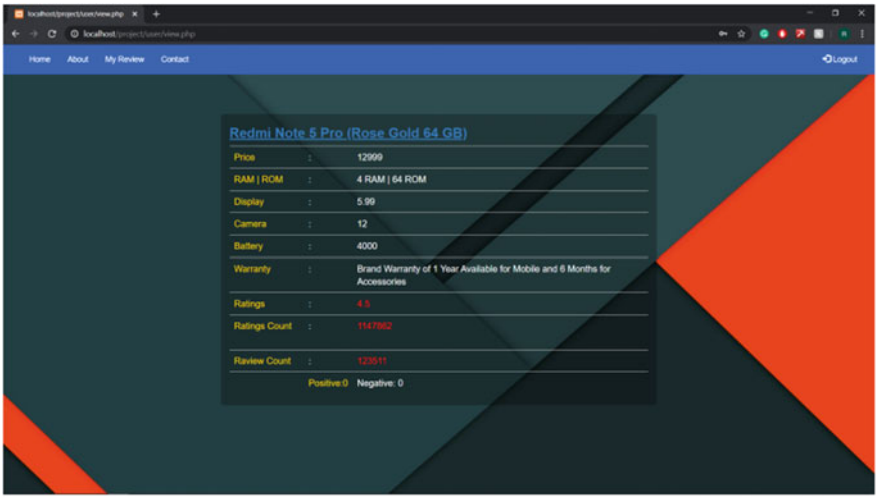

Fig. 6 The figure represents about the result of prediction with comparing rating and number of reviews it received

where the consumer should be fast able to represent his requirements, where rapid new product development is about creating a product in less time and facing the consequences whether it is positive or negative.

We use artificial intelligence (AI) to optimize it and create a automated process for a desktop application.

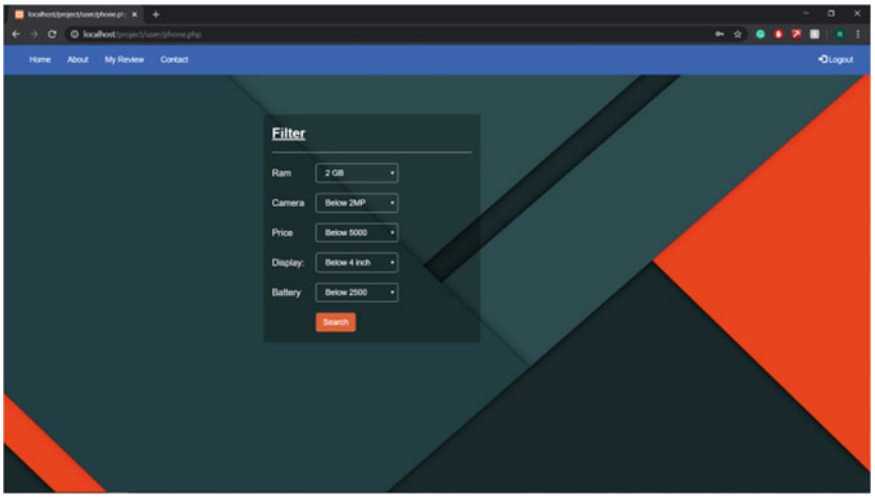

Fig. 7 We can get specifications filter of over product

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Identifying and Detection of Advertisement Click Fraud Based on Machine Learning

Jaladi Guna Vardhan Amrutha Raj, Jagannath Patro Allupati, and G. Kalaiarasi

Abstract Publicizing extortion, especially click misrepresentation, is a developing worry for the Web-based promoting industries. The utilization of snapbots, malware that naturally taps on advertisements to create fake traffic, has relentlessly expanded in the course of the most recent years. While the security business has concentrated on distinguishing and evacuating noxious doubles related with click bots, a superior comprehension of how fraudsters work inside the promotion biological system is should have been ready to disturb it productively. The demonstration of tapping on an advertisement, not due to enthusiasm for this advertisement, but instead as an approach to produce unlawful incomes for the application distributor.

Keywords Social network analysis algorithm · Click fraud · Machine learning

1 Introduction

The version carries three tiers: preprocessing, bunch recognizing, and post-getting ready. In the preprocessing step, the query that is less inclined to be deceitfully clicked is expelled. In the institution recognition step, a publicly assisting snap extortion bunch is same to a collection. Bunching strategy is applied to recognize pernicious gatherings [1, 2]. In the put up-making ready step, request clicks checked accidentally are separated [3]. The combination, versatility, and exactness are checked through the reproduction facts and multi-week click data of an Internet crawler business enterprise [4]. Flexible publicizing has picked up occurrence as a median for distributers to

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evolve their free packages. One of the precept concerns inside the in-utility promoting industry is the mainstream assault referred to as "click on misrepresentation|" [5].

2 Related Work

Click fraud in advertisements to group noxious distributers, Riwa Mouawi et al. [6], has assessed three distinct classifiers: KNN, SVM, and ANN. Every one of the three classifiers gave exceptionally encouraging outcomes. Pearce et al. [7] broke down the conduct of an enormous scope botnet called zero access that performs click misrepresentation. Blizard et al. [8] assessed a known site promotions malware whose fundamental objective is to build the income of the distributer by fooling the client into tapping the advertisement a subsequent time. Dave et al. [9] utilized the Bayes hypothesis to figure the proportion of non-pernicious clients following a non-malignant clicking occasion. This Bayes likelihood esteem was utilized to gauge the snap misrepresentation rate. Crussell et al. [10] assembled a choice tree dependent on the all out highlights removed from their ground truth dataset to arrange promotion demands versus none advertisement demand. Mill operator et al. [11] considered two groups of well known bots that performed click misrepresentation. Awad et al. [12] Because machine learning is being actively thought for network attacks, fraudulent activities. Alrwais et al. [13] examined the notable "Operational Ghost Click" advertisement related assault, where aggressors controlled promotion see meeting from blameless distributers. They played out a huge scope investigation of more than 7000 promotion solicitations to recognize the nearness of this assault [14]. Haddadi et al. [15] proposed another snap spam location strategy that makes irregular advertisements with arbitrary content. They accepted that clients tapping on these discretionary advertisements are noxious robotized devices. Reference [16] reviewed the state-of-the-art computer vision-based approaches and feature extraction methods using PCNN for the detection of images is discussed in [17]. Also, the images are clustered using bundled features [18]. The snap misrepresentation location frameworks, within the writing, are either overseen by using advertising structures (with out teaming up with publicists) or via sponsors (with out running together with commercial structures). Be that as it may, those i gatherings have inverse intentions as a long way as figuring out if a advertising click is deceitful or real [19]. While it is in light of a valid challenge for the promotion device to do not forget an commercial snap to have the option to charge the promoter for it, it is in mild of a valid difficulty for the sponsor to hail noxious advertisement solicitation to abstain from paying the advertisement set up [20]. On the customer facet, the distributer carries inside the utility an commercial, which is shipped by way of the advertising prepare on its site subsequent to combining it with any other container report made by using the click fraud detection model accumulating so as to cope with click on extortion reputation [21, 22]. The promotions in cellphone section indicated and clicks are overseen by showing the publicized websites on commercial snaps [23]. In the contemporary framework, this section is going approximately as a transfer

among diverse distributers and sponsors by using: (1) selecting which promotions to ship to the distributer for display, (2) charging publicists for each commercial snap and are paying the distributer a stage of the charged cash. The modern-day system gets rid of the accompanying highlights: (1) Percentage of period suspicious snaps in keeping with distributer (2) Total quantity of snaps in step with distributer. This incorporates suspicious and nonsuspicious ones. (3) Ratio of one of a kind IPs in whole variety of snaps in step with distributer: CFC researches he purchaser IP in each advertising call for by using gambling out an IP undertaking to make certain that the IP is not satirize [24, 25].

3 Proposed System

The proposed framework depends on social network analysis (SNA) the machine used to distinguish the primary entertainers who belong to his biological system which may be correctly affected through which we can be able to raise iof snap extortion model. As indicated by using the highlights of the thickness and concentricity, the distinguish of click misrepresentation can be done by the way of coming across of gatherings. Clickers have a place with a similar gathering regularly click is a meeting of similar promoters. What is more, for the same sponsor, clicks time is focused. Each organization consciousness incorporates numerous sponsors and their concerning click time. The greater promoters have a place with the bunch consciousness clicked through an IP within the important time window, the more likely the IP has an area with the gathering. So as to unequivocally display this bunching problem, characterize the Sync-Similarity of group focuses (Fig. 1).

Rather than utilizing structures created as regards to annoying malware basis, it can rather use crafted by using criminologists to disappointed systems of hoodlums. Quite, Which is plausible to depend on social network analysis (SNA), a method demonstrated to be viable while managing criminal structures.

The goal of this manner is to discover strategies to sturb the criminal organic gadget by inspecting the machine of social and enterprise connections among criminal on-display characters. In this type of exam, the maximum significant on-screen characters inside the machine, or key players, are identified.

4 Result

Figure 2 describes about the graph related to the age and gender. Where pink color is unsuspicious click and brown color is suspicious click. Similarly the orange color is also unsuspiciousclick.

The analysis is done in relation between the age, weekday is shown in Fig. 3 in the first half. Where as in the second half shows the relation between the daily times spent on site and week days for the clicked on ads or not.

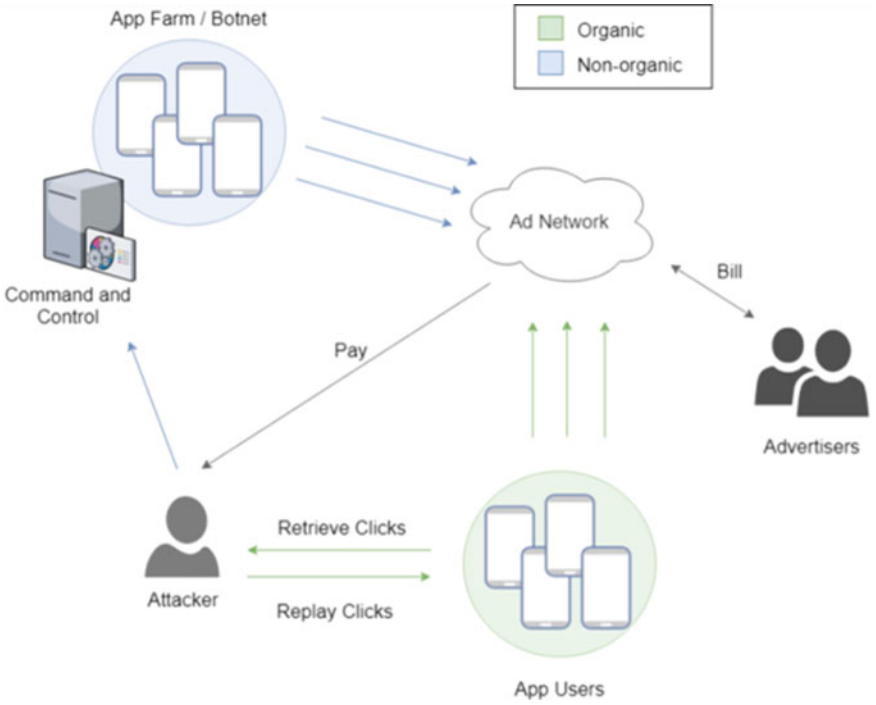

Fig. 1 Proposed system architecture (organic and non-organic click fraud)

The estimation of historical relationship between the returns of multiple assets is done by correlation matrix for all the variables which are present in the data sets. It used for the more advanced analysis as shown in Fig. 4.

The pair plot is used for the data sets which are taken. This shows all variables paired with all other variables (Fig. 5).

The factor plot is done to the data set for the age and week day's variables which are arranged in a single page (Fig. 6).

The plotting for the male vs count and the stacked bar chart of the week days vs clicked is done by using the count plot as illustrated in Fig. 7.

The factor plot which done in Fig. 6 which is done similarly for the click on ad and moth variables as shown in Fig. 8.

5 Conclusion

The proposed system uses social network analysis to find the important key players of the fraud environment. It can be determined that by means of putting off a very confined variety of actors the monetizing capability of the botnet might be severely

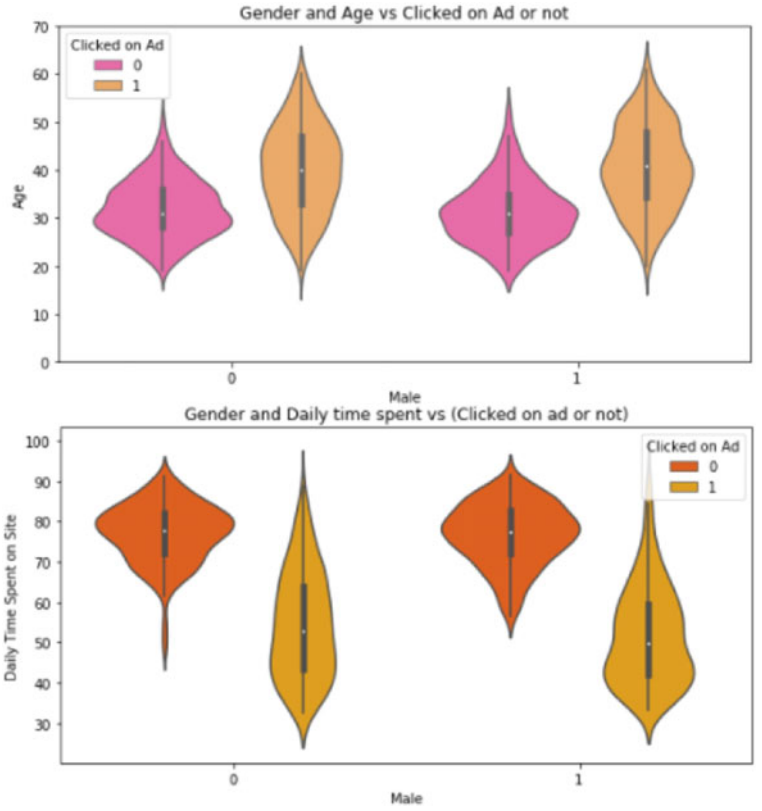

Fig. 2 Gender, age, and daily time spent (clicked on ad or not)

disrupted. It enables companies to enter in the advertising market by using lowering obstacles to access. This illustrates the importance of preventing the usage of these offerings by criminals. Finally, as click fraud and other sorts of ad-primarily-based monetizing schemes grow to be an increasingly more important supply of revenue for criminals, they argue that atmosphere disruption strategies based totally on information received from the analysis of redirection chains have to be more extensively used. While botnet take downs can achieve quick term success, they are much less efficient inside the long term.

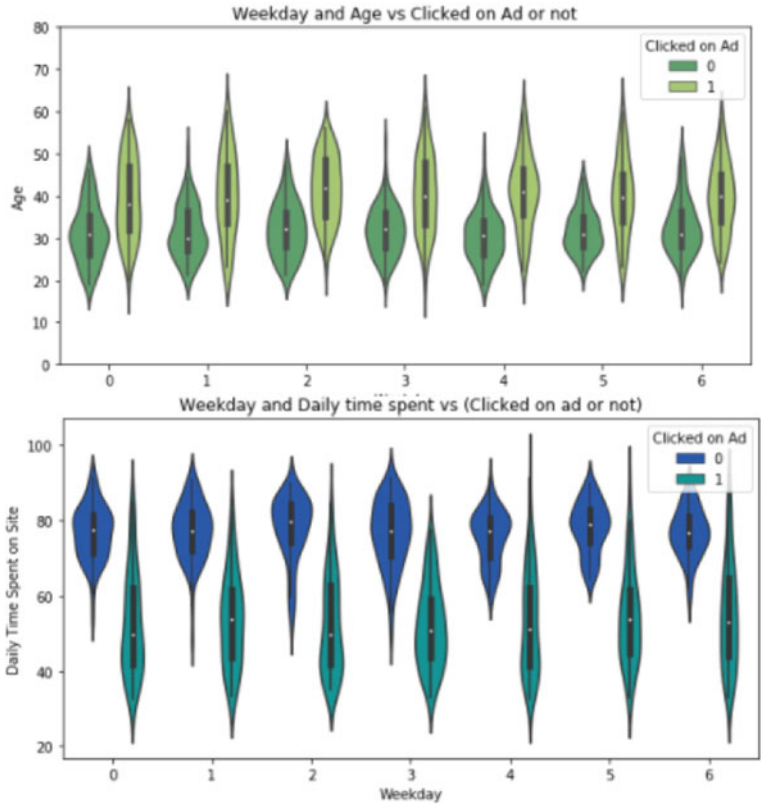

Fig. 3 Week day, age, and daily time spent (clicked on ad or not)

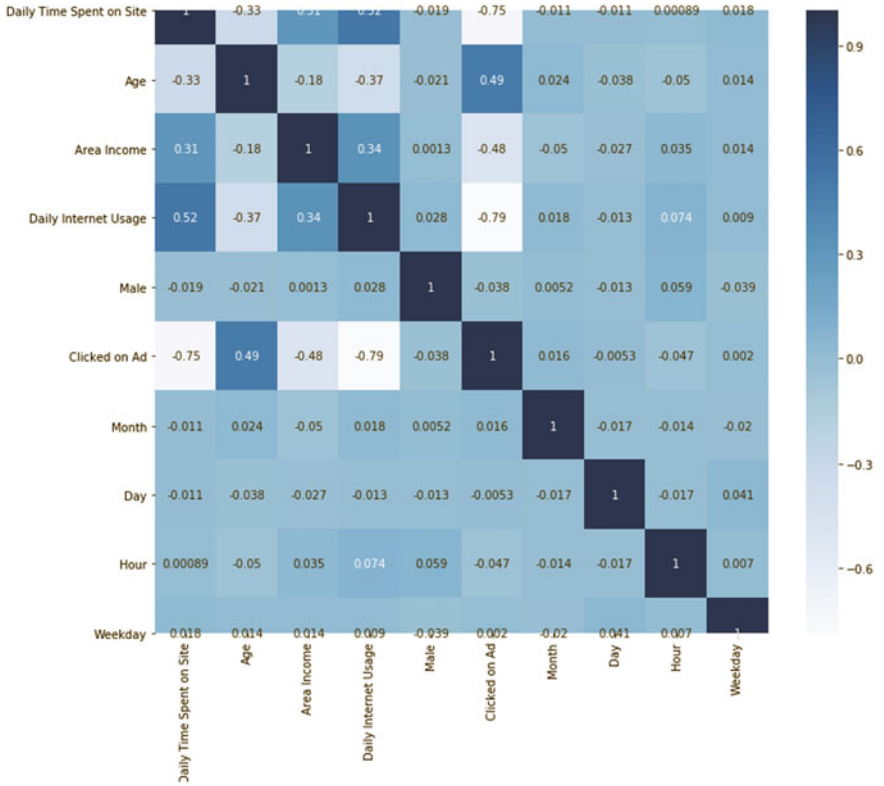

Fig. 4 Correlation matrix

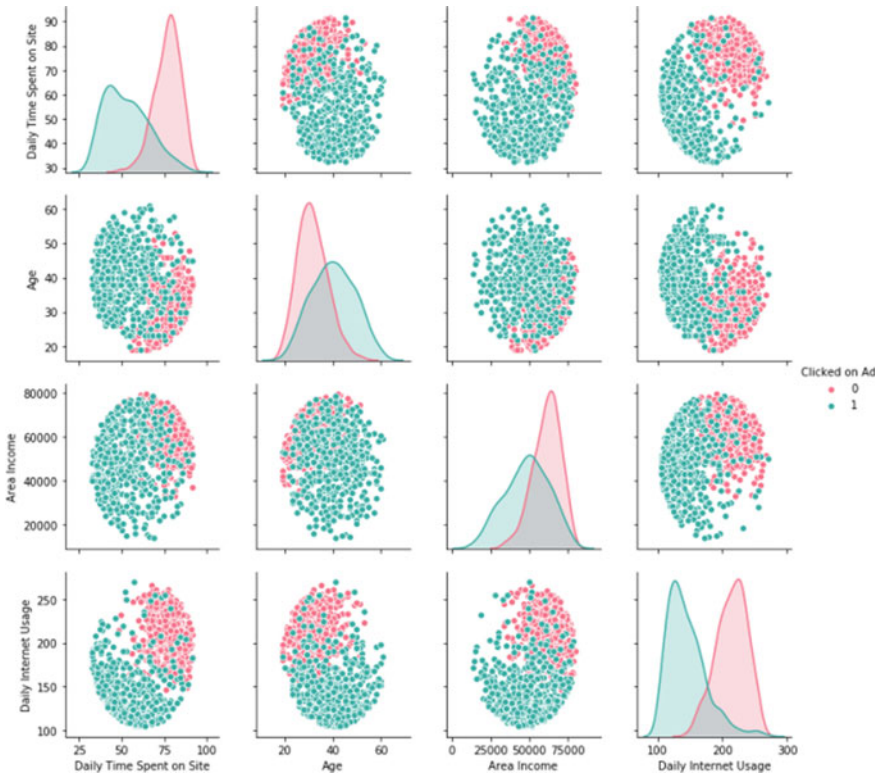

Fig. 5 Pair plot (age, area income, daily time spent on site, daily Internet usage)

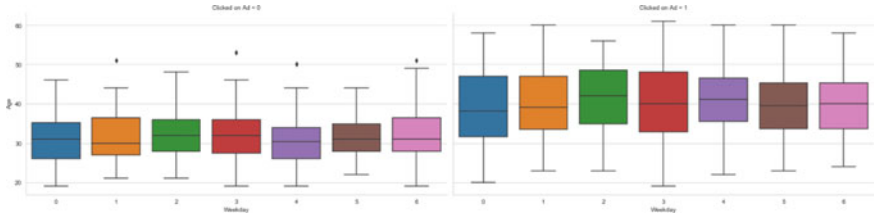

Fig. 6 Factor plot (week day clicked on Ad = 0.1)

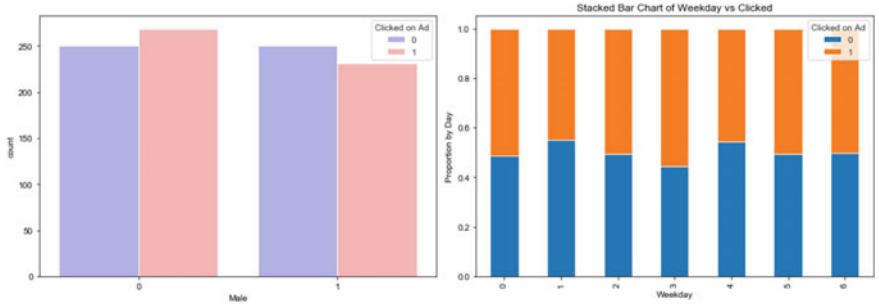

Fig. 7 Count plot (stacked bar chart of weekday)

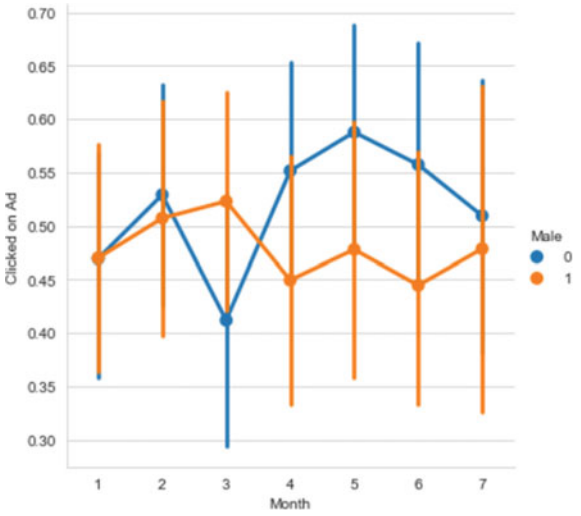

Fig. 8 Factor plot (month clicked on Ad)

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Touch-Less Heart Beat Detection on Improved LBP Algorithm

N. Sangeetha, J. Sangavi, T. Anandhi, P. Ajitha, A. Sivasangari, and R. M. Gomathi

Abstract Proposed approach illustrates Detection touch-less heartbeat and a cardiopulmonary sign. A microwave frame is attempted to find a good way off of 1 m from the pulse sound of a person by using a vector organize analyzer. The proposed method requires the ability to distinguish pulse patterns with both recurrence and the plausibleness of the force tuning. Calculations are made at 2.4, 5.8, 10, 16, and 60 GHz, and also at varying force rates between 0 and −27 dBm. A classification that applies cardiopulmonary activity is defined in terms of the air and heart beatings statistics. Using wavelet and wide channels, heartbeat rate and heart rate changeability are isolated from the test signal for SNRs between 0 and −20 dB.

Keywords Heart rate monitoring · Mobile face video · Cardiopulmonary · Ox meter sensor · Vector network analyzer

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1 Introduction

Human health is a significant factor for the advancement and progress of society. Home or individual social insurance advancements can resolve the burden of visiting a restorative office and help clients to deal with their wellbeing conditions well [1, 2]. As one of the home or individual medicinal services advances, day-by-day observing of fundamental signs, for example, circulatory strain and pulse, is essential to forestall and oversee different conditions and patients who have their imperative signs observed are bound to assume responsibility for their wellbeing [3]. Irregularity or variety in pulse might be a side effect of heart-related ailments, which are the essential driver of mortality overall [4]. In this manner, creating successful day-by-day pulse observing frameworks that permit at hazard and older populaces to perceive potential heart-related illnesses in ahead of schedule or treatable stages is basic.

Heart rate is a pivotal factor for the analysis of heart illnesses and one of the predominant parameters for cardiovascular maladies. Heart rate is characterized as the rate at which heart contracts every moment. It is a crucial physiological sign estimated in the human body that mirrors the physical and mental state [5]. Heart rate inconsistency is a proportion of varieties between every heartbeat that demonstrates the impacts of weight on an individual's body [6]. With the ascent of undesirable dietary patterns and stationary ways of life over the world, death rates because of cardiovascular infections (CVDs), stroke, septic stun, coronary heart sicknesses (CHDs) are quickly expanding [7, 8]. Ischemic coronary illness and stroke are the two significant cardiovascular infections liable for 80% passing in India [1–4]. Thus, the adaption of a solid way of life with the normal assessment of heart rate is basic to keep these infections under control. Standard restorative systems to screen heart rate are electrocardiogram (ECG) and heart rate Ox meter sensors [9]. These customary techniques give exact heart rate; however, the use of these gadgets can make harm old skin. In addition, wearing these gadgets for long time length can make outrageous uneasiness patients. Likewise, it cannot be utilized on neonates. Because of the unpredictable equipment, use of these machines at home can get confused with no master's supervision [10]. Accordingly, intrigue is developing to quantify heart rate with no touch between patients skin with the equipment so it very well may be estimated with no uneasiness [11, 12].

2 Related Work

Current audio input-based HRM methodologies could be requested in dual courses: contact based and contact free. Contact-related approaches are performed frequently using near sources of infrared light [13].

Mix and Viala et al. [4] suggested a swivel-like tool with an IR detection system positioned at the ear ligament to watch the circulatory system and measure the pulse a short time later. Till now, contact-based techniques are most definitely experienced

and completed as specific gear tools. Given communication methods the use of far-infrared light is done every day by encompassing light sources.

Pavlidis et al. [14] Pictures of gigantic shallo using a moist infrared camera, such as carotid and haven, the temperature changes in the vessel districts were then dismembered to test the pulse.

Verkruysse et al. [15] implemented an HRM protocol that involves reflective surfaces through touching. They used concealing films captured as test data by an all-encompassing camera and genuinely recognized several differentiating regions of interest (ROI) on a human face. The rapid change in Fourier was done to pick the intensity of frequencies in an ROI given by the RGB tones. They have shown that measurements of heartbeat from the human face are feasible with a run of the mill using light as the source of illumination.

Pursche et al. [7] paper depict a video-based estimation of the heartbeat area conducted to detect the physiological changes of the subject under an easy condition and to remember the motion. The picked ROI is separated into three areas and the mean characteristics of the pixels are resolved for all of them. The independent component analysis is performed to obtain a sensible sign after which top recognition is used to pick the beat that even a motivating force had taken out of the picture. As the manufactures note, the calculation does not yield "real-time" results; however, the characteristics acquired are exactly as predicted when different from other HR testing strategies appeared.

Garbey et al. [14] proposed a technique for calculating circulatory system velocity and vessel territories from warm infrared footage, dismembering the arm and wrist zones for pulse measurement; the recently cited systems are fundamentally liable to cost expensive warm infrared cameras, which can be hard to apply in negligible exertion.

3 Existing System

The Doppler microwave radar utility used for home testing was also extended late start. For example, the electrocardiograms are aggravating consuming misused people or late considered infants [16, 17]. Considering the Doppler hypothesis, a target with a semi-incidental advancement demonstrates the sign is transmitted with its stage changed when the goal situation varies [18–21]. Therefore, due to heartbeat and breath, the reflected close down the chest of the person contains information about the chest migration. On the other hand, the considered sign while holding breath depends on the movement of both the chest due to heartbeat alone [22, 23].

3.1 Disadvantages of the existing system

- Accuracy is low when contrasted with new calculations.
- It additionally requires some computational gadgets.
- Implementation cost is high.

4 Proposed System

The suggested system relies on using up to 20 GHz of operating a vector network analyzer (VNA) (Agilent N5230A 4-Port) and two horn radio wires. Numerous highlights are available, such as the decision of the scope time and the quantity of calculation focuses, using a VNA; Likewise, the transmitted sign's recurrence and emanated strength can be set and changed, and the time variety of the transmission coefficient S21 duration can be calculated. Due to the VNA's minimal recurrence (20 GHz), an up-change technique is used to achieve a signal of 60 GHz (Fig. 1).

The designed multi-frequency structure and the 60 GHz RF squares are represented in complexities. At absolute reuse, the VNA produces a continuous wave (CW) signal. The reflected closing of the person's chest is transmitted by the radio wire and has started to go into the VNA, where the time of S21 is handled. This stage links between the time the gathers and the sign transmitted with the credential. Calculations are made at several frequencies, respectively: 2.4 GHz, 5.8 GHz, 10 GHz, 16 GHz, and 60 GHz.

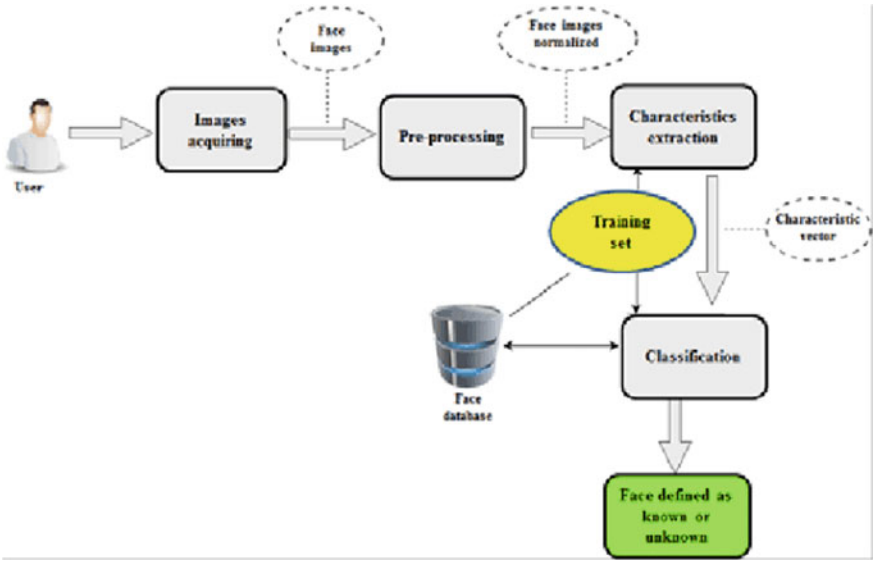

Fig. 1 Overview of the proposed system

4.1 Advantages of the Proposed System

- Accuracy is high.
- High computational handling.
- Independent of ethnicity.

5 Modules and Description

5.1 Facial Landmarks

Recognizing facial places of interest is a subset of the issue of shape estimate. A shape marker tries to limit key core focuses along the shape, provided an information image (and consistently a ROI that determines the object of interest). As regards facial places of interest, our goal is to perceive vital facial structures on the face using speculation systems of design.

5.2 Face Region

Many facial performance locators, but all treatments are basically aimed at restricting and impressing the position of the sensory organs in the face.

5.3 Recognize Face

Image exposure is a machine device used for showing human faces in cutting edge photographs in a variety of jobs. Face revealing also demonstrates the psychological technique by which individuals identify and interact with the appearances in a visual scene.

6 Conclusion

The proposed system shows the probability of describing the progress of heart beat at different working frequencies and assorted levels of strength. The device has been checked at GHz 2.4, 5.8, 10, 16, and 60. Higher affect ability to tiny expulsions at higher operational frequencies was found. The projected system, engaging at 2.4 GHz, shows the flexibility to differentiate the center activity at associate exuded power level as low as −27 dBm. The heartbeat signal licenses area of the apexes

evacuating the heartbeat rate but also pulse variance. The proposed system shows the probability on describing the progress of heart beat at different working frequencies and assorted levels of strength. The device has been checked at GHz 2.4, 5.8, 10, 16, and 60. Higher affect ability to tiny expulsions at higher operational frequencies was found. The heartbeat signal licenses area of the apexes evacuating the heartbeat rate but also pulse variance.

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Threat Level Detection in Android Platform Using Machine Learning Algorithms

D. Deepa, Sachitananda Jena, Yadavalli Ganesh, M. S. Roobini, and Anitha Ponraj

Abstract Android and Mac OS apps have become an important asset of our daily lives of mobile device users by which translates into an increase in mobile applications. Now, a one-day user can access an ample amount of applications through different platforms like play store, apple store, etc. Due to a certain amount of vulnerabilities, hackers are developing mobile malware, which in turn threatens the system and can lead to remote control, loss of privacy, etc. Therefore, it is necessary to detect the threat level of a certain application installed on mobile devices. In this next module, we present an approach in which we allow the user to select any application from the play store, where the user has the possibility to select a specific authorization, and the privacy policy extracts a list of relevant phrases and presents them, together a proper describing of the permission from the user . This interface allows the user to quickly evaluate the private owned risks of android apps that are highlighting the relevant sections of the private policies that are owned by them and providing useful information on sensitive permissions, a particular application has authority on it.

Keywords Privacy aware components · Naive Bayes · K-means clustering · K-nearest neighbor · Data Flow Diagram (DFD)

1 Introduction

Before the interface allows the user to search for any apps online, a list of permissions and the private policies are required to be retrieved automatically whenever it is possible [1]. The user has the option to select a specific permit, and the privacy policy extracts a list of relevant phrases and is presented to him, together with a precise description of the permit itself [2, 3]. This process then allows the user to quickly evaluate the private risks of android apps by highlighting the relevant sections

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of the private policy which is owned and providing useful information on sensitive permissions [4]. We present a possible new approach through which the analysis of private policies in the context of android applications [5]. The app we plan to implement greatly facilitates the process of understanding the private information related to installing third-party apps, and it has already been shown that it is able to highlight worrying cases of apps [6].

The process by which the tool is developed that has been taken into account of the process of expandability and subsequent developments that can be done to approach and can be easily integrated to increase reliability and efficiency [7]. In addition, if the application manages your personal or confidential data, also see the other requirements in the "Personal and Confidential Information" section below [8]. These online requirements add to the privacy or data protection law requirements to ensure security or privacy [9].

2 Related Work

Yerima et al. [10] proposed a survey consists of learning and detection phases in an android app. The learning phase generally consists of training set of harmful samples known in nature and another set of android applications, together when combined referred to as the application corpus. Empirical results and comparative analyses are presented that offer useful information for the development of effective solutions based on the static Bayesian analytical classification to detect unknown android threats [11]. The limits of traditional existing system, as well as feasible to filter applications for further analysis with complementary methods or manual reverse engineering analyzes by security analysts, thus reducing the costs and hard work required to discover new threat samples [12, 13].

Zhang et al. discussed about the system of the individual gathering private information that protects the system based on any platform and any key execution techniques. [14] If any system could meet the user's functional and non-functional requirements, with stable operation and high efficiency in carrying out the activities, then that system is not efficient. The greatest problem is as same as the screen lock, which makes normal use of cell phones difficult [15].

Felt et al. proposed and developed new techniques to detect privileges in android applications. [16] And apply automated testing techniques to our results show that applications generally have excessive privileges with only a few permissions, and that much additional permission can be attributed to the confusion of the developers. This indicates that developers try to get minimal privilege for their applications but fail due to errors in the API documentation and lack of understanding from the developers. The android API is too large to test all interdependent classes simultaneously, so in practice many objects are not available in the sequence group [17].

Wang et al. projected android permissions to accomplish this, static investigation includes a few double measurable procedures, [18] including decompiling, unscrambling, model coordinating, and examination of static framework calls. Examination

of hazard signals dependent on approvals. To acquire a premise, and initially apply the main other instrument which has been distributed to distinguish chance dependent on approvals, to be specific Kirin [19]. The present android approval cautioning approach has been insufficient in controlling malignant applications [20, 21]. This is mostly because of the way that the present authorization shows instrument flops as a powerful hazard correspondence system, as it cautions the client of hazardous consents in practically all authorizations. The present android approval cautioning approach has been extremely incapable in checking malevolent applications. This is mostly because of the way that the present authorization show component flops as a powerful hazard correspondence system, as it cautions the client of perilous consents in practically all consents [22].

Yang et al. about the app intent and analyzing sensitive data transmission in Android for Privacy Leakage Detection and extricate the base way (utilizing the Dijistra calculation) as a chain of occasions, which are actuated in grouping in the representative execution [23]. Right now, present our assessment results on [24] AppIntent's viability and exactness. In our assessment, representative execution driven by occasion space impediment utilizes an Intel Xeon machine with two eight center 2.0 GHz CPU and 32 GB of physical memory, which runs Debian Linux with form 2.6.32 of the piece. AppIntent-controlled execution runs on Android 2.3.

3 Proposed Work

From Fig. 1 shows the block diagram which can be easily explained through various modules that define the governance of the application used by the user to check and verify the presence of malware present in any of the applications present in the following android platform. The following modules are (a) Login/Registration, (b) Scan the android application, (c) Malware detection, (d) Android permission check.

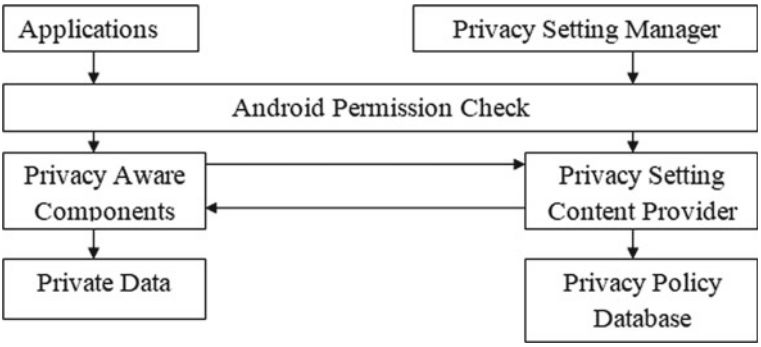

Fig. 1 Block diagram

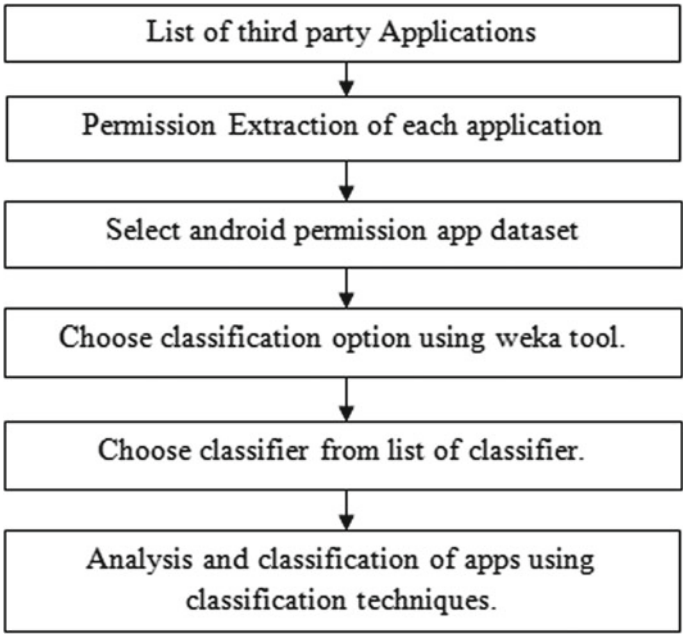

Fig. 2 Flowchart

Fig. 2 shows flow of proposed work can be explained through the concept of DFD. The DFD is a two-dimensional diagram that describes the data is processing and transmission inside of a system. The graphical representation recognizes each data source and how it interacts with other data sources to achieve a mutual result. To draw up a data flow diagram is necessary

- First step is to identify external inputs and outputs.
- Calculate how the inputs and outputs those are to be obtained through the process.
- Then, we should explain with the help of graphics how these connections are connected with each other and how they yield result.

(a) **Login module**
The very first activity that opens when the user opens the website is the login module. The user must provide the correct contact number and password details that the user entered during registration process, to access the website. If the information provided by the user is as same as the data that is registered to the data in the database table, then the user is allowed to accesses the website; otherwise, the login failed message is displayed, and the user must re-enter the correct details to register yet again.

(b) **Registration module**
Any person who wants to use or access the application that is available on the platform must register his/her details before logging in. Clicking the register

button in the login activity opens the registration activity, which allows the user to work on it. After the following steps, the person is registered by entering their personal details managed by the database. A user must re-enter the password in the password confirmation. When the user enters the details in all the columns and rows, the data is transferred to the database by clicking on the register button and the user logs in again. The registered user must log in to access the application. Validations are applied in all text boxes for the correct operation of the application. Like the information in each text box, it is essential that each text box, be it be any personal details including password for confirmation, will not be empty during registration. If one of these text boxes is empty, then the application will provide an informational message in each text box. Another validation is that the contact number must be valid and have ten digits, i.e., if the country is India. If any one of this rules is violated, then the registration will not be successful, and the user will have to register yet again, that is, the modification of the database. If all of the above guidelines are followed, then that person registration process is successful.

(c) **Application download**
In this module, many applications are already downloaded in mobile phone through play store or app store depending upon the mobile they use. After successful installation of the app, just find the malware present in various applications.

(d) **Android permission check**
Whenever an user who wishes to run an application he/she has to install the app and if the user doesn't understand the meaning of the permissions requested by an organization, and simply allowing all the permissions to all the applications that are available in the platform so as to yield a result of which harmful apps getting installed due to malicious activity behind the scene.

4 Results and Discussion

Initially, Fig. 3 we will identify the all third-party applications by means of scanning process that is installed or any other hidden activities running in the background of this platform. Then, try to extract the complete list of permissions of each application in the mobile device. Identify threats if possible by you. Take android app permissions to the dataset. Fig. 4 To identify the harmful applications apply classification algorithms. Note that the accuracy of spam classification given by the system and time required for execution varies from one platform to another. Results as accuracy among different harmful and normal apps classifiers are analyzed, thereby enabling the user more security for their platform they work on.

From Fig. 5 showing the graph about comparison between existing system software and proposed system software.

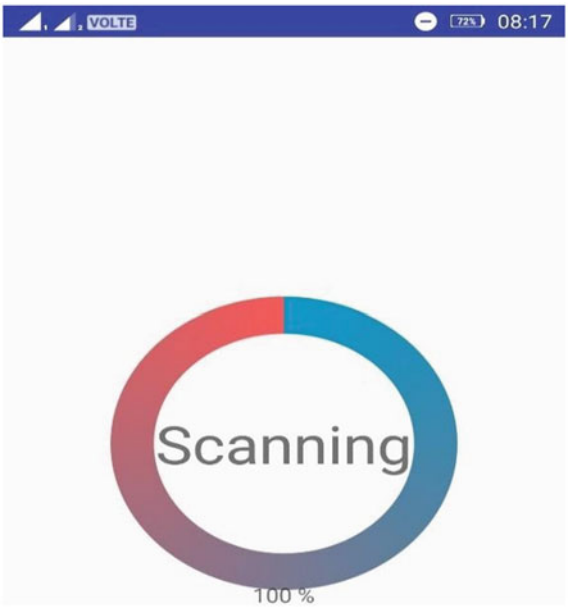

Fig. 3 Scanning in progress

5 Conclusion

The proposed system suggests that if any app that can handle personal or sensitive user information which are also called as additional requirements in the "Personal and Sensitive Information" in the given. These online requirements are in addition to any requirements as prescribed by any applicable private policy or data laws ensuring the safety of the user's application. This proposed shows that any user who wishes to install and use any third-party app doesn't understand the meaning of the permissions requested by an application, and thereby simply allowing all the permissions to all the apps that are available in the platform so as to yield a result of which harmful apps getting installed due to malicious activity behind the scene. Future works involve making of this approach available at a larger scale.

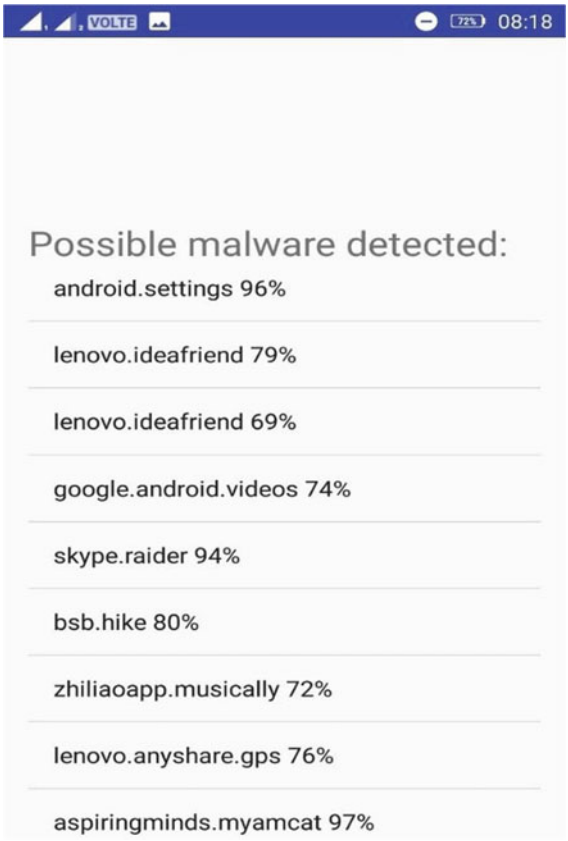

Fig. 4 Malware percentage

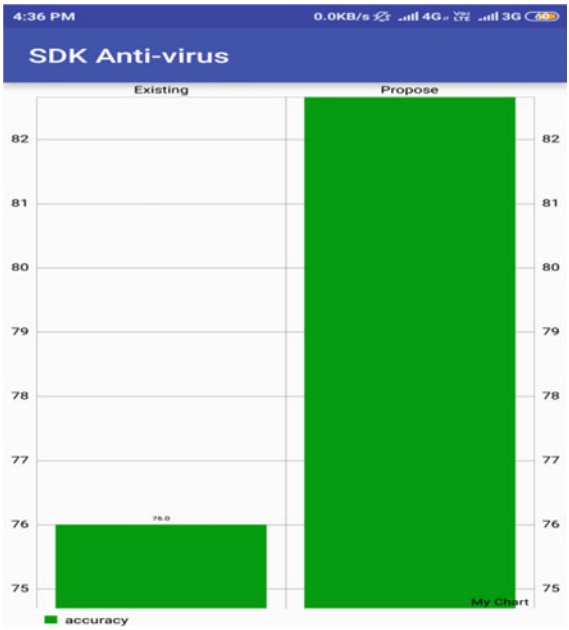

Fig. 5 Existing versus proposed graphs

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Implementing Urban Surveillance Systems in Smart Cities by Automated Object Detection Using Convolution Neural Network

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Abstract In the prefecture of this project is to conjure an accurate but yet cost-effective, viable solutions used in detecting number plate region by implementing the system and technologies needed to process the image locally and convolution neural network (CNN). In the world of smart cities, the object detection algorithm has become a crucial element in it's working. In urban surveillance applications, the image sensor/camera acts as a crucial aspect in the process of virtualizing the scene in which the scenario is monitored. A singular united deep convolutional neural network has been proposed that enables the ability to detect car/bike license plates to be obtained from a certain captured image and aids in recognizing the labels that have been captured. The whole structural integrity involves the need of any heuristic or tiring processes, such as the use of any provisional plate types or distinct character differences and also eliminates any intermediate procedures.

Keywords Car plate recognition and detection · Convolution neural networks · Image processing · Firebase

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1 Introduction

In the curious quest of implementing urban surveillance and the proprietary parts of it's system bloomed an idea behind our idea on the proposed functioning system that it assists with the processes of the image locally and deep convolutional neural network (CNN) techniques are put forth to help aid the process through number plate region-based detection and recognition [1, 2]. Our solution helps to satisfy the or aid the boost of urban security and discipline in areas where traffic seems to be an issue due to the increment on the number of cars in a smart city [3]. This system contains of a unique combination of technologies that are readily available in the market for purchase and use [4, 5]. A sophisticated deep convolutional neural network is put forth that helps to take multiple images and result's in the license's plate location and also gives us the plate labels simultaneously [6, 7]. It is a system that performs this function with high efficiency and accuracy. This system not only eliminates the intermediate steps that tend to accumulate errors but also acts as a catalyst for processing speed [8]. The union of both detection and recognition losses is taken into consideration and is jointly optimized [9]. The extracted features however would provide richer data and information for the later steps [10, 11]. This also helps in lesser time consumption, and thus, the time for processing the data is low [12, 13]. The algorithms that deal with edge detection algorithms help to assist in an accurate portrayal of arrays obtained from the image. The system addresses this problem by using computer vision [14, 15]. We were using a singular centralized computing server to help analyze, process, and store the collected data with the help of various image capturing devices that are littered throughout the smart city [16, 17]. Previously, all the input images were manually taken by assigned staff of a roadside established management and have been carefully annotated [18]. The updated license plate detection and recognition (LPDR) reacts in a different manner by approaching the problem by the evaluation on a minute and has a sophisticated vast dataset because of the lack of a singular huge diverse data-hub [19].

2 Related Surveys

2.1 The Implementation of a Trainable Neural Network—(2015)

Shi et al. [20] have put forth an implementation of sequence recognition for image-based processes can be done by using a highly trained type of neural network. This has a particular feature that helped in on-scene text detection. RNN had a certain advantage being that it did not need the specific location of each element. This made sequencing for an object easier to both train and test. The data manipulation involved in conversion of the obtained image and feature extractions were a crucial step in the whole framework [20].

2.2 Text Reading and Localization Using Convolutional Neural Network (CNN)—(2016)

Jaderberg et al. [21] brush upon using CNN's to help capture text in the wild scenarios. This system deals with text spotting, localization, and recognition in natural environments for image-based text retrieval. This system is an end-to-end design and is based upon a regional classification for detection and deep CNN's for recognition. The framework has been tested using CAPTCHA examples that are eight characters in length. It demonstrated performance in an astonishingly good manner by using synthetic training solutions for the problem [21].

2.3 Detection in a Vast Environment Using Density-Based Boundary Clustering—(2017)

Tian et al. [22] have characterized the license plate detection in a free and vast environment by implementing boundary clustering based on the density of elements. The whole process of detection is quite bare-bones and rapid. We tend to obtain more data about the license plate using this technique. Varying lighting and behind the scenes factors tend to affect the whole process and hence making it a tedious task to fulfill and also making the open scenario factor even more challenging. Time consumption takes a hit as we require real-time results [22].

2.4 Deep Learning Implementation in LPDR—(2017)

Selmi et al. [23] discuss about the topic on deep learning frameworks for automated license plate detection and recognition (LPDR) processes. Speaking on vehicular motion, the detection of movement of the license plate helps in the recognition process and is a key element in LPDR. This field of image processing is quite active in the world today as it unlocks countless possibilities. Sophisticated hardware modules are needed for image capturing and also are needed for high quality motion capture. Detection and recognition of license plates are tricky in situations where under drastic day-to-day weather variations, it is always tough to obtain accurate results [23].

2.5 Implementation of the Usage of CCPD and Efficiency Boosts—(2018)

Xu [24] states the usage of a recently obtained vast dataset and baseline to be used as a source. As far as research is concern, the most massive dataset that is publicly readily

available to date is the CCPD. It has more than 250,000 distinct vehicle images. It also provides vertices and postional annotations. Through comparative experiments, the results obtained in the speed and accuracy areas of this process have proved to be vastly superior than previously used object detection algorithms. The subsequent recognition failure is due to an imperfect bounding box that may eliminate a part of the plate. Extractions and resizing are operations dealt with older hardware such as less efficient CPU's making the process reasonably slower [24].

3 Proposed Methodology

In this initiative, we are proposing a unique combination of technologies which were available in the market. We are proposing to do the image processing in the local environment. The images from the camera were processed near the camera itself, and the results were published to the central server for further processing. The scope of this project is to present a cost-effective viable solution. Therefore, we will be implementing the system and technologies that are essential to process the image locally and convolution neural network (CNN) techniques used in detecting the number plate region.

In the past attempts in the field of recognition and detection of license plate algorithms, usually recognition and detection have been categorized into two separate processes. They are later solved by using relatively different methods. This is a major slow down to the whole LPDR process and hence needed to be addressed. Come to see of it, the processes involved in plate detection and recognition and very much correlated. The accuracy of recognition can be improved by using accurate bounded boxes that are obtained from the detection method. The recognition process is then completed, and the results point out to various false positives that can later be eliminated and vice versa. Therefore, we put forth a unified framework that helps to help achieve recognition and detection processes on the same level. A convolutional neural network is made out of intricate design plans. It fetches the image captured and then outputs the license plate's location and also the labels that pertain to the plate with astonishing accuracy and is simultaneously both, highly efficient and reliable. We help to prove that features can be used to help in urban surveillance and safety (Fig. 1).

4 Working Methodologies

Methodologies are the process of analyzing the principles or procedure for providing priority to the image and the preprocessing techniques used and also the filter and noise reduction process that are involved. In these techniques, we can analyze the image obtained and provide the next process to the neural network in branch way,

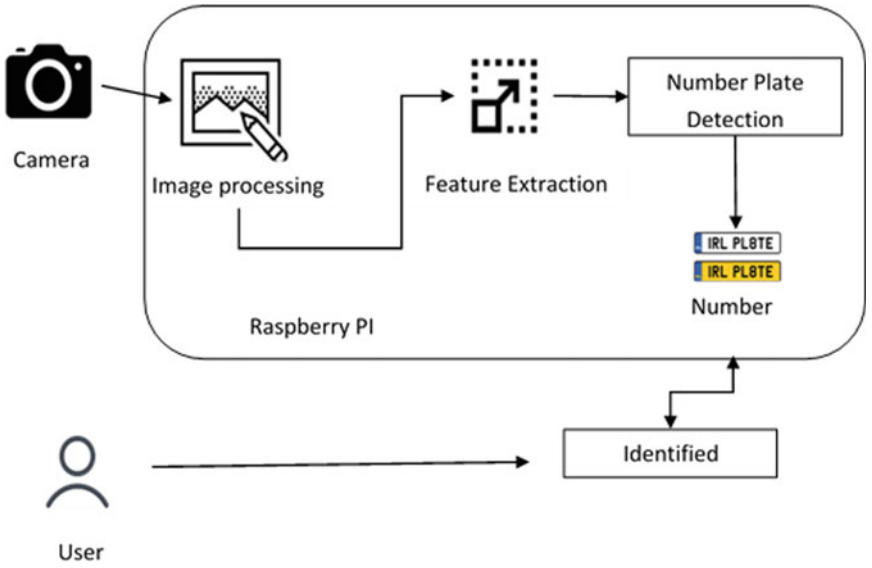

Fig. 1 Show the architecture diagram of the proposed system

and after completing the task, provider bounds to send the data to Firebase and hence sending the mail.

4.1 Image Capturing

The image capturing module deals with the implementation of a good framework that sets a reliable environment to perform well. The preparation of a better environmental variables shows better results for a python environment. Better hardware provides better results. This module of the system deals with capturing the input for the system to process. Hence, it also plays a crucial role of the initial process. This process, being so crucial needs to be paid more attention. The way of getting results is to get a camera with a great resolution and good shutter speed and ISO settings. This enables the computer to get images even in rough situations or even obtain images during bad weather. If the budget is flexible enough, then we can also upgrade to thermal cameras or 360° cameras such as GoPro's to help get better images.

4.2 Frame Cleaning and Framing

We then obtain the input image needed for processing. We implement noise reduction filters to help in the elimination of noise. The module is put into effect. Initially, the

obtained input is run through code and is converted into a monochrome picture. In the next step, we strip of all the values that are assigned to the pixels that correspond to the native colors. We then replace those values to that of the grayscale assigned ones. The new set of pixels should have a value of between 0 and 255 per pixel. Edge detection algorithms are deployed (Fig. 2).

4.3 Detecting the Number Plate Using Contours

After the process of edge detection and the implementation of the algorithms necessary, all the highest valued pixels are analyzed throughout the X and Y axes, in a horizontal and vertical pattern, respectively. The heatmap of the number of bright pixels will give us a decent perspective of the location of the amount of edges. It is based on the concentration of pixels and is scanned via the X-axis. It provides the probable position in the X-axis. The intensity of bright pixels in the y-axis is analyzed. We obtain the probable position of the Y-axis also. We can also state that the various custom text or images that may also be present in the car may hence this grabs the interest on the number plate to be of more than one region.

4.4 Transforming the Number Plate Image into Text

The interested region in the number plate area is specified in the previous process. The optimization of the number plate now initiates according to the obtained edges. We can state that followed by identification of the given region of interest; we can edit and manipulate the image based on the probable location of the number plate by using cropping tools. The convolution neural network (CNN) algorithm is performed. The module is deployed, and the obtained output image is then processed with an easy optimal character recognition software to convert to a text (Fig. 3).

4.5 Region-Based Convolutional Neural Network (R-CNN)

R-CNN was first invented by Ross Girshick in the year 2014. Region-based convolutional neural network (R-CNN) is the combination of two ideas. Firstly, in the task of vertical-pruning region approach, we need to perform localization and segmentation to certain elements; we can apply a highly optimized convolutional neural network (CNN) to aid the task. Secondly, when labeling the obtained data is rare, then we can significantly boost performance by pre-training for any secondary process in a supervised manner, which is later followed with domain-specific optimized fine-optimization for catalyst-based processes and data manipulation. The product from the above two mentioned statements have a common ground in combined region

Fig. 2 Image frame cleaning and preprocessing

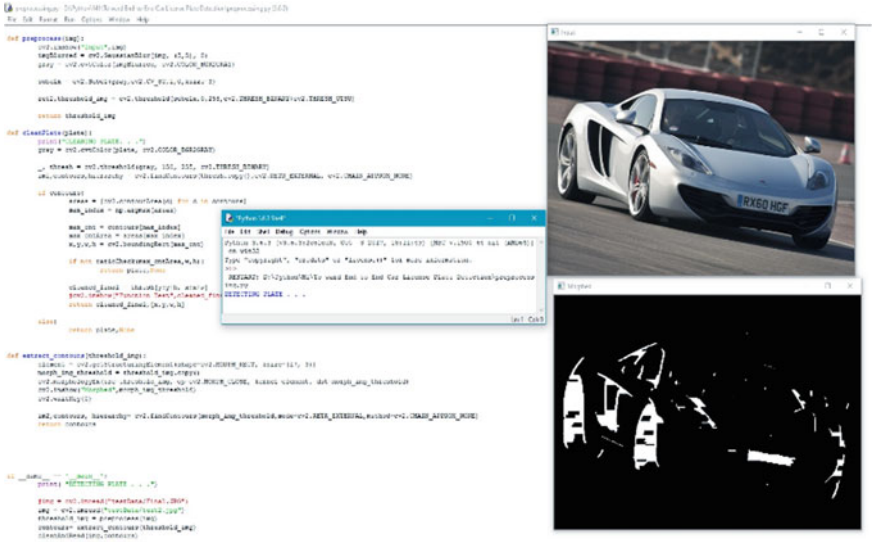

Fig. 3 Usage of contours for feature extraction and number reception

proposals with certain traits pertaining to CNN's, and hence, the final design for the structure of such a region-based network is come to be known as an R-CNN or region-based convolutional neural network. In R-CNN, we input an image and then using the basic feature detection algorithms such as edge detection, region-based mapping, specific area monitoring. We then obtain the needed region of proposals also known as regions of interest. The whole process can be labeled as selective search and is one of the main features of R-CNN's. After we obtain these said region proposals, we move on to the next step. The region proposals are extracted from the wrapped regions of the image; they go through an already trained CNN for further data analysis and extraction. We then implement AlexNet on the final layer of classification once the whole process of extraction is completed. The support vector machine (SVM) is then put into play. It helps us to categorize whether the input was an intended object or not by using techniques to add weights to the various parts of the image and then using threshold differentials to later eliminate those that do not fit the criteria of an "object."

The implementation of R-CNN works astonishingly well when it comes to real-time object time detection. The reasons stating that the requirement of a forward pass of the convolutional neural network (CNN), i.e., AlexNet for each and every single region proposal every time an image is inputted. This causes a lot of computational power, and hence, the systems behind the whole framework must be able to handle such load. It maybe 1500–2000 forward passes for each input. Secondly, every model must be trained individually, i.e., the image features that are generated from the CNN, the in-built classifier which predicts the class, and finally, the custom valued regression model that aids to tighten the bounding boxes. All these models need

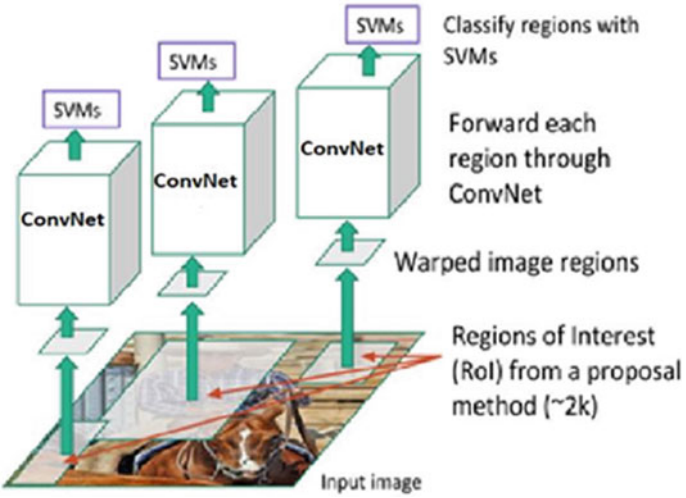

Fig. 4 Working of R-CNN

extremely accurate and reliable training methods to run efficiently and smoothly, hence making the pipeline very hard to train (Fig. 4).

4.6 Firebase

Firebase is used to assist with the process of fetching the output from the neural network and send it to the email address of the respective person to whom the authorities should report. This cloud service was known as Google cloud messaging (GCM) or Firebase cloud messaging (FCM) and is a very helpful mechanism when it comes to send messages via the cloud and also helps in transmitting various kinds of data to authenticated devices securely and reliably. It is a cross-platform solution as it is compatible with Android, iOS, and other various web applications to send and receive messages and also supports notifications during the transmission or reception of messages. The main advantage of Firebase is that we can use such a viable commodity for absolutely no cost as it is a free to use cloud-based messaging tool. This feature helps promote portability and also ensures that when the devices have Internet connectivity, then it assures guaranteed data transmission. In the past attempts in the field of recognition and detection of license plate algorithms, usually recognition and detection have been categorized into two separate processes. They are later solved by using relatively different methods. This is a major slow down to the whole LPDR process and hence needed to be addressed (Fig. 5).

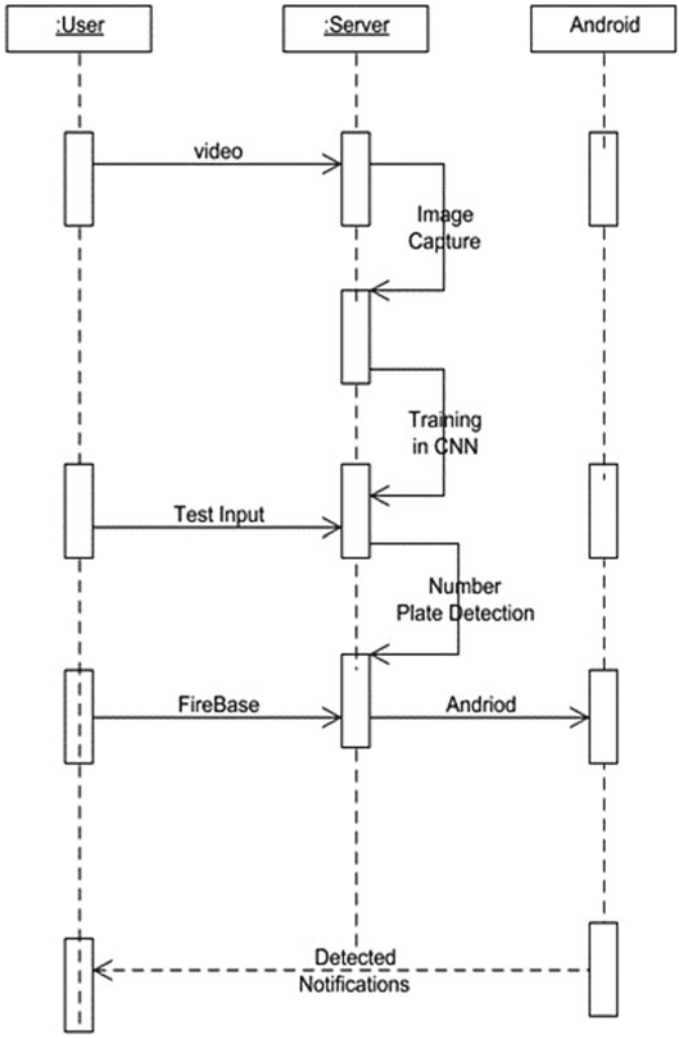

Fig. 5 Sequence diagram of the workflow

5 Experimental Result

Once the data structures are put into place and the documentation of each of the algorithms are taken, we can now move on to the software testing phase. In the need for the correction of errors, intentional or not, testing needs to be implemented in various form factors to check the vulnerability of various bugs or logical errors that may be present within the system's design to eliminate any flaws. The quality of the software that we produce must be of the highest, and hence, we perform various analysis to conjure an impeccable software solution. We can assess the most critical aspect of

a software, i.e., software quality assurance. The specifications of the implemented design of code will be ultimately tested here. We implement various test cases in the hope of the probability of finding a yet undiscovered error. The number plate obtained must be properly stored and sent to the designated destination. The testing points to the logical and syntax-based errors that can occur during program testing. A syntax error needs to be eliminated as it violates one or more rules. We should check for improperly defined field dimensions and omitted keywords. Incorrect data fields, invalid combination types, and out-off range items constitute as logical errors. The programmer must diagnose the output himself as logical outputs may not be detected by the computer as it has a set logical system built-in. A condition test must also be put into play as many of the conditional statements must be justified of it is purpose and also clean the slate of any unconditional errors that may lead to wrong outputs.

6 Conclusion

The key factor to the success and long duration of any system is user acceptance. The problem is hence tackled by using a real-time solution and hence even reducing time complexity. After testing and the final product is achieved, we can say that this project may help to aid social security and also portray the "power of images." Just by capturing a single image of a car moving when it isn't supposed to move can have a huge impact on society, we implemented image capturing and image processing techniques and followed various protocols. We then used R-CNN's to aid in automated object detection and obtained a final extraction image. We then broadcast the image over to authorities where rightful actions take place, and justice is served. In a world was various accidents and threats increasing day by day, we hope that technology such as this help monitor an urban environment and also provide unparalleled safety and security (Figs. 6, 7, and 8).

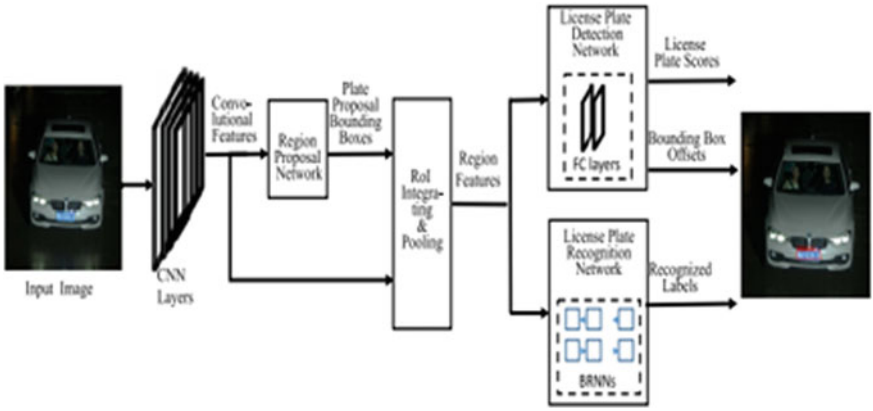

Fig. 6 Working of R-CNN in the LPDR

```
...:                 timeCheck = datetime.now().strftime('%Ss')
...:                 # Read next image
...:                 t_minus = t
...:                 t = t_plus
...:                 t_plus = cv2.cvtColor(image2, cv2.COLOR_RGB2GRAY)
...:
...:             if ret is False:
...:                 cap.release()
...:                 cv2.destroyAllWindows()
...:                 cap = cv2.VideoCapture(0)
{"LocationID":"1","DeviceID":"32","DeviceTime":1582760991027,"Class":1,"Count":0}
pixelDiff:148534
{"LocationID":"1","DeviceID":"32","DeviceTime":1582760992165,"Class":1,"Count":0}
pixelDiff:169088
{"LocationID":"1","DeviceID":"32","DeviceTime":1582760993102,"Class":1,"Count":0}
pixelDiff:165486
{"LocationID":"1","DeviceID":"32","DeviceTime":1582760994085,"Class":1,"Count":0}
pixelDiff:162506
{"LocationID":"1","DeviceID":"32","DeviceTime":1582760995134,"Class":1,"Count":0}
pixelDiff:158405
{"LocationID":"1","DeviceID":"32","DeviceTime":1582760996118,"Class":1,"Count":0}
pixelDiff:160484
{"LocationID":"1","DeviceID":"32","DeviceTime":1582760997092,"Class":1,"Count":0}
pixelDiff:158902
{"LocationID":"1","DeviceID":"32","DeviceTime":1582760998085,"Class":1,"Count":0}
```

Fig. 7 Real-time image rendering and processing

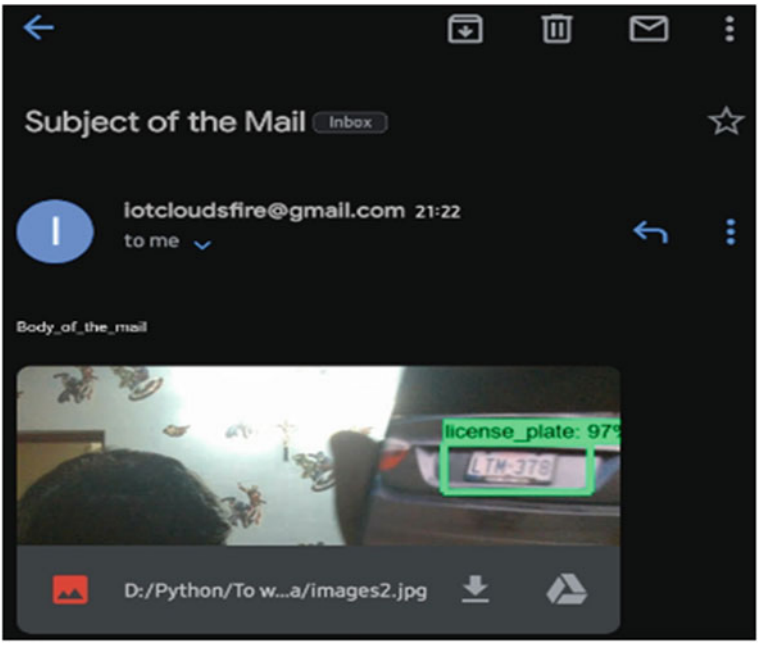

Fig. 8 Reception of the obtained image via Firebases

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Blockchain-Based Incentive Announcement In Vanet Using CreditCoin

P. Phani Sankar, P. Anil Kumar, and B. Bharathi

Abstract Ad hoc networks for cars (VANET) otherwise referred to as systems for wise transportation. In order to improve road well-being and maximize highway efficiency, VANET guarantees auspicious and exact match between vehicle to vehicle (V2V) and infrastructural vehicle (V2I). VANET is ineffective against malicious networks that can get into the structures and trigger real Medium Access Controls (MACs). It involves denial of service attacks, modification of knowledge, pantomime attacks, Sybil attacks, and replay attacks. Great security issues emerge with the proliferation of Blockchain. At the same time, a sample remains open for protection and discernibility. Steps were made to address the problems, thus revealing them to specific events. We are considering an echo statement in CreditCoin automobile declaration convention. This guarantees flexibility and security for use in the submission of comments. In CreditCoin, we design a stimulus portion centered on the Blockchain. When they gain or invest coins when driving powers, they track legendary focuses. In the meantime, CreditCoin does jam protection and keeps black. However, CreditCoin foreshadows a number of security threats and allows dependent defense in view of Blockchain, as trace manager approaches malignant hubs in an awful case.

Keywords VANET · Blockchain · Vehicular communication · Privacy · Security

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1 Introduction

In recent years, both foundations and business have taken Blockchain into account [1]. Blockchain is a novel worldview where skeptical gatherings make exchanges and oversee information without including a dependable outsider. Here, exchanges allude to cooperations happened between these gatherings. Blockchain accomplishes alter obstruction and detectability for the exchanges, offering secrecy and decentralization for the gatherings [2]. Because of these propelled highlights, Blockchain can be applied into a wide range of utilizations, running from cryptographic money, budgetary administrations, publicly supporting frameworks [3, 4], and Vehicular Ad Hoc Networks (VANETs) [5, 6]. As indicated by a report from meticulous research, the worldwide Blockchain market will hit $28 billion by 2025 [7]. Be that as it may, alongside its ubiquity, Blockchain has come an expanding number of attacks, seriously undermining the unfortunate casualty's security and protection. With respect to security, in spite of the fact that Blockchain can give namelessness naturally, it subjects to different digital attacks. For instance, Fergal et al. [8] show that an aggressor may exposure the genuine character of a given injured individual by dissecting his open exchange history. Endeavors have been made to counter these attacks. A model that tends to the protection concern is HAWK proposed by Kosba et al., putting away the encoded exchanges rather than plaintext ones so that the value-based security is ensured [9]. The term security in our paper alludes to information protection except if expressly expressed in any case. In information protection plots, the characters of gatherings are open. In any case, given a message, no productive foe can decide whether the message is from a particular gathering [10, 11].

Blockchain is a groundbreaking record-based database technology. Blockchain was introduced to Bitcoin by Satoshi just beyond the bat [4], a decentralized e-money framework. Blockchain becomes more and more relevant for web-based companies subsequently. Recently, because Blockchain-based Bitcoin is well recognized, it has become a hotly debated topic. In addition, center deals with doubles a whole or part of a database from the network of Blockchain-based systems. In this way, Blockchain-based systems aim to record information for the great characteristics of the modification and decentralization that VANETs esteem. There are two important problems creating a strong vehicle declaration agreement with the increasing safety concerns of information [5–8]. To start with, in a perfect world, all messages must be sent secretly in VANETs since they for the most part contain delicate data of clients, for example, vehicle numbers, driving inclinations, and client personalities [9, 12]. In any case, sending messages secretly doesn't guarantee the unwavering quality of the messages, in this manner diminishing the credit of vehicular declarations [13, 14]. Second, clients for the most part need excitement to advance any messages in VANETs if there is a hazard that their protection will be broken. Furthermore, clients don't profit by sending declarations, which additionally makes them need inspiration to react to messages [15].

Right now, request to determine these two issues, we fabricate a successful system for correspondence of savvy vehicles. Specifically, we propose a novel protection safeguarding impetus declaration organize dependent The CreditCoin on Blockchain, which contains two sections, the declaration agreement and the reward system. To the best of our knowledge, CreditCoin is the biggest safety savings motivational factor in VANETs rooted on Blockchain. It can generate trust in savvy vehicle correspondences. We suggest an echo-announcement in CreditCoin vehicle declaration conference. It saves ability and defense in the sending of statements for strategic use [16]. We plan an impetus system dependent on Blockchain in CreditCoin. Clients oversee notoriety focuses while they acquire or spend coins as impetuses. In the mean time, CreditCoin still jelly protection and accomplishes namelessness. Besides, in light of Blockchain, CreditCoin forestalls some intrusion breaches and stringent defense because when a surprising occasion arises the trace boss may obey pernicious hubs. CreditCoin is implemented methodically in the network simulator 2 and Java runtime environment 1.8 replication of high-speed transport. The test results reveal that in the reenactment of the professional and shrewd cars, CreditCoin is successful and innovative.

2 Related work

Wazid et al. [1] proposed Lightweight Decentralized Validation and Core Key Understanding Convention (LAKAP) for VANETs, utilizing one-way hash and bit-limited OR (XOR) tasks [15]. The proposed lightweight convention provides several highlights: It allows the device to provide diverse roadside unit choices after start-up, gives RSU the main RSU base as well as a nameless and intrackable environment, among other special features. In addition, three-validation procedures are proceeding: between vehicles, between vehicle heads and their specific category heads (CHs), and between CHs and their RSUs. In order to reduce estimation, scientists received a community device layout

Cui et al. [3] proposed monitoring of secure safety services conspires to improve the security and protection of customers through VANET with cuckoo line, as well as to restrict overhead correspondence [17]. The researchers suggested the usage of the cuckoo channel and combined hunting techniques in order to achieve higher rate of success than other confirmatory testing systems focused on PKI. In fact, the researchers suggested another test, which would contribute to enormous computing expenses, without bilinear pairings.

With security concerns in VANETs increasingly that since messages should be sent anonymously in VANETs, a few attacks have taken a consideration [18–20] (e.g., the Sybil assault). Such threats occur in an association of consumer protection and the unequivocal nature of the document. This has contributed to the primary issues of protection, e.g., namelessness, security, interconnectivity (i.e., a relation between two markers of a message identical to that of a single supporter), and recognizability.

Kounga et al. [21] proposed to monitor the age of the names of feathers that were forestalling the attacks of Sybil. Wu et al. [22] used special authentication and message-related logos to identify malignant consumers. Nonetheless, the next step requires expensive mixing operations, so that questionable communications are inefficient. The unknown declaration (i.e., the TA Announcement) suggested by Chen et al. [18] conspires with direct, enigmatic justification, and unknown one-time confirmation. The accreditation of the dangerous consumers can not be easily renounced in their scheme, thereby rising the profitability of the company by visiting assaults by malevolent cars.

Qin et al. [23] were provided a secure RSU by aliases managers, and Xia et al. [24] proposed an arrangement to submit versatile, high-quality encrypted mixed media information. Nonetheless, the structuring of these conventions [23] is a difficult undertaking [24], as the RSU is required to hide or encrypt numerous special messages in the standard VANET as light-security equipment [25].

Credit agreements are a typical strategy for displaying the relationships between customers in the network. In credit organizations, any hub is linked to the advertising, and by taking a determination on the reputation focus, it is challenging to decide if a hub is transparent or malignant. In this way, it is commonly used in decentralized structures and Sybil-tolerant frameworks in computerized currency. So recently so practicable, Kate imagined the framework of a Blockchain-based loan arranging in enigmatic structures of Sybil tolerance. Blockchain's physical money is currently generally considered at the latest. Nakamoto [4] have suggested Bitcoin, which is a cryptographically encrypted mone. Then, there is related research which focuses on the security of Blockchain-based systems; for example, Zerocash et al. [26], in particular by means of an open key encryption which can be used to monitor the coins. Nevertheless, in a scheme not regarded as stable in a payment company, the transactions can not be pursued. However, the authentication of legal understanding exchanges is also important for Blockchain networks, following the development of exchanges. The proof of work [4] and the algorithm of consensus is currently two comprehension formulas used by Blockchain to solve this problem.

3 Existing System

In existing systems, clients as a rule need eagerness to advance any messages in VANETs if there is a hazard that their security will be ruptured. What's more, clients don't profit by sending declarations, which likewise makes them need inspiration to react to messages. In a perfect world, all messages must be sent secretly in VANETs since they for the most part contain delicate data of clients, for example, vehicle numbers, driving inclinations, and client characters. In any case, sending messages secretly doesn't guarantee the unwavering quality of the messages, and furthermore, experience the ill effects of overwhelming outstanding task at hand.

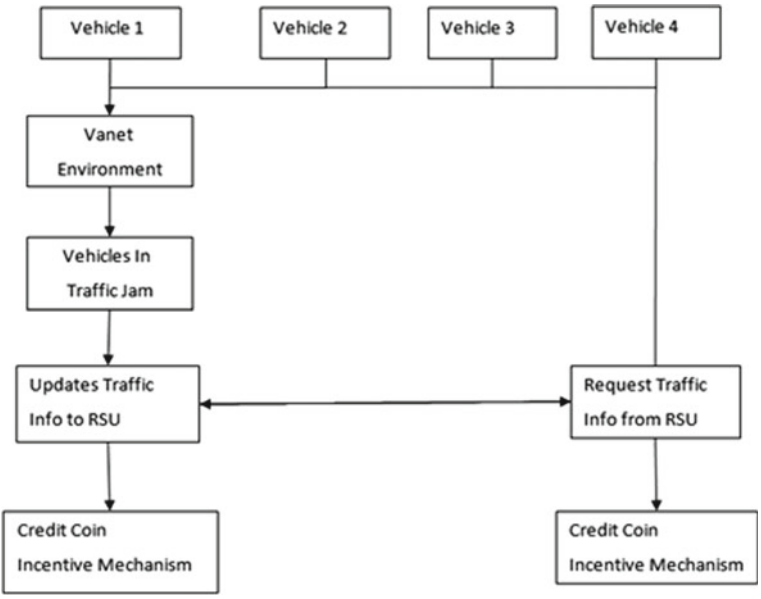

Fig. 1 Overview of the proposed system

4 Proposed System

In proposed framework, we propose another system called CreditCoin. It accomplishes productivity and security safeguarding for the commonsense use in sending declarations. We plan a motivator instrument dependent on Blockchain in CreditCoin. Clients oversee notoriety focuses while they acquire or spend coins as motivators. In the mean time, CreditCoin despite everything jelly protection and accomplishes secrecy. In addition, in light of Blockchain, CreditCoin hubs as a sudden occasion occurs forestalls. Several cyber threats and contingent defense are carried out when trace boss (Fig. 1).

5 Module Description

5.1 Network Formation

Right now, make a system arrangement. A system development comprises of hubs. Every hub has separation and range dependent on which inclusion territory is shaped. In light of inclusion territory hubs speak with one another and neighbor hubs are framed. On the off chance that goal hub is out of inclusion zone of source hub, message transmitted to goal by means of neighbors.

5.2 Neighbor Calculation

After network is framed dependent on vehicle area, and street side unit area neighbor is determined. In VANET condition, vehicle to vehicle or vehicle to street side unit correspondence happens dependent on their neighbors which have converging range. As vehicles are dynamic neighbors are additionally powerful and neighbors continue changing once vehicle begins to move starting with one area then onto the next.

5.3 Data Communication

After network is shaped and neighbors are determined powerfully, information correspondence happens among vehicle and street side unit. A vehicle in the system demands another vehicle in the system about traffic status through street side unit as they were out of range.

5.4 Blockchain

The clients solicitation and messages were safely put away in Blockchain usage. At the point when a CreditCoin was given or got, it is viewed as a square and added to the square chain. The square chain utilizes the excavators to affix the exchange subtleties as a square to the square chain.

6 Conclusion

The primary point of this undertaking is to build up a powerful declaration arrange called CreditCoin, another security protecting impetus declaration organize dependent on Blockchain. In CreditCoin, a cloud device manager supervises the traffic project, and Blockchain incentives transfers between clients. CreditCoin allows customers by commitments to exchange traffic data. It is ordered in the VANETs by the motivational vehicle force argument. The declaration convention guarantees that declarations are of unwavering consistency without uncovering consumer protection and is strong and efficient under situation that VANETs do not have complete confidence. For our reproductions, all the time for a consumer to create declarations is 174ms, which is significantly more successful than some conventions.

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Dynamic Symmetric Encryption Over E-mail in Cloud Server

J. Refonaa, Batta Deepika, Thumati Bhavana, S. Dhamodaran, and S. L. Jany Shabu

Abstract With the precinct of e-mail message discharge events, for example, the Hillary Clinton's electronic mail argument, certification besides safety of subtle e-mail info consume changed into customer's chief concern. Mixed e-mail is unmistakably a sensible response for giving security; regardless, it will outright tie their exercise. Open encryption with catchphrase search plan is a standard headway to solidify safekeeping shield in addition inconceivable feasibility works organized that can recognize a huge development in inspecting mixed electronic message in a cloud server. Within the paper, we recommend a applied PEKS plan termed by means of open key multi-catchphrase available encryption through covered edifices (PMSEHS). That may perhaps attract e-mail recipients toward the multi-watchword also Boolean requesting from the monstrous mixed electronic post database as savvy would be reasonable, deprived of skimpy extra data to the cloud server. In same manner, we provide relative tests, whichever show that our strategy takes a sophisticated capability in multi-catchphrase break down used for mixed messages.

Keywords Boolean query · Searchable encryption · Multi-keyword search · Encrypted electronic mail

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1 Introduction

Encoded e-mail stays by all accounts a feasible answer for giving security; however, it will extraordinarily restrain their tasks [1, 2]. Open encryption by catchphrase pursuit (PEKS) plot stays a prominent innovation toward fuse safety insurance in addition great feasibility works organized that can assume a significant job in looking over encoded electronic mail [3, 4]. Within paper, we recommend a useful PEKS plan so-called as open key multi-catchphrase accessible encryption through concealed edifices (PMSEHS) [5, 6]. It may well empower e-mail beneficiaries to ensure the multi-watchword besides Boolean inquiry in the enormous encoded electronic mail folder as quick as would be prudent, lacking uncovering extra data to the cloud server [7, 8]. We additionally give relative tests that exhibit our plan which has a higher effectiveness in multi-catchphrase look aimed at encoded messages [8, 9].

2 Related Work

Available encryption system (SE) licenses distant server exploration in a mixed database as showed by the request mark provided by customers, in the state which not any basic writing might be instructed [10, 11]. In utmost SE plans, facts possessor at first desires to contract a couple of catchphrases since information, by formerly routines SE figuring toward scramble watchwords then produce records, eventually supplies the documents and encoded facts scheduled by a far-flung server [12, 13]. Thereafter, information seeker can work together through the server near play out a chase in addition find qualified information; in any case, the server can pick up nonentity as of the mixed facts, record, or else explore mark [14, 15]. As showed by diverse submission circumstances, open encryption can be segregated into four classes [16, 17]. Open encryption with catchphrase search plan is a standard improvement to set security insurance and astounding operability composes, which can perceive a huge advancement in researching blended electronic mail in a cloud server [18]. Within the paper, we suggest a helpful PEKS plan termed as per open key multi-catchphrase accessible encryption through secured edifices (PMSEHS) [19, 20].

3 Existing System

In existing framework, most of open encryption plans suitable for encrypted e-mail (EEM) is created by repeated field because of its high viability. In existing, we can encrypt a user data only [21, 22]. The normal strings we are entered not to be encrypted.

4 Proposed System

In proposed framework, a functional PMSEHS plan named as open key multi-watchword accessible encryption with concealed structures and RSA calculation encryption with camouflaged structures [23, 24]. It encodes the entered string on backend and will be sent to the specific collector by means of gmail [25].

5 System Architecture

See Fig. 1.

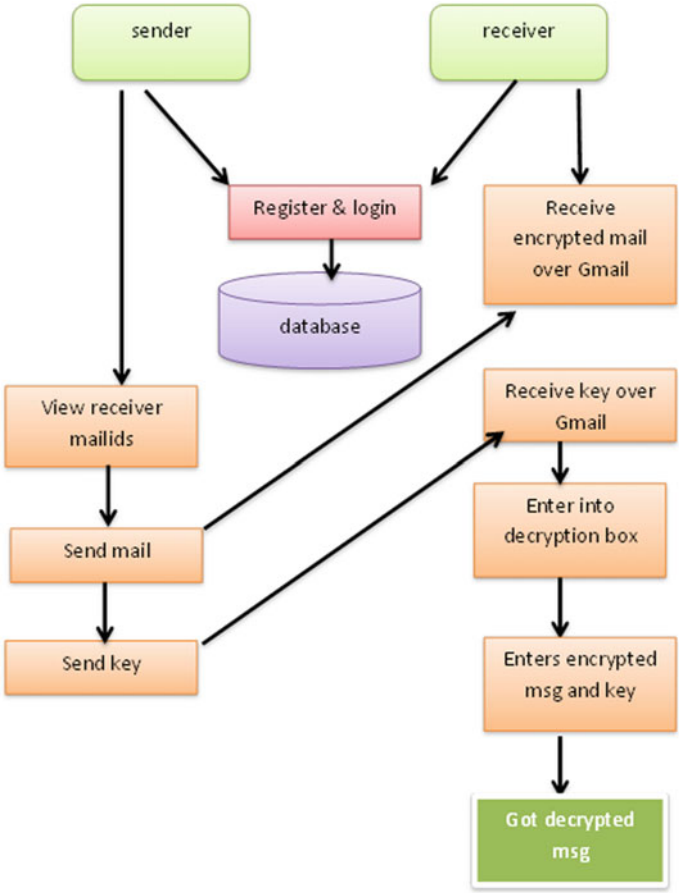

Fig. 1. System architecture

This framework is the theoretical method. This application user will register his details and logon it. Here, registered user only will send encrypted mail and decrypt mail. User have to register with validate mailed and password while registration. Used for characterizes the structure.

6 Module Description

1. User interface design.
2. User (sender and receiver) registration.
3. Sender sends mail.
4. Key generation.
5. Receiver gets encrypted mail.
6. Receiver gets key.
7. Receiver decrypt mail using key.

6.1 User Interface Design

The significant role of client is to go to the login window to the client window. This is made for the security reason. In login page, we have to give login client id and encrypted message. Then, it checks client id and encrypted message whether it is coordinate or not. If we give the invalid client id or encrypted message, then we cannot go to the client window from login window. This is used mainly for the validation of login client and server.

6.2 User (Sender and Receiver) Registration

In this application, user will register his details and logon it. Here, registered user only will send encrypted mail and decrypt mail. User have to register with validate mailed and password while registration. Both sender and receiver have this application for sending e-mails.

6.3 Sender Sends Mail

In this part, user1 or a sender will logon to the page; after logging on, he/she select's the particular receiver to send a mail; for sending e-mails, receiver have to register on this same application. For sending a mail, sender will click on send mail which will redirect to message box; here, sender has to enter his mail id and password and

then have to type a message. Typed message will be encrypted using RSA algorithm and received by user.

6.4 Key Generation

In this module sender after sending an encrypted message, sender has to send a key for same receiver to decrypt mail message. Key will generated by using same RSA algorithm.

6.5 Receiver Gets Encrypted Mail

Receiver will get an encrypted message in gmail inbox; by this, no one can understand the mail sent by sender. The encrypted mail will be decrypted using key.

6.6 Receiver Gets Key

Receiver will receive the key sent by the sender. After receiving the key only, the message will be decrypted.

6.7 Receiver Decrypt Mail Using Key

Receivers have to copy the both key and decrypted message. Then, the receiver have to logon to this web application and click on to decrypt option; there will be encryption and key box. Receiver has to enter the encrypted message and key into the box, after that the message will be decrypted, will show in the page

7 Conclusion

In this work, focusing on giving encoded communication cloud that ropes quick send cloud that chains watchword look, news item cloud that chains. Contact cloud, that ropes assistance forward cloud that chains shrouded structure, was given a catchphrase fixed pursuit back way the hunt calculation of PMSEHS will scan by comparing sequence in the concealed design as quick as could be expected under the circumstances, and afterward evaluate the relating code text has the watchword set the enemy of impact bin. The development of PMSEHS recommended and

demonstrated as if mBDH issue held then PMSEHS is secure. This plan underpins multi-catchphrase search as well as Boolean inquiry.

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Air Quality Prediction (IoT) Using Machine Learning

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Abstract The idea of the Internet of things (IoT) has become a popular research subject in many fields in recent years, including business, trade and education. To build sustainable urban life, smart cities employ IoT-based infrastructure and applications. IoT enables smart cities to make community residents more aware, responsive and effective by using information and communication technologies. As the number of IoT-based smart city applications increased, the amount of data produced by this application increased tremendously. Effective steps are taken by governments and community stakeholders to process these data and forecast potential consequences to ensure sustainable growth the field of forecasts; recurrent neural network methods were used in big data for many predictive problems. This inspires us to make use of recurrent neural network to predict IoT results. A novel model of recurrent neural network is therefore proposed in this paper to analyze IoT smart city data. Through this research, we have gathered SO_2 and NO_2 gasses at various locations through Chennai.

Keywords Internet of things (IoT) · Air quality · Recurrent neural network · Big data

1 Introduction

Internet of things (IoT) is known as daily object interconnection. By linking an increasing number of objects, it enhances the quality of human life. According to projections, IoT will have 50 billion connected devices by 2020. And we are deploying IoT sensors such as CO_2 and NO_2 in this project to collect the sensor values that can be collected and stored in the server for data analysis. Big data is used for data processing, the Hadoop distributed file system and recurrent neural networks are used for prediction. Apache Hadoop is an open-source software platform for

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distributed big data storage and distributed data processing. The Hadoop Distributed file system (HDFS) partitions files into file size-based blocks and distributes the blocks among the cluster nodes.

Recurrent neural networks are fairly primitive electronic neuron networks, based on the brain's neuronal structure. The method records one at a time and learns by comparing their (mostly arbitrary) record prediction to the known actual record. The errors from the first record's initial forecast are fed back to the network and used to change the network's algorithm for the second iteration.

2 Literature Survey

Examined that the neural network models are an efficient method for controlling air quality in big cities due to a low level of error estimation by exploring the possibilities of creating an air quality control prognostic method in big cities [1, 2]. Just 1.9% in test series and 1.4% in training series were in the optimally built false prognosis models only 1.9% in testing series and 1.4% in training series. Proposed a model for the estimation of concentrations of inorganic airborne pollutants: H_2S–SO_2, NO–NO_2–NO_x, CO (CO_2) and PM10 (aerodynamic particulate matter of 10ìm or less) from a risk area (two industrial area-IA) and urban area (UA) from Constanta [3]. A small cumulative absolute error of 0.42 was predicted from simulation result with the actual value in the urban area. It shows the efficacy and validity of the proposed approach in determining the different concentrations of airborne contaminants.

Studied the model evaluation shows that the degree of success in CO concentration forecasting is promising by evaluating a model for predicting CO concentration from 2002 to 2004 [4, 5]. Analyzed Internet traffic data over IP networks through the creation of an artificial neural network (ANN) model based on multi-layer perceptron (MLP) [6]. Levenberg Marquardt Algorithm (LM) and Resilient Backpropagation Algorithm (RP) models were developed for effecive analysis of internet traffic over the network in the time series manner.

Found that for all contaminants using the CNN model, the association between expected and observed data was greater (0.54–0.87) [7]. The CNN model estimated concentrations of SO_2 that were higher than those of PM10. Another interesting finding was that all contaminants were expected better in winter concentrations than in summer concentrations [8]. Experiments showed that accurate predictions of missing concentrations of air pollutants can be made using the new approach found in the CNN model by predicting daily concentrations of air pollutants (PM10 and SO_2) from the Istanbul air pollution measurement stations in Yenibosna and Umraniye for periods when pollution data was not reported [9, 10]. Historical Ozone component (O_3) observations were used to predict air pollution concentrations of NO_2 and SO_2 in urban areas by using Adaptive Neuro Fuzzy techniques [11]. Proposed algorithm focused primarily on pollution caused by vehicle smoke in urban areas and implemented various fuzzy rules to demonstrate the extent of air pollution induced

by vehicle smoke and dust in nearby Jabalpur areas examined the ability of artificial neural network technique in air temperature prediction for daily and monthly ambient [12]. In feed-forward network and Elman network, the mean, minimum, and maximum ambient air temperature was used as the input parameter during the years 1961–2004 [13, 14]. The values of R, MSE and MAE variables in both networks showed that the ANN method is a good model in the prediction of ambient air temperature, whereas the estimates of the mean temperature one day ahead and the maximum temperature one month ahead are more reliable using the Elman network [15].

Computer based models play a vital importance in research and analysis and for decision support systems [16, 17]. For both training and testing stages, the efficiency of the proposed solution is calculated by the mean squared error. Comparison between the functionality of the hybrid ICA-NN and the listed MLP network provides the evidence that the ICA-NN was superior with an reasonable accuracy for figure in terms of reliable performance [18, 19]. ANN approach was applied in problem solving techniques and decision making to improve the environmental factors [20]. Peninsular Malaysia centered on the use of main component analysis (PCA) and artificial neural network (ANN) to predict air pollutant index (API) in the seven selected Malaysian air monitoring stations in the seven-year database in the southern region (2005–2011) [21, 22].

3 Motivation

It is concluded that the ANN approach can be used effectively as decision-making and problem-solving strategies for better environmental management [23, 24]. Peninsular Malaysia based on the use of main component analysis (PCA) and artificial neural network (ANN) to predict air pollutant index (API) in the seven-year database selected Malaysian air monitoring stations in the southern region (2005–2011).

4 Proposed System

Effective recurrent neural network methods are deployed and an IoT-based hardware is connected to air quality sensors which allow us to collect real-time air quality prediction data. The key idea here is to forecast the air quality values in relation to the location values of the previous year and to build awareness about air pollution. In the proposed system, the air pollution data from the Raspberry pi sensor was collected to the system. In several locations, the data was collected, and finally, the data stored in the MYSQL server. The detailed flow diagram for the proposed systems is shown in Fig. 1.

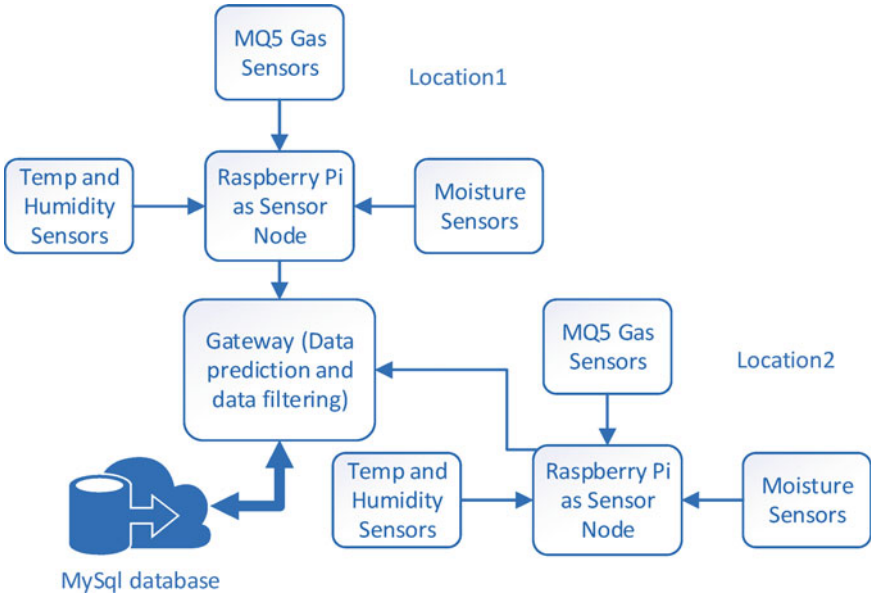


Fig. 1 Flow diagram of air quality monitoring using IoT

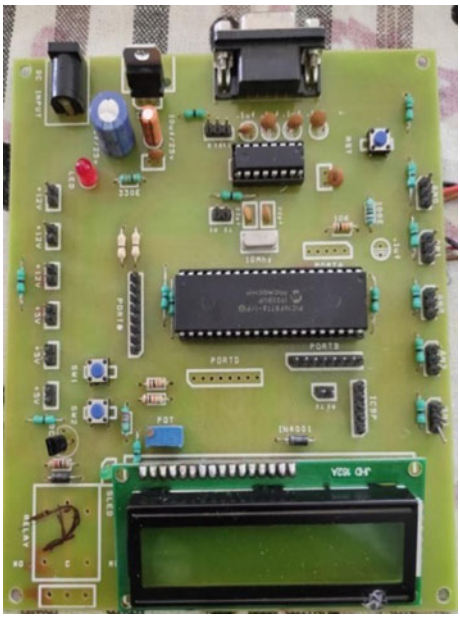
4.1 PIC Board

PIC microcontrollers are electronic circuits that can be configured to perform a wide range of tasks. They can be programmed for being timers or managing a production line, and more. This is used for linking the device to the circuit microcontroller as shown in Fig. 2.

4.2 Nitrogen Dioxide Sensor

In urban settings, the main source of nitrogen dioxide gas is the burning of fossil fuels. This is most generally related to emissions from motor vehicles in urban areas. Areas with high-density road networks near to large populations like cities and towns are at highest risk of over-exposure. The manufacturing sites would also contain high nitrogen dioxide concentrations. Those include any industry that uses processes such as power plants, electrical utilities and industrial boilers for combustion. Long-term exposure to nitrogen dioxide gas can lead to respiratory problems such as bronchitis and asthma. Aeroqual provides a fixed or portable NO_2 sensor for calculating the nitrogen dioxide concentrations for studies of human exposure as well as health and safety at industrial and urban sites. Here, this NO_2 sensor is used to measure the

Fig. 2 PC bord



current position concentration of NO_2 gases and then it collects the parameters of NO_2 gas in microgram/cubic meter.

4.3 Sulfur Dioxide Sensor

Sulfur dioxide is a colorless gas with a strong odor. It is not combustible but an highly poisonous substance. Sulfur dioxide when mixed with water is highly corrosive sulfuric acid and causes chemical burns. There are two key reasons why control of sulfur dioxide levels is important: because industrial buildings such as power plants emit significant quantities of sulfur dioxide and sulfur dioxide is a highly reactive gas. Sulfur dioxide is heavier than air, so it is measured by PemTech using electromechanical technology. OSHA has set the PEL for sulfur dioxide to be just 5 ppm, as it can be highly harmful to be exposed to only small levels for a short time. Here, this SO_2 sensor is used to measure the current position concentration of SO_2 gasses and then it collects the SO_2 gas data in microgram/cubic meter.

5 Implementation

The user interface architecture is implemented using Java coding for the user to pick the data input and location for data analysis. Using this module, all data is analyzed

using the big data and recurrent neural network to predict the location's air pollution and then the IOT sensor is interfaced with the Java coding application.

5.1 Recurrent Neural Network

The recurrent neural network is based on the concept of saving a layer's output and feeding this back to input to help predict the year's outcome. Here, the first layer is generated with the product of the sum of the weights and the features similar to the feed-forward neural network. If this is determined, the recurrent neural network cycle begins; it means that each neuron would recall any knowledge that it had in the previous time phase from one-time phase to the next. This makes each neuron function in the output of computations as a memory cell. We need to let the neural network operate on front propagation in this step and remember what information it needs for later use. IoT sensors such as SO_2 and NO_2 are interfaced with the microcontroller for real-time data collection and storage on a centralized server and then all data is collected from the sensors and the generated data set is stored for analysis in a centralized database using a recurrent neural network to extract the useful data generated for data analysis. All data is stored in a centralized database called MYSQL and then all data is collected from the sensors and the data set for data analysis is generated. We deploy big data-HDFS for the process of data processing and prediction. For data analysis, all sensor values are collected and stored in the server and then all data is processed and analyzed using a neural network to capture the data and predict air pollution at a given location and time. The values are compared with the approved data collection, and the values of the sensors are also processed. Alerted to monitor emissions and safeguard the atmosphere until the data is analyzed.

5.2 Comparative Analysis

Many of them control the air quality in current systems and these systems can not predict the air quality of the gases. And it depends on the quality of the air which affects how you live and breathe. Therefore, it is important to take precautionary measures to forecast air pollution parameters such as sulfur dioxide and nitrogen dioxide. Such parameters can have a direct impact on degree of air pollution and are measured using sensing instruments. In proposed research, IOT-based hardware and sensor interface to detect the existing runtime air pollution of various contaminants in the air and thus deploy the principles of big data and recurrent neural networks help us predict the air quality of gases with values of previous years concerning location.

6 Result and Discussion

In this section of results, briefly review the table below to find out the concentration of gasses such as SO_2 and NO_2 in microgram/cubic meter parameters in some areas of Chennai city. The air pollution concentrations such as SO_2 and NO_2 were collection for the month of Feb 2018–2019. The real time sensor data of Feb 2020 were compared with the collected concentrations. Table 1 highlighted the standard index about air quality.

The air quality concentrations of SO_2 and NO_2 from various parts of the city (Anna Nagar, Adyar, Nungambakkam, etc.) were calibrated with the IoT sensor and the data stored in the MYSQL database. Figure 3 shows the sensor calibrated value of NO_2 and SO_2.

The recurrent neural network is a time series prediction method. In this study, the concentration values of NO_2 and SO_2 were analyzed as a time series manner and the data was interpreted in MATLAB for training and testing purpose. Finally, Figure 4 shows the comparative analysis of sensor data with the RNN.

Table 1 Air quality index

Air quality category	Air quality index
Good	0–50
Satisfactory	51–100
Moderate	101–200
Poor	201–300
Very poor	301–400
Severe	401–500

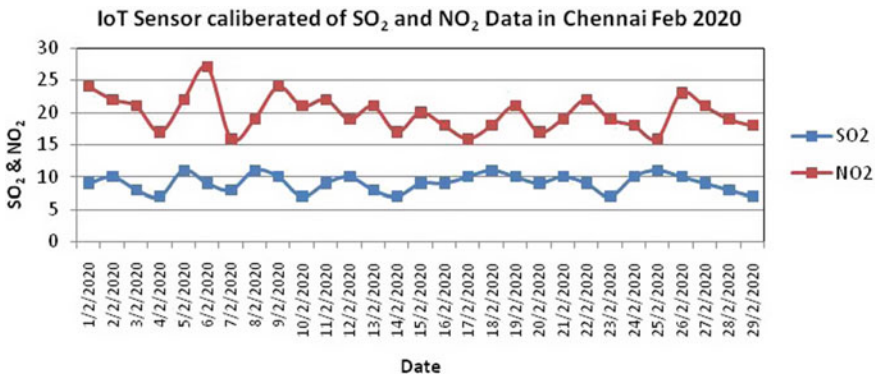


Fig. 3 NO_2 and SO_2 concentrations from IoT sensor

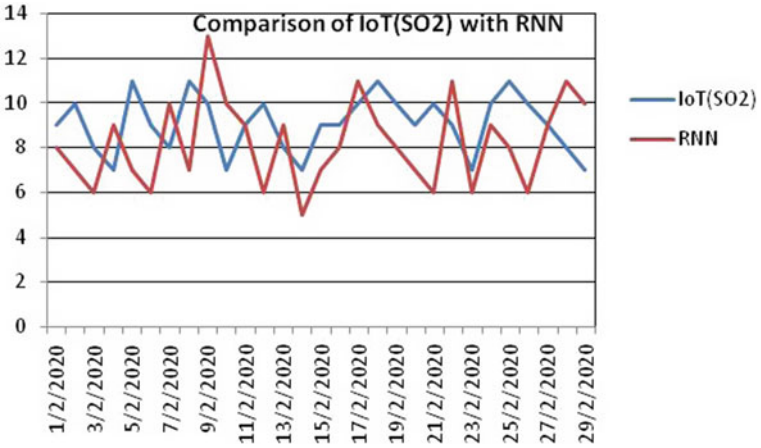


Fig. 4 Comparative analysis of IoT-SO_2 with RNN

7 Conclusion

In this study, along with recurrent neural network, we deploy the principle of IOT and big data for successful analysis and prediction of air pollution. Thus, we are forecasting the air quality of various air pollutants for years to come in this phase.

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Options-Based Sequential Auction for Dynamic Cloud Resourse Allocation

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Abstract The contemporary arrangement on cloud asset movement is regularly centered around considering the relationship among clients and cloud boss. Considering, the consistent improvement in the clients' requesting and the rising of private cloud suppliers (CPs) attract the cloud supervisor to lease additional assets from the CPs in order to deal with their amassed assignments and pull in more clients. This likewise renders the investments between the cloud administrators and the CPs a basic issue to look at. In this paper, we analyze the two coordinated efforts through a two-organize auction segment. For the collaborations among clients and cloud supervisors, we embrace the alternatives based consecutive closeouts to plan the cloud asset portion worldview. When contrasted with existing works, our system can deal with clients with heterogeneous requests, give honesty as the overwhelming methodology, appreciate a straightforward victor assurance strategy, and block the postponed passage issue. We likewise give the presentation examination of the OBSAs, which is among the first recorded as a hard copy. Concerning facilitated endeavors equivalent markets for asset gathering. We get the radicalism of the CPs by their offered costs. We direct a wide evaluation of the two markets and perceive the commitment frameworks of the cloud boss.

Keywords Cloud suppliers · OBSA · SECaaS · QoS

1 Introduction

Registering administrations are progressively cloud-based, partnerships are putting resources into cloud-based safety efforts [1, 2]. The Security-as a-Service (SECaaS) worldview permits clients to redistribute security to the cloud, through the installment of a membership expense [3, 4]. Be that as it may, no security framework is impenetrable, and even one effective assault can bring about the loss of information and

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income worth a great many dollars [5, 6]. To get ready for this result, customers may in like manner purchase computerized insurance to get prize by virtue of misfortune [7, 8]. To achieve cost sufficiency, it is essential to modify provisioning of security and assurance, in any occasion, when future costs and perils are uncertain [9]. To this end, we acquaint a stochastic streamlining model with ideally arrangement security and protection benefits in the cloud [10–12]. Since the model we configuration is a blended whole number issue we likewise present a fractional Lagrange multiplier calculation that exploits the complete unimodularity property to discover the arrangement in polynomial time [13, 14]. We likewise apply affectability investigation to locate the specific resistance of choice factors to parameter changes [15, 16]. We show the viability of these strategies utilizing numerical outcomes dependent on genuine assault information to exhibit a practical testing condition, and find that security and protection are associated [17, 18].

2 Related Survey

2.1 Combinatorial Reverse Auction Based Scheduling in Multirate Wireless Systems (2007)

Crafty booking calculations are viable in misusing channel varieties and augmenting framework throughput in multirate remote systems. Regardless, most arranging counts ignore the per-customer nature of-organization (QoS) requirements and endeavor to dispense resources (for example, the opportunities) among various customers. This prompts a miracle regularly suggested as the introduction issue, wherein the estimations disregard to satisfy the base opening essentials of the customers on account of substitutability and complementarily necessities of customer spaces [19].

2.2 Generalized Network Flows for Combinatorial Auctions (2011)

Right now, address the issue of speaking to offers for combinatorial sell-offs and utilizing those structures for Winner Determination. We propose a diagram-based language utilizing summed up organize streams to speak to the offers. The understanding of victor assurance is then observed as a total of individual inclinations. We propel the language from illustrative, compactness, and control perspectives [20].

2.3 SAIL: A Strategy-Proof Auction Mechanism for Cooperative Communication (2013)

Helpful correspondence is another design to reduce the low channel use and sign blurring issues in the present remote system. The accomplishment of helpful correspondence intensely relies upon the effective task of transfer asset. Closeout hypothesis has been applied effectively to designate restricted assets in remote system for quite a long time. Be that as it may, the vast majority of the current closeout systems limited purchasers to utilize straightforward offering language, which extraordinarily brings down the social government assistance and transfer task effectiveness. Right now, model the trade task as a combinatorial arrangement with flexible commitment language and propose SAIL, which is strategy-assertion and approximately efficient combinatorial closeout for hand-off endeavor in strong correspondence [21].

2.4 A Framework for Truthful Online Auctions in Cloud Computing with Heterogeneous User Demands (2013)

Auction-style pricing policies can effectively reflect the underlying trends in demand and supply for the cloud resources, and thereby attracted a research interest recently. In particular, a desirable cloud auction design should be online to timely reflect the fluctuation of supply and demand relations, (2) expressive to support the heterogeneous user demands, and (3) truthful to discourage users from cheating behaviors. Meeting these requirements simultaneously is non-trivial, and most existing auction mechanism designs do not directly apply. To meet these goals, this paper conducts the first work on a framework for truthful online cloud auctions where users with heterogeneous demands could come and leave on the fly [22].

2.5 ARMOR: A Secure Combinatorial Auction for Heterogeneous Spectrum (2018)

Dynamic range allotment by means of closeout is a powerful answer for range lack. Combinatorial range closeout empowers purchasers to communicate enhanced inclinations toward various blends of channels. In spite of the push to guarantee honesty and expand social government assistance, range closeout likewise faces potential security dangers [23].

3 Proposed Methods

Right now, explore the two correspondences through a two-plan sell off system. For the correspondences among clients and cloud heads, we get the OBSA method to structure the cloud resource task point of view. A sequential deal is where a couple of things are sold, reliably, to a comparable social affair of potential buyers. A progressive deal changes from a combinatorial closeout, wherein various things are emptied at the same time and the administrators can offer on packs of things. Our model has a couple of focal points over standard combinatorial and simultaneous models. The focal favorable position of such a model is, that is can be associated in conditions where combinatorial and synchronous models cannot. Figure 1 shows the system architecture for auction mechanism.

3.1 User Interface Design

This is the essential module of our endeavor. The fundamental activity for the customer is to move login window to customer window. This module has made for the security reason. Right now, we need to enter login client id and riddle state. It will check username and puzzle state is sort out or not (genuine client id and noteworthy secret key). In the event that we enter any invalid username or riddle word, we cannot go into login window to client window; it will show bungle message. So we are keeping from unapproved client going into the login window to client window. It

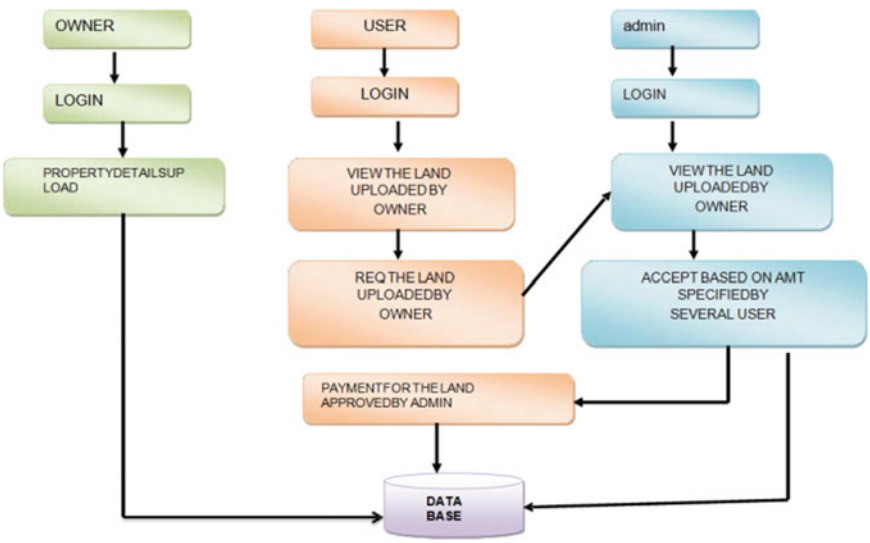

Fig. 1 System Architecture for auction mechanism

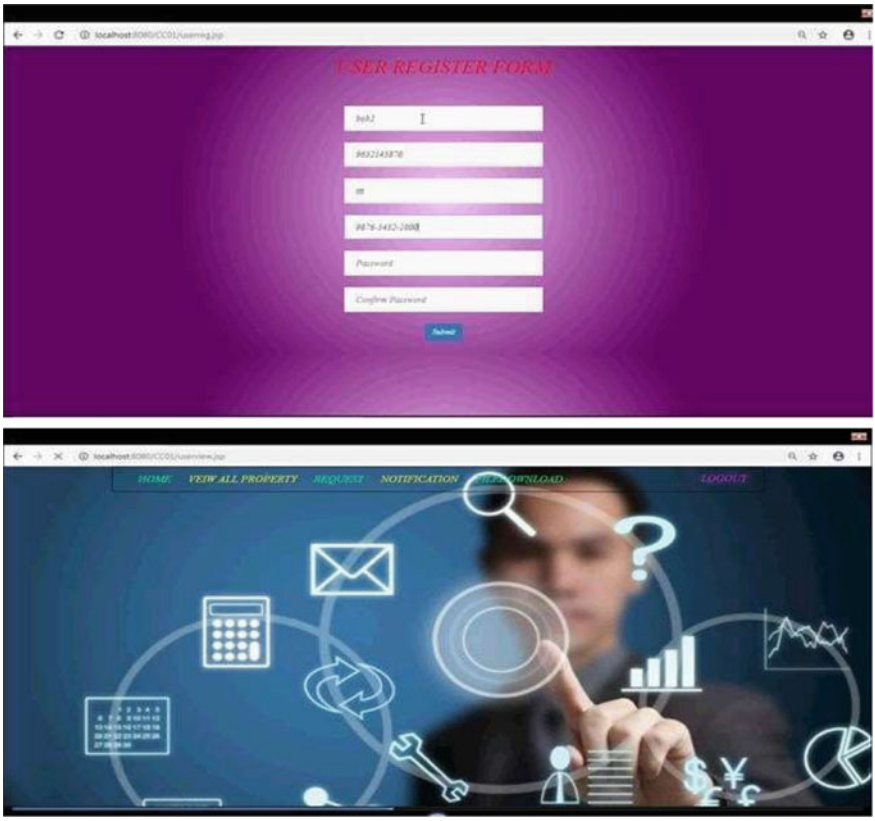

Fig. 2 User interface images

will give a lovely security to our endeavor. So server contain customer id and puzzle key server what is more check the assertion of the customer. It well improves the security and keeping from unapproved client goes into the system. In our endeavor, we are using JSP for making game arrangement. Here, we favor the login customer and server underwriting. Figure 2 displays user interface images.

3.2 Owner Upload Details

The owner will register with his details and log in by login id and password by which he created. After login, owner will enter the property details like where it is located, including cost, upload the documents or proof of a property with his address and phone number. The owner can also view the properties which are selling by other owners, and if he likes, he can log in as a user and can buy it. In a similar way,

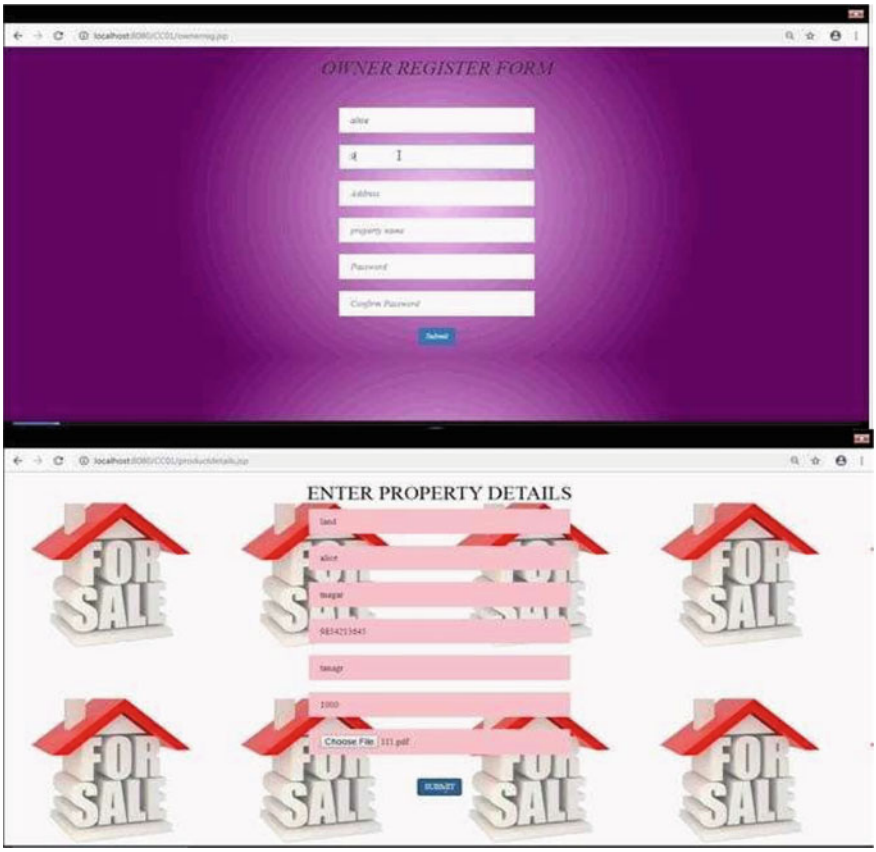

Fig. 3 Owner upload details diagram

several owners can register and enter the details. The login details should be valid; otherwise, it shows error. Figure 3 shows the owner registration details form.

3.3 Admin Login and Verify

In this, admin will login with his unique id and password; after logging, admin can view the properties which are uploaded by the owners. The main work of admin is to check the documents uploaded by the owner and he also checks whether the cost of the property is worthy or not. If the documents are valid, he will accept; otherwise, reject it. He acts as a mediator between the owner and the user (Fig. 4).

Fig. 4 Admin login and verify

3.4 User Request Product Based on Coast and Location

The user will register with his details and log in by login id and password by which he registered. He can view all the properties, costs, and details of the owners. After watching all the properties, he can choose and send the request to the selected one in the request option. There is a notification option in which he can see whether his request is accepted are not (Fig. 5).

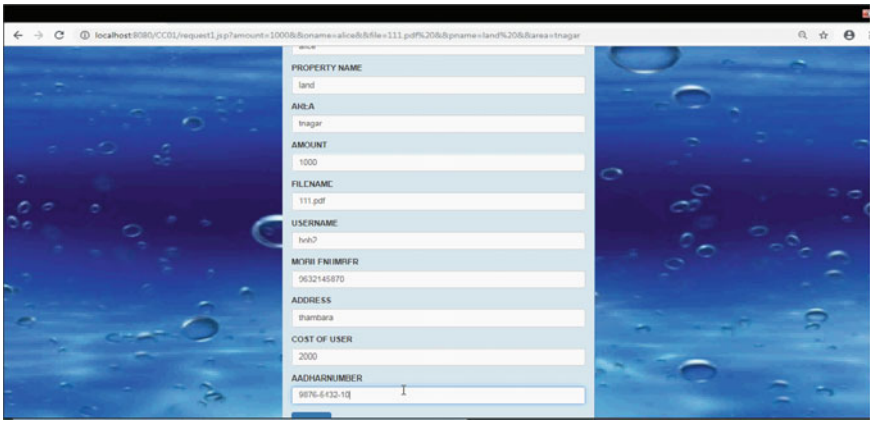

Fig. 5 User request product based on cost and location

Fig. 6 Admin response

3.5 Admin Response

In this, the admin will have an inbox option in which he can view the requests of the users. Then, he checks with the users of a corresponding property and also verifies whether the details of the user are correct and also whose cost matches the owner's price. Then admin selects whose is best among all the users and makes the user get the notification for paying the amount directly to the owner. Figure 6 displays admin response details.

3.6 Payment Session from User

In payment session from user, the user will have a notification option in which he can see the notifications like admin after accepting the request. Then, it will show the payment option after clicking it directly opens a payment page through which he can pay by debit/credit card, net banking, and PayPal payment, etc.… along with GST. The user cannot manipulate the amount at paying time because it comes with a fixed amount and after paying, he can download the documents. The advantage is user can access from anywhere and handle the auction (Fig. 7).

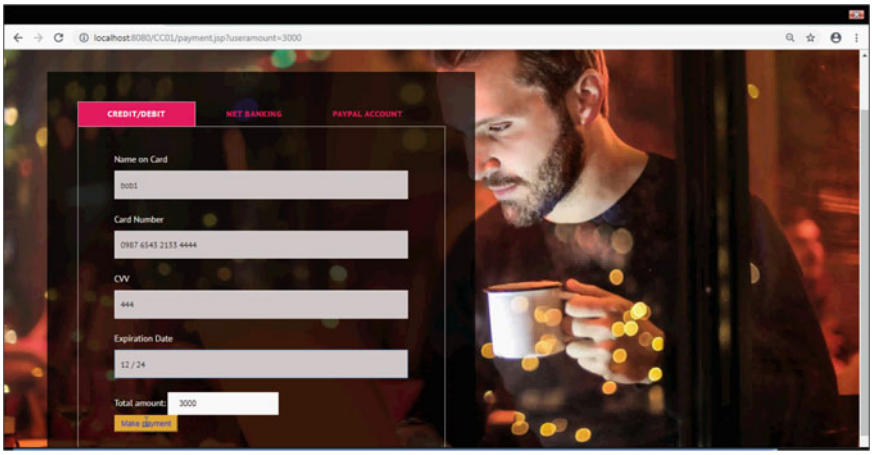

Fig. 7 Payment session from user

4 Experimental Results

The inspiration driving testing is to discover fails. Testing is the path toward endeavoring to locate every conceivable issue or deficiency in a work thing. It gives a way to deal with oversee check the estimation of fragments, sub social events, parties also as a finished thing. It is the course toward tackling programming to ensure that the software system satisfies its requirements and customer needs and does not battle in an unacceptable manner. There are different sorts of test. Each test type keeps an eye

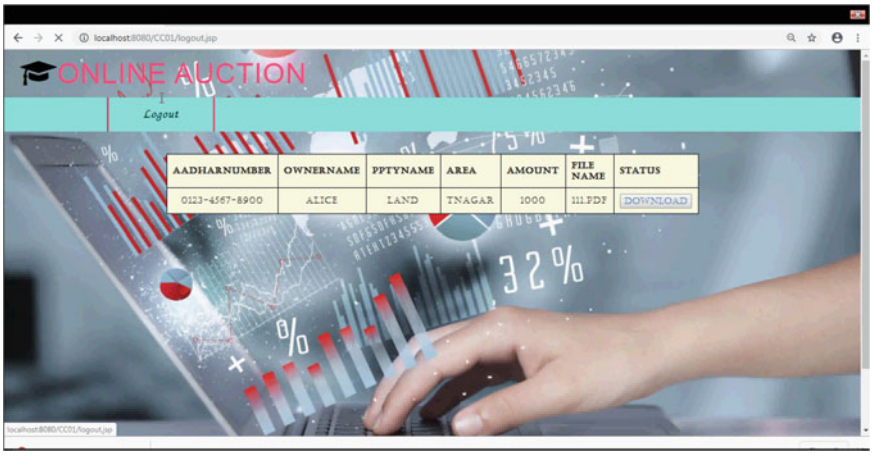

Fig. 8 Downloading the documents after payment

out for explicit testing necessities. Figure 8 displays the page to download payment receipt.

5 Conclusion

Right now, we have proposed a complete two-phase system to portray asset assignment and assembling in current cloud systems. The essential stage depicts the joint efforts between the PAs and the CCN heads. For this stage, OBSAs nearby their theoretical examination a repurposed, which welcome a clear champ confirmation procedure and give the trustworthiness properties. The subsequent stage models the communications between the CCN administrators and the CPs. For this stage, a hypothetical system is created to display the offering conduct of the CCN supervisors.

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Classification and Mapping of Adaptive Security for Mobile Computing

J. Refonaa, S. L. Jany Shabu, S. Dhamodaran, Battula Mythili, and Bikki Vineetha

Abstract Within the paper, we examine how to place mobile phones on behalf of permitting correspondences in a fiasco reconvert via connecting the holes amid different types of isolated system. We include structured as well as actualized android applications. In this application, we use this to convey to other colleagues simple to approach to impart utilizing distributed storage; in this module, client transfer the catastrophe area and other client will see the calamity area and get the specific area in map. It sees and gives cell phones the capacities of interchanges in misfortune recuperation such a assembling of mobile phones. This will be able to cooperatively stir up and about in addition to express disaster communication during a energy industrious method through their locale in addition to location information during sort in the direction of assist salvage activities. This application will likewise give the close by clinics and fire station and police headquarters. We group telephone numbers as a replica function so that it can take over the advanced android cells. Exploratory outcomes exhibit that group telephone can suitably assure association necessity besides extraordinarily support salvage activities during misfortune healing.

Keywords Autonomous computing · Security · Software engineering proof · Mapping research · Mobile computing

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1 Introduction

Versatile or else portable registering has risen the same as a troublesome innovation to supplant the conventional processing ideal models with setting mindful, associated, and portability-driven calculation [1, 2]. In particular, portable figuring engages its clients—abusing setting mindfulness and portability—to perform assortment of errands, for example, business exchanges, long-range informal communication, area following alongside well-being and wellness monitoring [3, 4]. An enormous multiplication of versatile processing can be ascribed to reasonable availability (organizing) that supplements the anyplace, whenever cell phones furnished with installed sensors (equipment) and uninhibitedly accessible portable applications (programming) [5]. In spite of its advantages, portable figuring involves various issues identifying with asset destitution, vitality effectiveness, heterogeneity of versatile equipment/programming and most unmistakably security and protection of cell phone and its information [6–10]. In portable registering setting, security alludes to the guideline, practices, and procedures that guarantee the secrecy and trustworthiness of (clients' and gadgets') information by limiting information utilization or access from unapproved elements. When a cell phone consolidates its installed equipment assets (e.g., GPS, Wi-Fi sensors) with uninhibitedly accessible programming applications (e.g., area following, beat observing), the gadget produces helpful information, for example, area-based administrations and well-being-related proposals [11]. Be that as it may, any kind of information prepared or shared through a cell phone is helpless against different security dangers [12]. For instance, information identifying with a client's heartbeat observing or current area can be attacked as a demonstration of vindictiveness to access client's well-being and vicinity information [13]. A cell phone works in a powerful domain, i.e., a situation with visit changes in organize setups, client areas, setting data, and the information that as often as conceivable enters or leaves a wireless [14]. For instance, consider an untouchable gaming application that agree to employ convenient assets and transporting the SMS for requesting of the gaming appliance [15, 16]. The gaming application will usually send a large number of requests to secure the information related to the cell phone and other assets [17].

2 Related Work

Information security and information protection are treated as practically identical and compatible terms alluding to keeping up the uprightness of information. Information security and protection as ideas are reciprocal; anyway, a qualification between them must be kept up [18]. In particular, security alludes to the execution of practices and procedures that guarantee the privacy, accessibility, and honesty of information by limiting information use or access by unapproved substances [19]. In correlation, security cannot be impartially characterized, as it is the essential human right to

figure out what and how much data about them ought to be open or private [20]. Security must be firmly implied the same as solitary privilege to make certain and suitable usage of personal information via making sense of what, how much, although besides by whom toward share the information [21, 22]. Instance, during a telephonic correspondence, protection permits single privilege toward give/refute some entrance toward their influence; otherwise, personal information, through safety instrument, for example, encryption empowers protection safeguarding of correspondence [23].

3 Existing System

Existing framework is the utilized organized shaped by the identifications to gather the data from caught survivors. Reina broadly assessed impromptu steering convention in calamity situations.

4 Proposed System

In proposed framework, we research how to assemble mobiles phones for giving correspondences in a debacle reconvert by voyage above the holes along with different types of isolated systems (Fig. 1).

5 System Architecture

Framework aim is the functional representation that characterizes the formation, behavior, besides more perspectives on a structure. An aim representation is a proper representation and description of a structure, sorted out such that supports idea concerning the structures and practices of the structure. A structure design can consist of structure parts and the sub- frameworks built up, that will collaborate to actualize the common structure. There have been actions to formalize dialects to depict structure manufacturing on the whole these are called design illustration dialects.

6 Module Description

1. Login/registration
2. Database creation
3. Disaster kit
4. Bluetooth chat

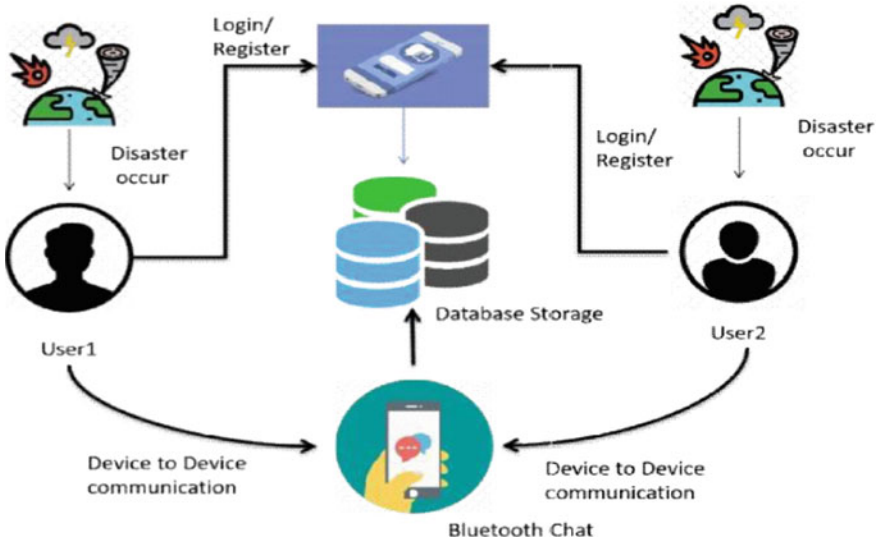

Fig. 1. System architecture

5. Hospital and policestation
6. Feed back.

6.1 Login/Registration

In this module, we have structure for login and information exchange screen. Android utilized xml to create traditional screens in our application and Java for coding. The information exchange page contains email id or client name, versatile number, and secret word those sorts of subtleties ought to be put away in database. Login screen contains client id or username and secret phrase. When the client login the application, it ought to recover the information to the database and join dependent on client input if its Matches client name, secret phrase to permit in the Application else it gave an alarm and demonstrate a message to the client.

6.2 Database Creation

In this application, user will register his details and logon it. Here, registered user only will send encrypted mail and decrypt mail. User has to register with validate mail and password while registration. Both sender and receiver have this application for sending emails.

6.3 Disaster Kit

In this module, we have come to a conclusion that this procedure can end up as a debacle. So, now the next step is to get to the application and share the calamity details. This application can be utilized as a client manual for think about catastrophic events, artificial fiascos, calamity the executives life cycle, first aid pack, and so on. It incorporates subtleties of help line focuses with in-manufactured calling highlight. Versatile application, likewise, gives data identified with tremors, floods, avalanches, violent winds, torrents, urban floods and warmth wave, and so forth.

6.4 Bluetooth Chat

In this module, we have plan a procedure of group visit that can be include a client, it is a gathering of talking in content. Group visit includes a part in a gathering that can be bunch talks.

6.5 Hospital and Police Station

In this module, we need to go ahead and actualize the closure made by the medical clinic. It can be a reason for the crisis and it may affect the application module too.

6.6 Feedback

Input is a fundamental piece of recommendations and conveying software engineers. It encourages students to increase their latent at different phases of conveying, elevate their consciousness of traits and territories for growth, and be aware of moves to be prepared to develop implementation.

7 Conclusion

With respect to the grouping and mapping plans, the centre can create after effects on the examination. It can explore, regulate and disperse all the accessible information. Results and Mapping Study Benefits: Discoveries of mapping studies provide motivation and inspiration for prospect study to be added to the progress of the up and coming age of answers for secure portable information, gadgets, and correspondence.

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An Extensible Framework to Optimize the Work Execution Model

Pratul Chandra, Ravi Teja, and A. Velmurugan

Abstract Organizations have known about the significance of Quality of Service (QoS) for seriousness for quite a while. It has been broadly perceived that work process frameworks are an appropriate answer for dealing with the QoS of procedures and work processes. The right administration of the QoS of work processes takes into consideration organizations to expand consumer loyalty, lessen interior expenses, and increment included worth administrations. The propose framework shows a novel strategy, made out of a few stages, portraying how organizations can apply information mining calculations to anticipate the QoS for their running work process occurrences. Our strategy has been approved utilizing experimentation by applying various information mining calculations to anticipate the QoS of work process. This framework proposes a conveyed work process mining approach that can rediscover ICN-based organized work process models through steadily amalgamating a progression of vertically or on a level plane divided transient work cases. The methodology has two fundamental calculations: One is a transient section disclosure calculation that can find a lot of worldly part models from the divided work process order occasion logs, and the other is a work process mining calculation that rediscovers an organized work process model from the found fleeting piece models.

Keywords Process mining · Noise · Business process · Event log · BPM

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1 Introduction

In order to create and enhance its human-driven data system and, by expansion, its productivity, numerous businesses make the use of Business Process Boards (BPM) for improving business process unpredictability. Procedure mining is an innovation in BPM which aims at deleting useful information from occasionally executed logs and creating process models [1, 2]. The found procedure model can be utilized for ensuing investigation, to assist ventures with streamlining business forms, and to decrease the executives costs [3, 4]. Procedure mining chiefly incorporates model revelation, conformance checking, and process improvement, whereby model disclosure alludes to the investigation of the occasion log, extraction of important data, and development of the procedure model [5]. The found procedure model can be utilized for checking and examination, for example, distinguishing bottlenecks in the process that devour pointless time and assets [6, 7]. Divulging the process is a key element of BPM. Many methods have been suggested since late on mining calculations [8]. In the case of various issues such as the loops, undetectable assignments, the copying of errands, no decision structure, and log commotions, most equations have weaknesses. The problems of circles discussed by Agrawal, der Aalst and De Medeiros suggested an excavation technique for imperceptible errands and concentrated the structure without non-decision [9]. Questionable follow information alludes to mistakes or atypical directions showed up in the log information, for example, directions that are inaccurately spared during business process execution, or atypical procedure model conduct [10, 11]. In the event that procedure mining does not examine and separate the unsure direction information, the conventional procedure mining calculation will shape a procedure model that does not match to the real procedure [12, 13]. These calculations expect that there is no dubious directions information in the log; the issue of procedure mining is investigated right now [14]. Since it is extremely hard to ensure that these speculation are steady with the right occasion log, it is critical to treat the dubious direction information [15]. So as to take care of the issue of edge choice while evacuating questionable information, [16].

2 Literature Survey

Title 1: Evaluation Algorithm for Clustering Quality Based on Information Entropy

Creator: Liang Xingxing, XiuBaoxin, Fan Changjun, Chen Chao

As a branch of statistics, cluster analysis has been extensively studied and widely used in many applications. Cluster analysis has recently become a highly active topic in data mining research. As a data mining function, cluster analysis can be used as a standalone tool to gain insight into the distribution of data, to observe the characteristics of each cluster. Alternatively, it may serve as a preprocessing step for other algorithms. Infact, clustering is known as unsupervised learning because

the class label information is not presented. For this reason, clustering is a form of learning by observation, rather than learning by examples. It means that we always do not know whether the clustering partition is good. In general, the clustering partition need to be evaluated within quality and effectiveness. In this paper, a new evaluation algorithm is proposed which based on information entropy, to evaluate the quality of clustering. Inorder to improve the evaluation results, it takes full advantage of the marked data and other information, and constrains the number of clusters to enhance the credibility of the process. The membership degree is defined according to the distance of tuples. This method broadens the original information entropy method application on non-convex data set, while the convex data set has a good application. It is validated by taking an experiment on data set R15 and data set Jain, demonstrating the effectiveness of the different types of data sets.

Title 2: Improvement of ID3 Algorithm Based on Simplified Information Entropy and Coordination Degree

Creator: WANG Ying-ying, LI Yi-bin, RONG Xue-wen

In data classification mining, the decision tree method is a key algorithm. Iterative Dichotomiser 3 (ID3) algorithm which was presented by Quinlan is a famous decision tree algorithms, but ID3 has some shortcomings such as high complex computation in computing the information entropy expression, multivalue bios problem in the process of selecting an optimal attribute, large scales, etc. In order to solve the above problems, the improved ID3 algorithm is proposed, which combines the simplified information entropy with coordination degree in rough set theory. The experiment result has proved the feasibility of the optimized way.

Title 3: Knowledge reduction method based on information entropy for port big data using MapReduce

Creator: Weiping Cui, Lei Huang

With the volume of port data growing at an unprecedented rate, analyzing and extracting knowledge from large-scale data sets have become a new challenge in decision making. But, the application of standard data mining tools in such data sets is not straightforward. Hence, we develop a parallel large-scale knowledge reduction method based on rough set for knowledge acquisition using MapReduce in this paper. It designs and implements the Map and Reduce functions using data and task parallelism. Then, it constructs the parallel algorithm framework model for knowledge reduction using MapReduce, which can be used to compute a reduct for the algorithms based on information entropy. The experimental results demonstrate that the proposed parallel knowledge reduction method can efficiently process massive datasets on Hadoop platform, with highly speed up the classification process and largely reduce the storage requirements.

Title 4: Process Discovery from Dependence—Complete Event Logs

Creator: Wei Song, Hans-Arno Jacobsen, Chunyang Ye, and Xiaoxing Ma

Process mining, especially process discovery, has been utilized to extract process models from event logs. One challenge faced by process discovery is to identify concurrency effectively. State-of-the-art approaches employ activity orders in traces to undertake process discovery and they require stringent completeness notions of event logs. Thus, they may fail to extract appropriate processes when event logs cannot meet the completeness criteria. To address this problem, we propose in this paper a novel technique which leverages activity dependences in traces. Based on the observation that activities with no dependencies can be executed in parallel, our technique is in a position to discover processes with concurrencies even if the logs fail to meet the completeness criteria. That is, our technique calls for a weaker notion of completeness. We evaluate our technique through experiments on both real-world and semi- synthetic event logs, and the conformance checking results demonstrate the effectiveness of our technique and its relative advantages compared with state-of-the-art approaches.

Title 5: Research on Cross-Language Text Keyword Extraction Based on Information Entropy and Text Rank

Creator: Xiaoyu Zhang, Yongbin Wang and Lin Wu

In order to extract keywords from cross-language documents as accurately as possible, especially for the language whose keyword extraction technology is not mature, a text keyword extraction method based on information entropy and Text Rank is proposed to extract the accurate keywords from the translated Chinese documents. This method determines the basic importance of words according to the information entropy of words, and then uses the information entropy of words to vote iteratively through the Text Rank algorithm. This method solves the problem that Text Rank algorithm easily extracts frequent non key words as keywords. The experimental results show that the proposed method can extract keywords more accurately than Text Rank in the processing of cross-lingual bilingual translated documents.

3 Existing System

The current framework improve the first recurrence grid. Likewise, before deciding the connection edge, we have to prejudge the equal structure ahead of time to expel the impact of the unevenness between equal exercises while computing the edge. In this way, the judgment of the equal connection ought to likewise be reflected in the improved recurrence framework [17, 18]. To forestall movement reliance, which is more noteworthy than the recurrence edge in unsure information influencing the judgment of equal structure, we should characterize the choice limit for equal structures. This is the standard none-zero estimate of the FM recurrence network components. The unsure information can't be totally expelled by the recurrence limit. Subsequent to getting equal exercises, we have to ascertain the relationship

between's exercises dependent on the improved recurrence network to develop the connection grid [19]. At that point we can utilize the most extreme entropy rule to decide the limit for preparing dubious log information as per the relationship framework.

3.1 Disadvantages of Existing System

- Difficult to control the size of the choice tree model
- It is hard to build enough memory to the principle memory
- The procedure of catchphrase extraction isn't productive
- The conventional TextRank strategy has an enormous mistake in catchphrase extraction.

3.2 Proposed System

We present an Enhanced Fuzzy-based Weighted Association Rule Mining (E-FWARM) calculation for effective mining of the successive itemsets. The prefiltering technique is applied to the info dataset to evacuate the thing having low difference.

Data discretization is performed and E-FWARM is applied for mining the successive itemsets.

The proposed E-FWARM calculation yields greatest incessant things, affiliation rules, precision and least execution time than the current calculations.

3.3 Advantages of Proposed System

- Prediction accuracy is improved by using the association rules
- Effective generation of the frequent itemsets and association rules is ensured by maintaining the feasibility of the neural network.

4 System Architecture

Concentrate on portraying another technique that can be utilized by organizations to apply information mining calculations to chronicled information and anticipate QoS for their running work process examples. In the primary stage, the work process log is dissected and information mining calculations are applied to anticipate the way that will be trailed by work process occasions a runtime [20]. This is called way mining. Way mining distinguishes which exercises will in all likelihood be executed

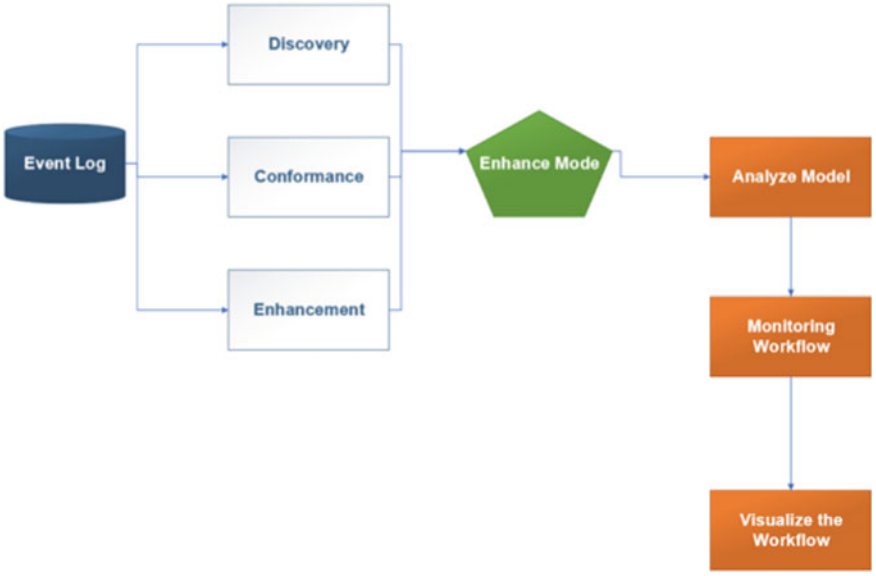

Fig. 1. Architecture of the proposed system

with regards to a work process case. When we know the way, we likewise know the exercises that will be conjured at runtime. For every movement we build a QoS action model dependent on authentic information (otherwise called fleeting or value-based) which depicts the runtime conduct (term and cost) of an action. In the last stage, we figure the QoS of the general work process dependent on the way anticipated and from the QoS action models utilizing a lot of decrease rules [21]. The QoS of a work process is legitimately reliant on which exercises are conjured during its execution (Fig. 1).

5 Conclusion

This framework proposed a disseminated organized work process mining approach rediscovering an organized work process from the dispersed work process piece logs. The methodology depends on the organized work process model structured by the data control net work process demonstrating philosophy, and it considered the work process fracture systems, for example, vertical discontinuity and even fracture. At long last, This paper demonstrated that it can appropriately deal with the conveyed work process pieces logs with the institution occasion accounts of the three unique kinds of control advances—consecutive, conjunctive and disjunctive changes—on the on a level plane divided work process forms through the on a level plane circulated work process section logs.

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Energy Price Forecasting in Python Using Machine Learning Algorithm

P. G. S. Mohith, P. Madhava Krishna, and A. Velmurugan

Abstract One of the primary objectives of shrewd framework is to decrease power top burden and to adjust the hole between power market interest. Clients can participate in the activities of keen matrix, where the vitality cost can be decreased by vitality conservation also, load moving. Right now, estimating is a key pointer of clients exchanging load. For the most part, exact point cost anticipating is normal due to the necessity of economy and industry. As for clients, they are really anxious to know whether the power cost surpasses the particular client characterized edges, which they used to choose to turn the heap on or then again off. Under this situation, clients require the power value characterization. Subsequently, some particular limits dependent on point value estimating calculations are utilized to characterize the power cost. Capacity estimation methods are the essential of point value anticipating calculations, in which the essential procedure of value development is imitated by a value model. In addition, value grouping requires lower precision. Consequently, power cost arrangement turns into a key need in the value determining. In genuine world, the power costs are impacted by a number of components in which demand and supply are the two direct factors. Other than them, the power costs are impacted by physical attributes, for example, fuel value, power necessity, sustainable power source supply, and so forth also, it fluctuates hourly. Power cost anticipating is a huge piece of keen framework since it makes shrewd network cost productive. Since the power value changes often and a lot of keen meters screen the earth, for example, fuel age, wind age, and transmission, continuously, the measure of recorded information is very enormous.

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Keywords Energy price · Forecasting · Machine learning algorithm · Power value · Power estimation

1 Introduction

Continuous power estimating models can possibly prompt financial and ecological focal point contrasted with the current basic level rates. Specifically, they can give end clients the chance to lessen their power consumptions by reacting to evaluate that fluctuates with various times [1]. Nonetheless, later contemplates have uncovered that the absence of information among clients about how to react to time-differing costs just as the absence of compelling structure robotization frameworks are two significant hindrances for completely using the potential advantages of continuous valuing levies [2, 3]. We handle these issues by proposing the power an ideal what is more, programmed private in the vitality utilization booking system which endeavors to accomplish an ideal exchange off between the limiting the power installment and the limiting the pausing time for the activity of every apparatus in family unit in nearness of a constant evaluating tax joined with slanting square rates [4, 5]. Our structure requires least exertion from the clients and depends on straightforward direct programming calculations [6, 7]. In addition, we contend that any private burden control procedure, progressively power valuing situations, we utilize the require cost expectation abilities [8, 9]. This is especially genuine if the service organizations give cost data just a couple of hours in front of time. By applying a straightforward and productive weighted normal cost forecast channel to the real hourlybased value esteems utilized by the Illinois Power Organization from January 2007 to December 2009, we acquire the ideal decisions of the coefficients for every day of the week to be utilized by the value indicator channel [10–12]. Reenactment results show that the mix of the proposed vitality utilization planning structure and the value indicator channel prompts noteworthy decrease in clients' installments as well as additionally in the subsequent top to-average proportion in load interest for different burden situations [13, 14]. In this way, the organization of the proposed ideal vitality utilization planning plans is advantageous for both end clients and service organizations [13, 15].

2 Literature Review

Power Price Forecasting With Viable Feature Preprocessing Creator: JunHua Zhao

Anticipating power cost in a deregulated showcase is significant for the market members. Highlight preprocessing procedure in an estimating model is fundamental and can essentially impact the anticipating exactness. Albeit a few component preprocessing methods have been applied in power value determining issue, node liberate

research is led to study and think about their exhibitions. Along these lines, how to choose viable element preprocessing methods in value estimating models stays an issue. Right now, creators direct a complete investigation of existing element preprocessing procedures and their experimental exhibitions in value gauging issue. It is exhibited in our analysis that successful component preprocessing can incredibly upgrade the estimating precision. In addition, it can distinguish the potential-related variables of power cost. The creators additionally propose a conversation about choosing reasonable element preprocessing methods in value gauging issue, which can be helpful for the scientists who need to coordinate powerful element preprocessing strategies in their value anticipating models.

Right now, a few gauging strategies have been applied in power value anticipating issue. These endeavors incorporate time arrangement estimating models, for example, ARIMA and fuzzy-neural autoregressive model. The relapse models, for example, dynamic relapse is likewise applied in power value determining. Neural networks have been utilized to tackle this issue and has been joined with wavelet systems to improve the presentation. Garch model is demonstrated to have great execution. As of late, SVM has additionally been applied in power showcase value gauging and accomplished fulfilled outcomes. Different endeavors right now gated expert (GE) model, hidden Markov model (HMM) and stochastic system exchanging models.

Highlight extraction procedures can be utilized to develop new highlights that are commonly free and diminish the clamors. In the power cost datasets, numerous highlights can be constantly watched. Regardless of whether a large portion of these ascribes is pertinent to the value, stays an issue. Other than the insignificant highlights, related highlights and commotions additionally exist in most power value information. Superfluous and connected highlights, just as commotions in the information, are significant motivations to the presentation debasement of anticipating models. In this way, viable element prepreparing procedures, which can take care of the two issues referenced above, are important to be incorporated with existing estimating models to accomplish higher anticipating exactness. Additionally, include choice can likewise be useful to the subjective research of recognizing the pertinent components of power cost.

Feature selection/extraction have been a rich research region in insights, AI and information mining, and generally applied to numerous fields, for example, content order, picture recovery, and client relationship the board. A few element choice procedures are proposed as a preprocessing device choosing significant component subset. Highlight extraction methods are applied creating autonomous highlights, which despite everything keep up the connection between unique highlights and reaction variable. These sorts of systems incorporate head part investigation (PCA) and free segment examination (ICA). Signal handling systems, for example, wavelet change, are additionally applied to decrease the commotions from the preparation information. A portion of these procedures have been applied in the power value estimating issue. Nonetheless, no efficient research has been directed at this point to contemplate the general exhibitions of various element preprocessing strategies.

Without this sort of exact investigation, it is hard to decide great and appropriate component prehandling method to be utilized.

3 Related Factors of Electricity Price

Power is an extraordinary ware in that organic market must be coordinated momentarily. Its extraordinary attributes in putting away, age and transmission make its costs more unpredictable than standard wares [16]. In genuine world, power costs are impacted by various elements, which are delineated in Fig. 1. Request and supply are two direct factors affecting power cost. Other than them, the power costs likewise are affected by physical attributes of intensity framework, fuel costs, and plant working expenses. In the long haul, spot costs can likewise be affected by monetary elements, government strategy, charges, swelling, financial development, innovative enhancements, power plant portfolio, conceivable eliminating of atomic force, and absence of market incitement for new market sections.

As is appeared in Fig. 1, given countless highlights, physically figure out which highlight to be remembered for the gauging model, is tedious and troublesome. Besides, preparing the model with all highlights accessible can prompt noteworthy execution corruption, which will be shown in the analysis. In this manner, compelling element prehandling systems are important to be utilized in the value gauging models. Highlight prepreparing techniques [10, 17]. In this segment, the creators will initially present the fundamental methodology of highlight prehandling. The known element prehandling systems will at that point be gathered and talked about separately. We will likewise give a general rule of picking appropriate component preprocessing strategy in a particular circumstance.

Fig. 1 Major drivers of power cost

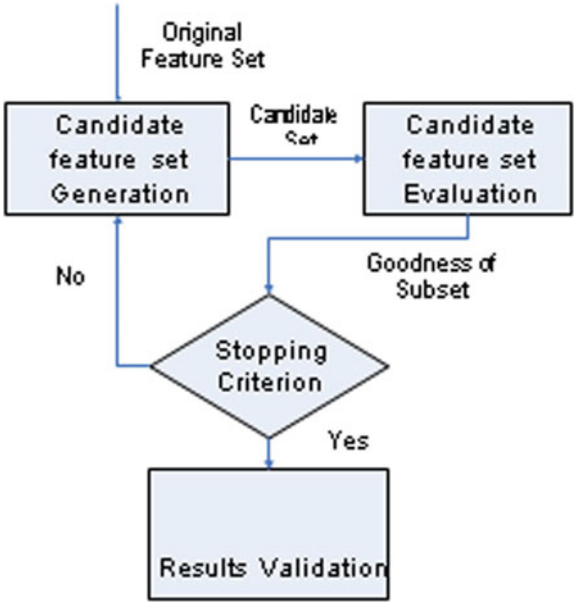

Fig. 2 System of highlight pre-preprocessing

Strategy of feature preprocessing: Right now, will talk about the methodology of highlight preprocessing in subtleties. Essential strategy of highlight prehandling is represented in Fig. 2. As is appeared in Fig. 1, highlight prehandling for the most part incorporates four significant advances:

Candidate set age: Candidate set age is a pursuit technique that produces up-and-comer highlight sets for assessment dependent on a specific hunt system. Here, the applicant highlight set scan be subsets of the first list of capabilities (include determination) and can likewise be changes of unique list of capabilities (include extraction). Highlight preprocessing systems can be arranged by the divers enquiry.

Candidate set assessment: Each up-and-comer include set is assessed and contrasted and the past best one as per a specific assessment basis. In the event that the new list of capabilities ends up being better, it replaces the past best list of capabilities [18]. As indicated by the diverse assessment models utilized in the applicant set assessment step, include preprocessing strategies can likewise be classified as channel model, wrapper model and half and half model. Halting basis [19, 20]. The procedure of subset age and assessment is rehashed until a given halting standard is fulfilled. Results approval. At last, the chose ideal subset is normally important to be approved by earlier information or various tests with manufactured and additionally certifiable informational indexes [21, 22].

- Stopping basis: The procedure of subset age and assessment is rehashed until a given halting model is fulfilled.

- Results approval: Finally, the chose ideal subset is generally important to be approved by earlier information or various tests with engineered as well as certifiable informational indexes.

4 K-Means Clustering Algorithm

k-implies is one of the least complex unaided learning calculations that tackle the notable bunching issue. The system follows a basic and simple approach to order a given informational collection through a specific number of groups (expect *k* bunches) fixed apriorism. The fundamental thought is to characterize *k* focuses, one for each group. These focuses ought to be put in the cleverness path on account of various area causes distinctive outcome. In this way, the better decision is to put them; however, much as could reasonably be expected far away from one another The following stage is to take each direct having a place toward a given informational index and partner it to the closest focus [23]. At the point, when no point is pending, the initial step is finished, and an early gathering age is finished. Now, we have to re-compute *k* new centroids as bary center of the bunches coming about because of the past advance. After we have these *k* new centroids, another coupling must be done between similar informational collection focuses and the closest new focus. A circle has been produced. As a result of this circle, we may see that the *k* places change their area bit by bit until no more changes are done or at the end of the day, communities do not move any more. At long last, this calculation targets limiting a target work know as squared mistake work given by:

Squared mistake work:

$$J(V) = \sum_{i=1}^{c} \sum_{j=1}^{c_i} \left(\left\| x_i - v_j \right\| \right)^2 \tag{1}$$

where

'$\|x_i - v_j\|$' is the Euclidean separation among x_i and v_j 'c_i' is the quantity of information focuses in ith group, 'c' is the quantity of bunches focuses.

Algorithmic steps for *k*-means grouping

Let $X = \{x_1, x_2, x_3, \ldots\ldots\ldots\ldots, x_n\}$ be the arrangement of information focuses and $V = \{v_1, v_2, \ldots, v_c\}$ be the arrangement of focuses.

1. Randomly select 'c' bunch focuses.
2. Calculate the separation between every datum point and group focuses.
3. Assign the information point to the group community whose good ways from the bunch place are least of all the group place.
4. Recalculate the new group community utilizing:

New group community utilization:

$$v_i = (1/c_i) \sum_{j=1}^{c_i} x_i \tag{2}$$

where 'c_i' speaks to the quantity of information focuses in *Ith* bunch.

5. Recalculate the separation between every datum point and new got bunch habitats.
6. If no information point was reassigned then stop, in any case rehash from stage 3).

5 Proposed System

Right now, researching the power value estimating issue. Our objective is to foresee the power cost precisely by utilizing the large information from network. To conquer this difficult impediment, we propose a support vector machine (SVM)-supported structure that can anticipate the cost effectively.

SVM is a classifier that attempts to discover a hyperplane which can separate information into the right classes [24]. The help vector is a section of information that could assist with deciding the hyperplane. We propose a parallelized power gauging structure, called hybrid determination, extraction and classification (HSEC). The three segments of HSEC are parallelized hybrid feature selector (HFS) in light of gray correlation analysis (GCA), highlight extraction process dependent on kernel guideline component analysis (KPCA) and differential advancement (DE) based SVM classifier. The HSEC performs highlight designing by choosing highlights comparing to the time grouping and the dimensional decrease of power cost information highlights. The HFS utilizes the combination of two element selectors dependent on GCA rather than one to give a suitable determination of highlights.

6 Results and Discussion

See Figs. 3 and 4.

7 Conclusion

The power value anticipating issue in savvy lattice by means of joint thought of highlight designing and classifier parameters modification. A power value estimating system which comprises of two-phases include handling and improved SVM classifier has been proposed to tackle this issue. In particular, to choose those significant highlights, another half and half element selector dependent on GCA is utilized to process the n-dimensional time grouping as an information. Furthermore, KPCA is

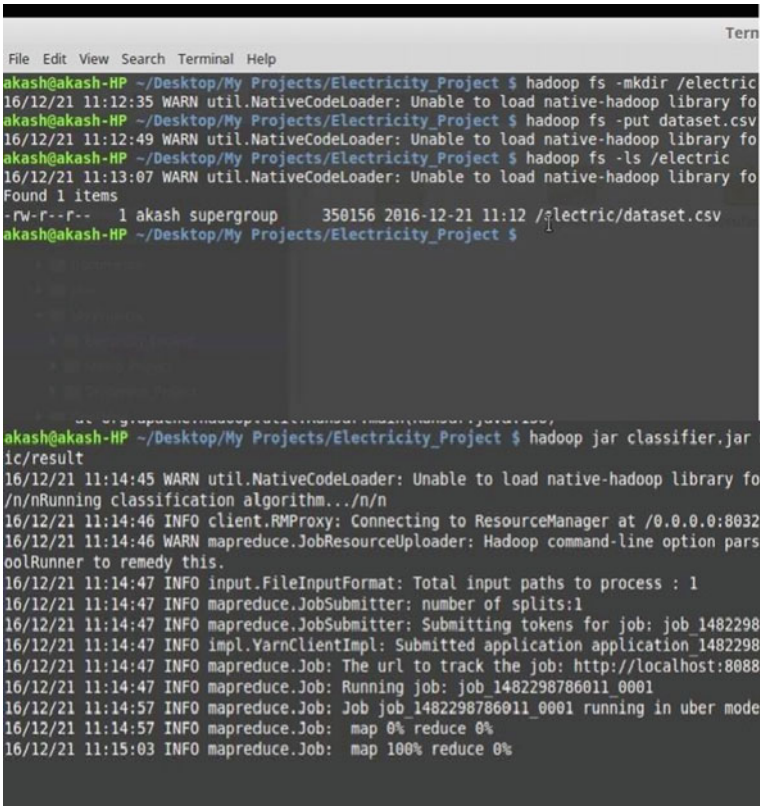

Fig. 3 KPCA calculation outcomes

applied to remove new highlights with less repetition, which helps SVM classifier in precision and speed. Additionally, the DE calculation acquires the fitting super parameters for DE-SVM consequently and productively. The numerical outcomes have demonstrated that our proposed system is more exact than other benchmark calculations. With the thought of the immense measures of information, it is critical for our structure to enough use calculation assets and bolster the equal registering. Not the same as conventional power value gauging approaches where the date is handled successively, the genius presented structure is anything but difficult to actualize on parallelized and appropriated framework. Later on, the continuous necessity will be considered right now.

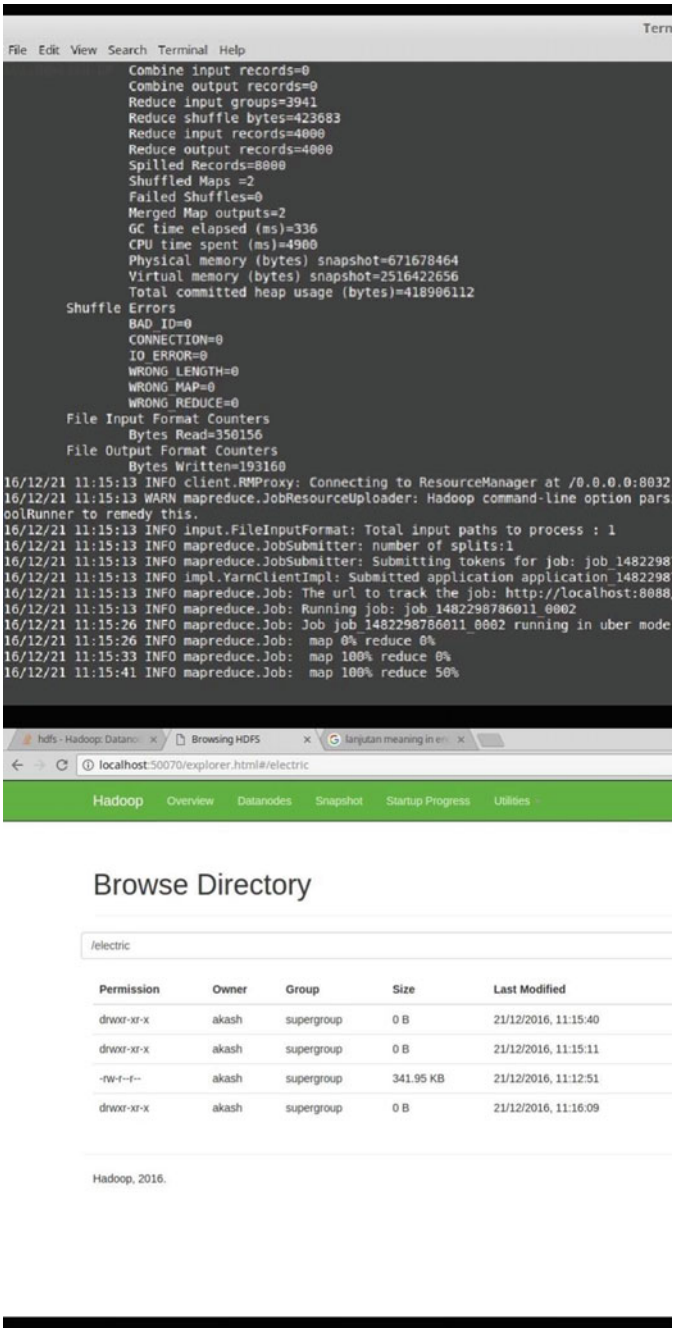

Fig. 4 DE calculation results

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Optimized Intrusion Detection System Using Computational Intelligent Algorithm

P. J. Sajith and G. Nagarajan

Abstract The broad development of the radio frequency identification (RFID) in internet of things (IoT) application has provoked system interruption recognition, which turn into a basic part of intrusion detection system. Because of the open society of the IoT, the security of IoT frameworks and information is dependably in danger. The major objective of this research paper is to design an intrusion detection system framework using Anomaly-Based Detection technique. Optimization of interesting rules from a dense database is determined, using computation intelligent algorithm such as genetic algorithm (GA), genetic programming (GP), and swarm intelligence algorithm.

Keywords Internet of things · RFID · Genetic algorithm · Genetic programming · Swarm intelligence

1 Introduction

An intrusion detection system (IDS) is a software application or hardware appliance that monitors traffic moving on networks and through systems to search for suspicious activity and known threats, sending up alerts when it finds such items. There are two types of IDS system, host-based IDS and network-based IDS. In host-based IDS, a software intelligent agent would monitor the input and output packets from devices. It performs log analysis, file integrity checking, policy monitoring, rootkit detection, real time alerting, and active response. In network-based IDS, sensor will do the monitoring work. The connected network monitors and analyze the network traffics.

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Similarly, there are two types of IDS techniques, Signature-based IDS and Anomaly-based IDS. In Signature-based IDS, a specific signature pattern is used to analyze the content of each packets in all 7 layers. Whereas, in Anomaly-based IDS, it monitors the network traffic and it compares it against standard baseline for normal use. These classification helps to identify whether it is normal or anomalous network.

2 Background

The Anomaly-Based Detection (ABD) [1] identifies the intrusion detection based on the behavior observation. If there is any change in the normal activity, it will be notify. There are two type of anomaly detection self-learning system and programmed model. Programmed model (ABD), in this model, the system will be trained to detect any abnormal changes. The administrator decide a threshold to flags system if any abnormality was there. Self-learning system (ABD) operated by a set of standard normal operation. This model is structured by observing the network strategies over a set of time. Lu and Traore [2] implemented a genetic programming-based intrusion detection system. They used DARPA dataset. According to them, the FPR is low. Bankovic et al. [3] used KDD99cup dataset. They used principal component analysis-based method to extract data.

3 Proposed System Design

The overall functional diagram of the proposed system is shown in the Fig. 1. The information collected over time regarding the network and the corresponding data are extracted and stored in a relational database after pre-processing. From the database, the required data knowledge are extracted using GNP-based fuzzy rule extraction method [4]. The rules initially defined are updated by computing the support, confidence, and the chi-square attributes. According to this, the datasets are classified.

Using this system, the intruders can be classified accurately using the proposed GNP-based classifier [10]. This classifier [5, 6] used both binary and continuous values for rule extraction. The working principle of the above system is explained below:

The extracted dataset consist of source IP address, destination IP address, and source and destination port number. During pre-processing, the missing elements and redundant data are all eliminated. As shown in Fig. 2.

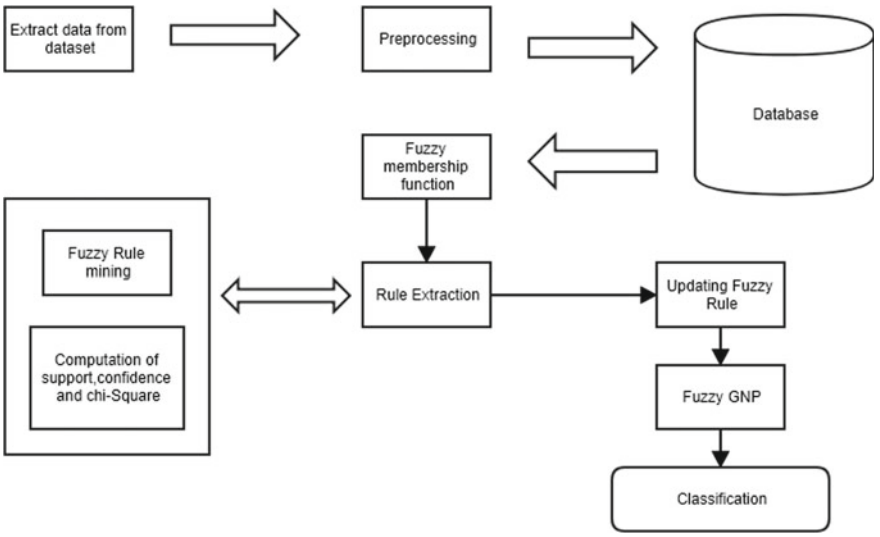

Fig. 1 Overall system design

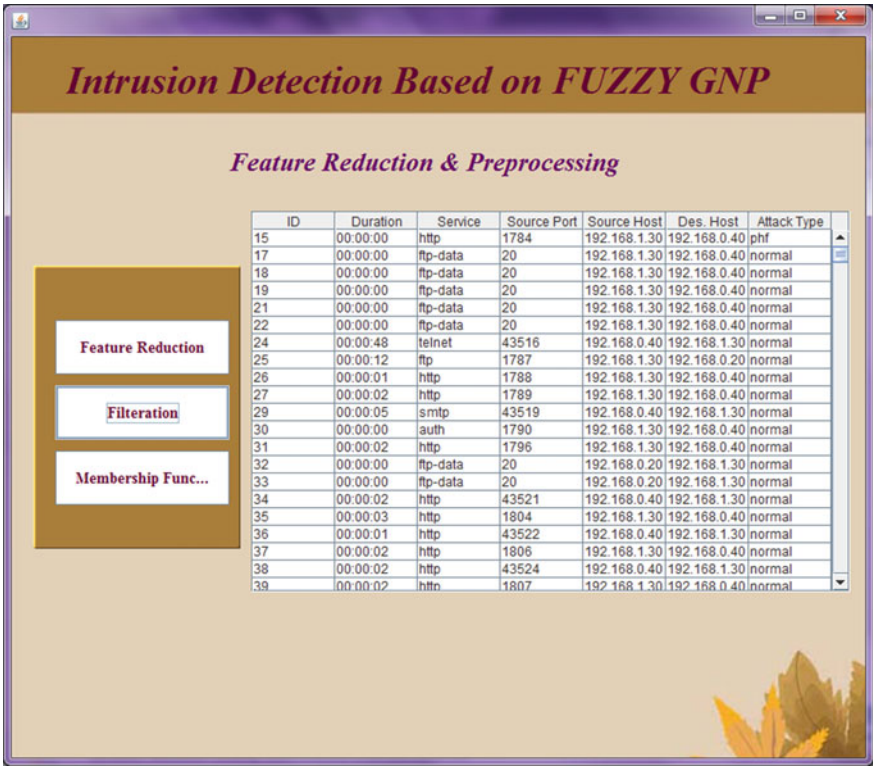

Fig. 2 Data pre-processing

Fig. 3 Fuzzy attribute calculation

For the convenience of fuzzy rule formation, the continuous attributes of the database are linguistically transformed as α, β, and γ to represent low, mild, and high attributes, respectively. To combine the discrete and continuous values in this paper, GNP-based fuzzy rule mining is used. The fuzzy rules are extracted and updated using the confidence and support values [11]. This above process is shown in Fig. 3a, b.

Another important parameter used to update are chi-square value (C). If (X, Y) be the support value of a x_i and y_j. Then, the updated C value for N tuples is calculated as shown in Eq. (1). Where z is the union of (x) and (y). The implementation result shown in Fig. 4.

$$C = \frac{N(z - x.y)^2}{xy(1-x)(1-y)} \tag{1}$$

The fitness (f) of the fuzzy rule [7] is determined by the following equation Eq. (2) and shown in Fig. 5. Where d_{r}, d_{ir} are the correctly and incorrectly determined data. T and N are the total number of trained and test data, respectively. The value is scaled between $[-1, 1]$. If the value is high, then the positive false rate is low and vice versa.

$$f = \frac{d_{\mathrm{r}}}{T} - \frac{d_{\mathrm{ir}}}{N} \tag{2}$$

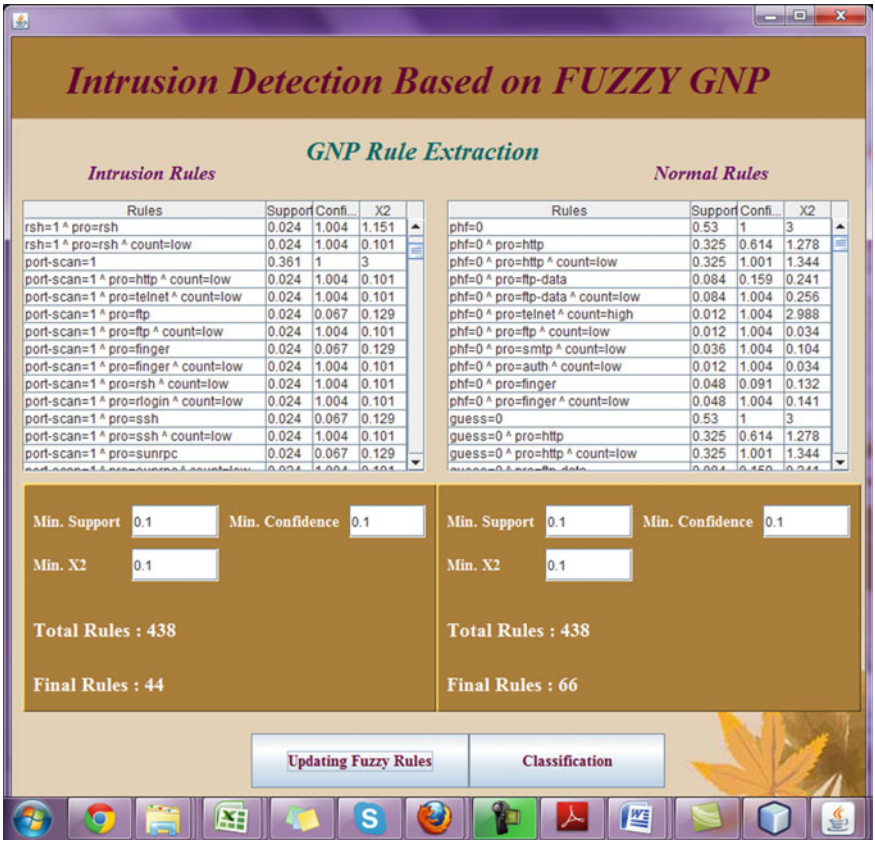

Fig. 4 Chi-square updation

4 Conclusion

In this work, based on fuzzy rule generation a GNP classifier is designed for sub-attribute selection and utilization. This intrusion detection-based classifier [8, 9] is used to detect anomaly in the network. This proposed system extract many effective rules, which can be used for anomaly detection.

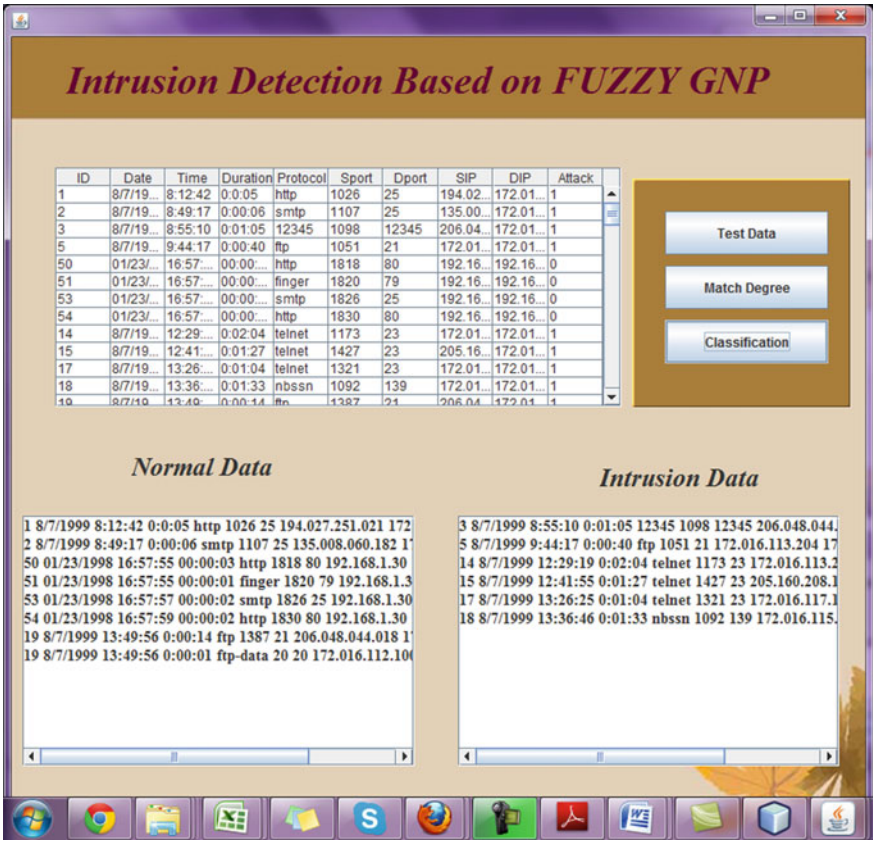

Fig. 5 GNP-based fuzzy rule implementation

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Non-linear Modified Energy Detector (NMED) for Random Signals in Gaussian Noise of Cognitive Radio

P. K. Srivastava and Anil Kumar Jakkani

Abstract The mathematical modeling of conventional energy detector (CED) uses the squaring operation of signal amplitude to detect the random signals in Gaussian noise of cognitive radio (CR). In our approach, this operation is replaced by the arbitrary positive power operation. By choosing an optimum value for this operation with respect to the system settings, it has been observed that the non-linear modified energy detector (NMED) with better performances can be obtained. From the results, it is also observed that the improvement in the performance of current wireless systems. And we can conclude that the conventional energy system could not deliver the optimum performance in CR networks.

Keywords Cognitive radio · Energy detector · Gaussian noise · Random signal detection · Spectrum sensing

1 Introduction

Cognitive radio (CR) is the most promising technique for the efficient wireless communication system design. Cognitive radio is a very well-known term in wireless world. The cognitive tasks are the first one that is radio-scene analysis. It senses the wireless channel, estimates the interference, and observes the phenomenon. The second one is estimation and decision making. In this, it estimates the channel state information, detects the spectrum holes where the secondary can transmit, decision making process, and predicts the channel throughput or transmitter capacity. Finally, the third one is to perform the wireless access and link control operation. In this, it performs transmit power control operation, dynamic spectrum management as the requirements are changed dynamically and game theoretic resource management.

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Spectrum sensing is one of the important modules in it for the efficient spectrum allocation and utilization [1]. The primary objective is to find the unoccupied spectrum so that it can be allocated to the secondary users without interfering any of the primary users.

There are many techniques for spectrum detection in CR networks [2]. Energy detection technique is most widely used because of its low complexity. Another advantage of an energy detector is that it does not require any knowledge on the signals. The first step in the energy detector is to convert the received analog signal into digital form. Then, calculate the frequency components of multiband signals. In the next step, calculate the mean square value to find the received signal energy. Then, it is compared with a threshold value which decides the presence of a signal.

Cognitive radio [3] shows a way to improve the spectrum utilization both in licensed and unlicensed bands. It is one of the major research interests to be focused by academicians and industry experts. In the CR networks, there are two types of users. The first one is the primary user who holds the licensed spectrum from the regulatory authority. And the second one is the secondary user who leases the channels from primary users without interfering their spectrum channels. The concept spectrum sensing is very helpful to find the unused channels for the allocation of secondary users. Energy detection at the physical layer is used for the purpose of spectrum sensing due to its low complexity and fast sensing decisions.

It is a challenging task to allot the unused spectrum channels of primary users in their absence to the unlicensed secondary users [4]. In CR networks, the secondary user senses unused spectrum of the primary user for a period of time and starts transmitting over that channel in that period. As the primary user arrives, immediately the secondary user has to vacate the allocated spectrum and releases the channel to primary user. It should be performed very quickly without interfering the primary user channels. Many detection techniques are proposed by the researchers like matched filtering-based detection [5], cyclostationary detection, etc. [6–9]. Among all these methods, the energy detection technique is simple and easy to implement.

The major drawback of the CED is its unsatisfactory performance at the low SNR. For an accurate calculation of threshold value, an exact knowledge of the noise power is required. In this case, the energy detector can detect the presence of primary user even at very low SNR. As the noise power changes with time and location, it is difficult to measure the exact noise power. A generalized expression is proposed for the energy detection under noise uncertainty by replacing the squaring operation of the signal amplitude in the CED with an arbitrary positive power constant. Generalized energy detector is designed to detect the weak random signals via vibrational resonance [10]. This approach is based on the artificial injection of high-frequency sinusoidal interference signals in the detector.

Cognitive radio has gained more importance to overcome the problems of spectrum scarcity and its inefficient use [11]. It can increase the spectral efficiency by accessing frequency bands depending on the opportunity and availability. Energy detection technique can be used for this purpose. And the fading effects are ignored to evaluate for the performance analysis. It analyzes the different fading models that affect the spectral detection in CR networks.

The energy detector [1] is the most widely used tool for spectrum sensing and efficient spectrum allocation in cognitive radio. But the theoretical and actual detection performances of the CED are not equal in complex Gaussian noise, which causes the reduction in the optimized accuracy. This problem can be solved by an efficient energy detector in complex Gaussian noise. It gives an improved performance as it uses the central chi-square distribution with $2N$ degrees of freedom.

Concept of cognitive radio [12] solves the conflictions of spectrum allotment and utilization. Energy detector can allot it efficiently in the CR networks. These detectors are designed with less complexity. It is necessary to study the performance of these energy detectors in the noisy environments. The performances of energy detectors are studied and analyzed under the different forms of noise models. Selection of the decision threshold decides the performance of a detector. Under the known noise model with a proper selection of threshold, the detection performance can be increased.

2 Derivation

By considering the binary hypothesis testing problem as given below

$$Y_i = \begin{cases} w_i : H_o \\ S_i + w_i : H_l \end{cases} \tag{1}$$

here, H_o and H_l represent the hypothesizes without and with the signal. w_i is AWGN of a particular signal sample i (an integer ranges from 1 to n) with mean ($m = 0$), variance $\left(\sigma_n^2\right)$.

$$w_i \sim N\left(0, \sigma_n^2\right) \tag{2}$$

Assume that the random signal S_i is also a Gaussian distribution with mean ($m = 0$), variance $\left(\sigma_s^2\right)$.

$$S_i \sim N\left(0, \sigma_s^2\right) \tag{3}$$

The binary pulse position modulated ultra-wide bandwidth systems have the bit intervals either 0 or 1. Depending on the data bit value (either 0 or 1), the signal will be transmitted in the first or the second parts of the bit intervals, respectively. At the receiver, the signal is detected by comparing the energy of both the parts of bit intervals. In a CR network, let Y_i is the signal received from the primary user. Consider the signal samples that are independent. Similarly, consider the noise samples also independent.

The joint probability density functions for the above mentioned hypothesizes are given by Eqs. (4) and (5), respectively.

$$p(y|H_o) = \frac{1}{\left(\sqrt{2\Pi\sigma^2}\right)^n} e^{-\frac{\sum_{i=1}^{n} y_i^2}{2\sigma^2}} \tag{4}$$

$$p(y|H_l, s) = \frac{1}{\left(\sqrt{2\Pi\sigma^2}\right)^n} e^{-\frac{\sum_{i=1}^{n} (y_i - s_i)^2}{2\sigma^2}} \tag{5}$$

Also, the CED can be derived as following,

$$W = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{y_i}{\sigma}\right)^2 \underset{H_o}{\overset{H_1}{\gtrless}} \tau \tag{6}$$

$\left(\frac{y_i}{\sigma}\right)$ represents the normalized signal and τ represents the detection threshold. The probability density functions (*p.d.f.*'s) of W under H_o, as well as H_l are the Gamma distributions as follows below

$$p_{w|H_O}(x) = \frac{1}{\theta_o^{k_o}\Gamma(k_O)} x^{k_o - 1} e^{-\frac{x}{\theta_0}}, \quad x \geq 0 \tag{7}$$

here, the shape and scale parameters are $k_{o=}\frac{n}{2}$, $\theta_o = \frac{2}{n}$, respectively, where $\Gamma(\cdot)$ represents the Gamma function

$$p_{w|H_l}(x) = \frac{1}{\theta_1^{k_1}\Gamma(k_1)} x^{k_1 - 1} e^{-\frac{x}{\theta_1}}, \quad x \geq 0 \tag{8}$$

here, the parameters $k_1 = \frac{n}{2}$, $\theta_1 = \frac{2}{n}(1 + \Upsilon)$, $\Upsilon = \frac{\alpha^2}{\sigma^2}$ is the ASNR [1, 12]. The probability of false alarm is given by

$$P_F = \Pr\{W > \tau | H_o\} \tag{9}$$

and the probability of detection is given by

$$P_D = \Pr\{W > \tau | H_l\} \tag{10}$$

The performance of the hypothesis testing problem is measured using the receiver operating characteristics (ROC) curve. The relationship between the probability of false alarm and the probability of detection is described by using the ROC curves. From (7) and (9), we can derive the detection threshold (τ) using the Neyman-Pearson rule as

$$\tau = F_{W|H_O}^{-1}(1 - P_F, k_O, \theta_O). \tag{11}$$

From Eqs. (8), (10) and (11), we can derive the ROC for the CED as given below

$$P_D = 1 - F_{w|H_l}(\tau, k_1, \theta_1)$$
$$= 1 - F_{W|H_l}\left(F^{-1}_{W|H_O}(1 - P_F, k_O, \theta_O), k_1, \theta_1\right) \tag{12}$$

where $F_{W|H_l}(x, k_1, \theta_1) = \int_0^x \frac{1}{\theta_1^{k_1}\Gamma(k_1)} t^{k_1-1} \mathrm{e}^{-\frac{t}{\theta_1}} \mathrm{d}t$ is the cumulative distribution function of a Gamma distribution, whereas $F^{-1}_{W|H_o}(x, k_O, \theta_O)$ is the inverse function of $F_{W|H_O}(x, k_O, \theta_O) = \int_0^x \frac{1}{\theta_O^{k_o}\Gamma(k_O)} t^{k_o-1} \mathrm{e}^{-\frac{t}{\theta_o}} \mathrm{d}t$ with the parameters k_O and θ_O. The detector given by Eq. (6) can maximize the generalized likelihood function. The detection performance can be improved deriving a new energy detector as

$$W_n = \frac{1}{n}\sum_{i=1}^{n}\left(\left|\frac{\mathrm{y_i}}{\sigma}\right|\right)^{\alpha} \underset{H_o}{\overset{H_1}{\gtrless}} T_\mathrm{n} \tag{13}$$

where α is a positive constant and T_n is the new detection threshold. Here, W_n is approximated as the Gamma random variable. Its mean and variances under H_o and H_l are given by (14) and (15), respectively.

$$E\{W_n|H_O\} = \frac{2^{\alpha/2}}{\sqrt{\pi}}\Gamma\left(\frac{\alpha+1}{2}\right)$$
$$V_{\mathrm{ar}}\{W_n|H_O\} = \frac{2^p\Gamma\left(\frac{2\alpha+1}{2}\right)}{n\sqrt{\pi}} - \frac{2^p}{n\pi}\Gamma^2\left(\frac{\alpha+1}{2}\right) \tag{14}$$

$$E\{W_n|H_l\} = \frac{2^{\alpha/2}}{\sqrt{\pi}}\Gamma\left(\frac{\alpha+1}{2}\right)\left(\sqrt{1+\gamma}\right)^{\alpha}$$
$$V_{\mathrm{ar}}\{W_n|H_l\} = \frac{2^{\alpha}(1+\gamma)^{\alpha}\Gamma\left(\frac{2\alpha+1}{2}\right)}{n\sqrt{\pi}}$$
$$- \frac{2^{\alpha}(1+\gamma)^{\alpha}}{n\pi}\Gamma^2\left(\frac{\alpha+1}{2}\right) \tag{15}$$

The corresponding p.d.f.'s of W_n are given by Eqs. (16) and (17), respectively.

$$k_0' = \frac{E^2\{W_n|H_O\}}{V_{\mathrm{ar}}\{W_n|H_O\}}$$
$$= n.\frac{\Gamma^2\left(\frac{\alpha+1}{2}\right)}{\Gamma\left(\frac{2\alpha+1}{2}\right)\sqrt{\pi} - \Gamma^2\left(\frac{\alpha+1}{2}\right)}$$
$$\theta_0' = \frac{V_{\mathrm{ar}}\{W_n|H_O\}}{E\{W_n|H_O\}}$$
$$= \frac{2^{\alpha/2}}{n}.\frac{\sqrt{\pi}\Gamma\left(\frac{2\alpha+1}{2}\right) - \Gamma^2\left(\frac{\alpha+1}{2}\right)}{\Gamma\left(\frac{\alpha+1}{2}\right)\sqrt{\pi}} \tag{16}$$

$$k'_O = \frac{E^2\{W_n|H_l\}}{V_{\text{ar}}\{W_n|H_l\}} = n.\frac{\Gamma^2\left(\frac{\alpha+1}{2}\right)}{\Gamma\left(\frac{2\alpha+1}{2}\right)\sqrt{\pi} - \Gamma^2\left(\frac{\alpha+1}{2}\right)}$$

$$\theta'_O = \frac{V_{\text{ar}}\{W_n|H_l\}}{E\{W_n|H_l\}} = \frac{2^{\alpha/2}(1+\gamma)^{\alpha/2}}{n}.\frac{\sqrt{\pi}\Gamma\left(\frac{2\alpha+1}{2}\right) - \Gamma^2\left(\frac{\alpha+1}{2}\right)}{\Gamma\left(\frac{\alpha+1}{2}\right)\sqrt{\pi}} \tag{17}$$

From (16) and (17), we can derive the detection threshold as

$$T_n = F^{-1}_{W_n|H_O}\left(1 - P_F, k'_O, \theta'_O\right) \tag{18}$$

and the ROC curve for the new detector as

$$P_D = 1 - F_{W_n|H_l}\left(T', k'_1, \theta'_1\right) = 1 - F_{W_n|H_l}\left(F^{-1}_{W_n|H_O}\left(1 - P_F, k'_O, \theta'_O\right), k'_1, \theta'_1\right) \tag{19}$$

We can find the different optimum values for α from (19) that is

(i) To maximize the probability of detection at fixed values of P_F, γ and n
(ii) To minimize the probability of false alarm as a function of P_F, γ and n
(iii) To minimize the sample size n at fixed values of P_F, P_D and γ
(iv) To minimize the sample size is a function of P_D, P_F and γ.

Hence, Eq. (19) is the generalized expression which is useful for different applications. The analytical expression to calculate the optimum values of α is critical to obtain, if not impossible. These optimum values of α will be tested for different parameters like P_F, P_D, γ, or n with the help of numerical calculations.

3 Results and Analysis

The performance analysis of the CED and the MED are presented here. Figures 1 and 2 show that the comparison of simulated CDF and Gamma approximation for W_n under H_o and H_l, respectively. These figures show that the Gamma function performs mostly well. Its accuracy improves with a decrease in α, increase in n, or decrease in γ.

The ASNR (γ) plays major role in the approximation error. As the UWB systems work at a low SNR to reduce the power consumption and the signals of licensed users are weaker in the CR systems, then the accuracy of the Gamma approximation

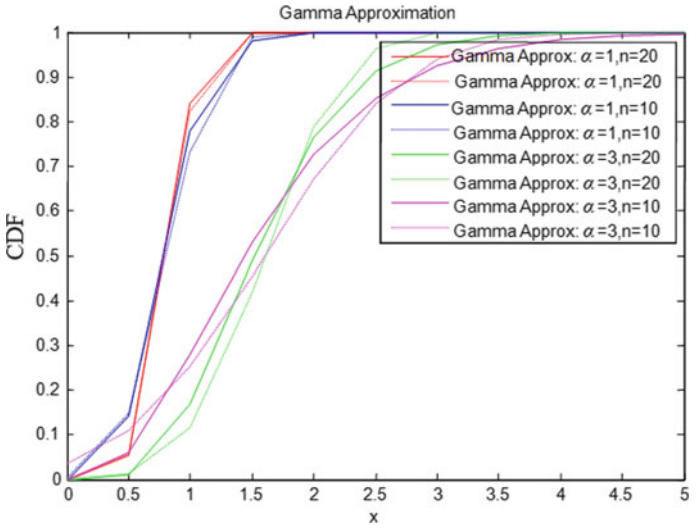

Fig. 1 Plot of simulated CDF and Gamma approximation for W_n under H_o with $\gamma = 0\ dB$.

will be sufficient for practical energy detectors. Further, it can be increased with the help of more number of samples.

The optimum value of α to maximize the probability of detection w.r.to P_F for different fixed values of γ and n is shown in Fig. 3. From this figure, we can observe that the reduction in the optimum value of α with the increase in P_F. This rate of the decrement is almost constant for the low values of P_F. However, at the very low values of P_F approximately 1, α value falls with steeper slope.

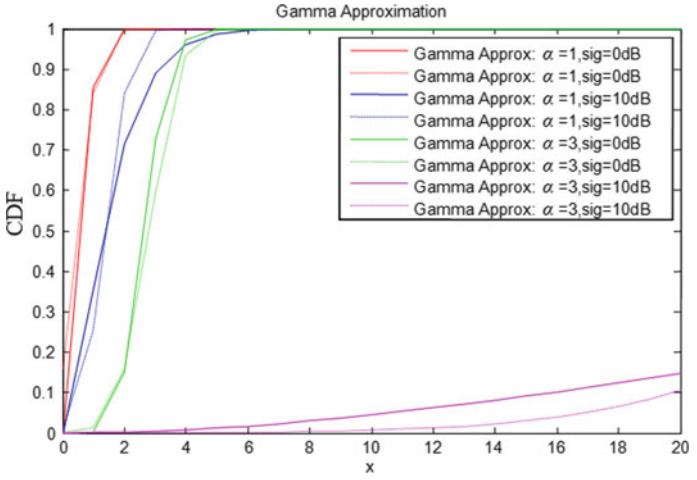

Fig. 2 Plot of simulated CDF and Gamma approx. For W_n under H_l with n = 10

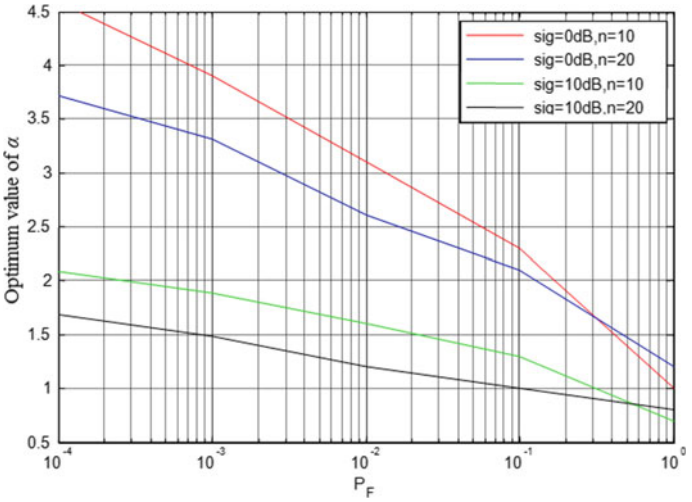

Fig. 3 The optimum value of α to maximize the probability of detection w.r.t *PF*

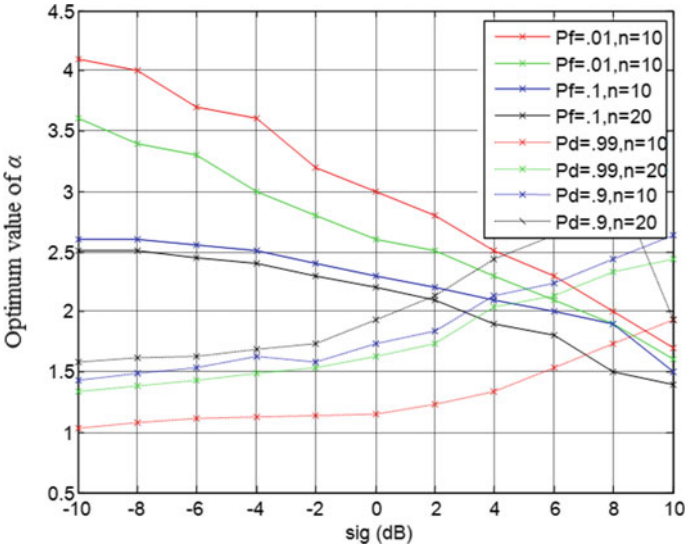

Fig. 4 The optimum value of α to maximize the probability of detection w.r.to γ

Equation (7) explains that P_F is the probability for the cognitive radio to decide that the licensed band is occupied while it is actually free. In the CR networks, P_F should be very low which is less than 0.1 and the optimum α should not be equal to 2 in these cases either. Finally, the CED results into poor performance. The optimum value for α to maximize the probability of detection w.r.t γ for different fixed values

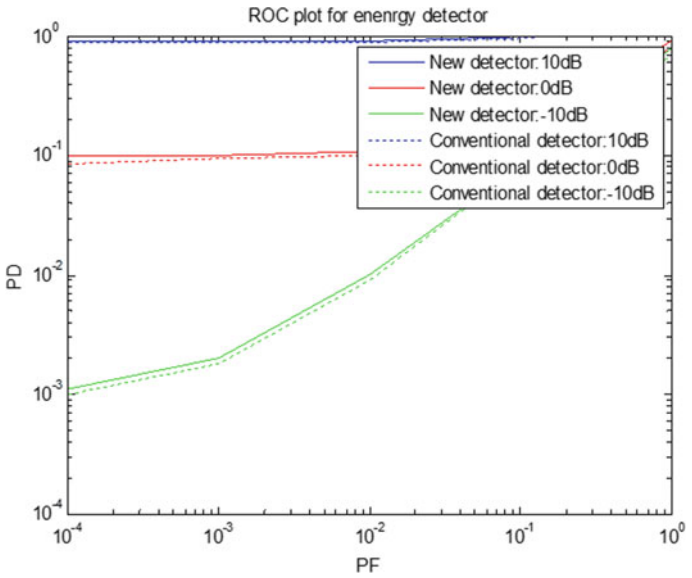

Fig. 5 Plot of ROC for the CED and NMED when $n = 10$ for different values of γ

of P_F and n, as well as the optimum value of α to minimize the probability of false alarm w.r.t γ for different fixed values of P_D and n are shown in Fig. 4.

Comparison of the ROCs for the CED and NMED detectors when $n = 10$ for different values of γ is shown in Fig. 5. Theoretically, the results for these detectors can be obtained using Eqs. (12) and (19). This NMED detector performance is better than the CED detector. It can be observed that the increase in the performance gain as the P_F decreases, and the most significant region is $P_F \leq 10^{-3}$.

BER performance of both the detectors is compared for a BPPM UWB system in the IEEE CM1 channel and the results shown in Fig. 6. Also, it is observed that the better performance of the NMED over the CED detector. Ncept of cognitive radio [12] solves the conflictions of spectrum allotment and utilization. Energy detector can allot it efficiently in the CR networks. These detectors are designed with less complexity. It is necessary to study the performance of these energy detectors in the noisy environments. The performances of energy detectors are studied and analyzed under the different forms of noise models. Selection of the decision threshold decides the performance of a detector. Under the known noise model with a proper selection of threshold, the detection performance can be increased.

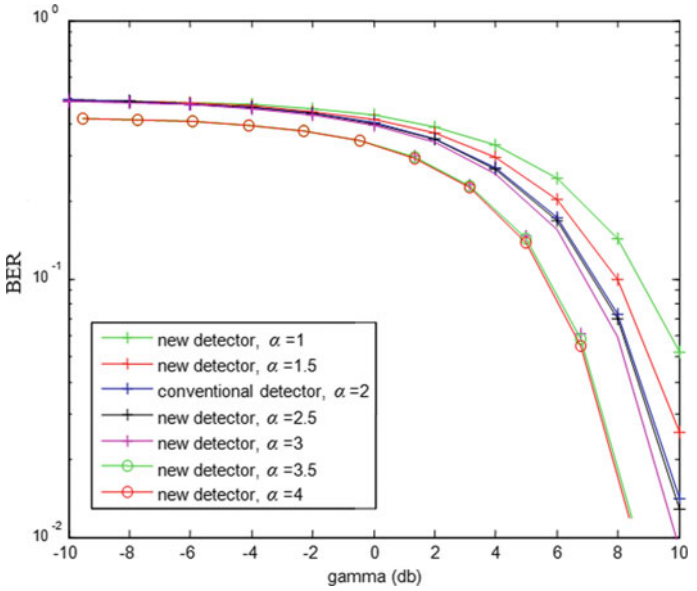

Fig. 6 Plot of BER w.r.t gamma function for the different α values

4 Conclusion

From the results, it is clear that the performance of non-linear modified energy detector is far better than the CED. The optimum power operation depends on the probability of false alarm, ASNR, and sample size. This new mathematical modeling in which the squaring operation of signal amplitude is replaced by the arbitrary positive power operation outperforms the CED. Also, the similar methods are adopted in equalization and power control for achieving the best performance.

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Internet of Things for Enhanced Food Safety and Quality Assurance: A Literature Review

Raquel Margarida Dias, Gonçalo Marques, and Akash Kumar Bhoi

Abstract Internet of things (IoT) concept is related to a ubiquitous and pervasive connection of cyber-physical systems to the Internet. These cyber-physical systems can be identified and incorporate communication and sensing capabilities which turn them able to cooperate in a collective objective. IoT architectures have been successfully tested and valeted in several fields. Food safety is a relevant topic for public health and well-being. This paper presents a literature review on the application of IoT architectures for food monitoring in the past five years (2014–2019). The main contribution is to synthesize the existing body of knowledge, to identify common threads and gaps that would open up new challenging, relevant, and significant research directions. The review on real applications of IoT for food quality monitoring has conducted by analysed 13 studies which show that IoT implementation in this field is rare. The results state that most of the IoT implementations have been conducted in Asia, particularly by Indian authors. The most used sensors in these systems are temperature, humidity and gas sensors, and the most used communication technologies are ZigBee, Wi-Fi, radio-frequency identification (RFID), and Bluetooth low energy (BLE). Furthermore, the authors found exceptional potential in the implementation of IoT for food monitoring systems; however, some limitations are also found.

Keywords Food quality · Food safety · Internet of things · Monitoring systems · Sensors · Wireless sensor networks

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1 Introduction

Internet of things (IoT) can be defined as the ubiquitous and pervasive appearance of cyber-physical systems with developed communication and sensing capabilities. IoT has been used in several domains such as agriculture [1–4], noise pollution supervision [5–8], environmental quality monitoring [9–14], and other numerous applications of daily human routine. IoT provides several opportunities on data acquisition, processing, and transmission using cyber-physical systems to improve productivity and safety [15–20]. Agricultural environments are an appropriate scenario for IoT development as its applications need continuous supervision and control functionalities. The data collected in this context is relevant for the decision making on possible interventions for enhanced productivity [21]. Furthermore, IoT systems have been applied to the agricultural field for different activities to supervise numerous relevant parameters during production such as temperature, relative humidity, soil moisture during the production, and transportation processes [22]. IoT-based architectures can address several challenges in the agriculture field related supply chain, logistics and storage to promote food quality and safety.

Food storage facilities should incorporate real-time monitoring of the environmental conditions in order to ensure high-quality storage conditions for enhanced food safety and quality. On the one hand, the agricultural products can be infected by the activity of rodents or arthropods during storage with critical health on overall public health [23, 24]. On the other hand, environmental conditions such as temperature and relative humidity are relevant to the pathogen's growth during storage [25]. However, there is a relative lack of interest in the implementation of IoT to develop enhanced food safety systems. According to a review presented in [26], the first paper on this topic dates from 2011, and the number has increased in the last years as in 2018, the published papers are only nine.

Mobile sensors and wireless communication technologies must be used to create hardware and software systems to monitor food and environmental contamination. Mobile phones incorporate relevant processing units and numerous communications technologies such as NFC, BLE, 3G/4G, and Wi-Fi. Therefore, mobile devices can be used not only for data consulting but also for data acquisition regarding the food quality and safety domain.

This paper presents a literature review on the application of IoT architectures for food monitoring. Taking into account the lack of interest in the applicability of IoT in the food safety field, this document collects, analyses, and synthesizes the implementation of IoT monitoring systems for enhanced food safety and quality in the past few years (2014–2018). The literature is examined, focusing on the supported communication technologies, power source, processing unit, sensing unit, countries of the authors, and year distribution. The main contribution is to synthesize the existing body of knowledge, to identify common threads and gaps that would open up new challenging, relevant, and significant research directions. The rest of the document is structured as follows: Sect. 2 presents the select IoT monitoring systems

and presents the selection criteria, Sect. 3 describes the results and discussion, and the conclusion is presented in Sect. 4.

2 IoT Monitoring Systems for Enhanced Food Safety and Quality

This section presents several studies conducted on IoT monitoring systems for enhanced food quality and safety. The research studies are selected by following these four criteria: (1) incorporate IoT architectures; (2) use low-cost sensors; (3) present results on the implementation of the IoT system and does not describe only conceptual approaches, and (4) are published in previous six years (2014–2019).

In the first search, we found 17 papers presented in [27–43]. After paper analysis, the studies presented in [27–30] were removed because they only describe conceptual approaches and reviews on state of the art and does not present results on the implementation of IoT systems. Therefore, in this section, 13 research studies are presented [31–43].

An IoT implementation to provide quality control of vegetable storage facilities is presented in [31]. In this study, ten sensor nodes equipped with temperature and humidity sensors are used combined with a coordinator node through a star topology wireless sensor network (WSN). This WSN used ZigBee communication technologies for data transmission, and the coordinator is connected to a laptop. The laptop is connected to the Internet using Wi-Fi. The data is collected every 16 min by the sensor nodes and transmitted to the coordinator unit. The coordinator updates the remover server database every 25 min. The sensors nodes are powered using 3AA alkaline batteries, which must be replaced every ten weeks.

A cold chain system for multi-channel food monitoring is proposed by [32]. The proposed method incorporates different types of data collection using fixed and mobile sensors for temperature supervision. A WSN is used for data collection by implementing ZigBee communication. The results are promising as the experimental activities state reduced cost not only for the product price but also for energy consumption.

A cloud-based monitoring system designed for the wine sector, which covers all the wine production phases from production to storage, is presented by the authors of [33]. The proposed method provides real-time and offline monitoring using WSN and off-the-shelf sensors. The WSN is based on the Waspmote microcontroller and uses ZigBee for data transmission. Two WSN topologies are presented. On the one hand, a centralized topology is included for offline data access and storage. On the other hand, a distributed topology is implemented for real-time data consulting using cloud technologies. This solution also provides a Web application for data consulting and alerts.

A miniaturized hardware prototype that incorporates a CMOS image sensor for food contamination monitoring is presented in [34]. The system provides mobile

phone compatibility for data analysis and transmission. The proposed immunosensor system is wirelessly connected to the smartphone and presents an IoT architecture for food-borne pathogens analysis. The collected data can be consulted through a Web application.

Rajakumar et al. present a data acquisition system based on IoT for microbial activity monitoring of milk storage facilities [35]. The proposed system includes temperature, viscosity, salinity, gas, and liquid levels sensors. The prototype incorporates an RFID reader, which is used to process milk identification details. This system is powered from the power grid. The proposed method is a low-cost approach to detect milk adulteration and microbial activity.

A food supply chain system based on IoT is proposed by [36]. The proposed method incorporates a Raspberry Pi as a processing unit and a GPS module for geolocation. A temperature sensor and a Waspmote sensor shield are included for food quality monitoring. The systems ensure data collection and warnings regarding food contamination for the food producer and clients.

A low-cost IoT system for real-time food traceability and monitoring during the transportation is presented in [37]. The microcontroller used is the Raspberry Pi. The proposed method incorporates temperature and humidity sensors. Moreover, the system provides RFID communication to read to distinguish and identify the products. The data can be accessed using a Web application. This IoT system provides both Wi-Fi and GSM/GPRS communication technologies.

The authors of [38] propose a food monitoring system based on IoT architecture. The proposed method incorporates a photosensor developed by the authors to detect organophosphorus compounds. The data collected is transmitted to a mobile device through BLE and is handled using an Android application. The photo detection process holds a dynamic range, high sensitivity, and low power consumption.

An IoT monitoring system for enhanced food quality is presented by [39]. The system implements ZigBee for data communication with the computer, and desktop application has been developed in LabView for data consulting. The proposed hardware system incorporates a BM680 sensor for temperature, humidity, air pressure, and air quality monitoring.

An IoT-based food monitoring system designed especially for meat freshness assessment is proposed by [40]. This system uses RFID technology for product identification and data transmission with the server computer. The proposed method is implemented on the TI MSP430 microcontroller and incorporates temperature, humidity, and ammonia sensor. The authors have conducted several experiments, and results ensure the efficiency of the proposed solution for meat freshness evaluation.

A LoRa-based sensor node is proposed by [41]. This system incorporates an SHT21 for temperature and humidity monitoring. Several tests have been conducted on a potatoes storage facility focusing on the energy consumption of the system using 20 sensor nodes. The processing unit is based on the ATmega 1284P and uses the IoT Contiki operating system.

An IoT-based security system for food storage monitoring which incorporate a PIR and an ultrasonic distance sensor is presented in [42]. The proposed method aims to detect attacks from rodents or insects and automatically trigger a rodent

repeller. The data collected is shared in real time using the ThingWorx cloud platform. Furthermore, this system incorporates notifications via SMS.

Srivastava et al. propose an IoT system for food storage monitoring based on a Raspberry Pi microcontroller [43]. The system incorporates BLE communication features to trigger real-time notifications to smartphones, and Wi-Fi communication is used to provide an Internet connection. This method incorporates several sensors for environmental temperature, moisture, and light assessment. A desktop interface has been developed, which is executed in the processing unit.

3 Results and Discussion

Different IoT architectures and approaches for IAQ supervision were reviewed in Sect. 2. The presented studies incorporate different types of hardware and WSN topologies for food quality monitoring. Several studies are based on well-known platforms used in the development of numerous IoT systems for other fields of research such as Raspberry Pi, Arduino, TI MSP430, and Waspmote.

This section presents the analysis of the studies regarding the publication year, the authors' geolocation, the processing unit, the sensing unit, and the data visualization and analytics methods used in the IoT implementation to identify common threads and gaps. Furthermore, the power supply used in these studies is also analysed among the connectivity used.

Table 1 presents the distribution of the analysed studies according to the authors' geolocation and year of publication.

The distribution of studies according to their year of publication does present high variation over the analysed period. Three studies are published in 2018 and 2016, one study was reported in 2017, and two articles are published in the remaining years.

Table 1 Distribution of the studies according to the authors' country and year of publication

		2014	2015	2016	2017	2018	2019
Europe	Finland	–	–	–	–	[31]	–
	Bosnia and Herzegovina	–	[37]	–	–	–	–
	Macedonia	[33]	–	–	–	–	–
	Germany	–	–	–	–	–	[41]
	Romania	–	–	–	–	–	[39]
Asia	South Korea	[40]	–	[34]	–	–	–
	India	–	–	[42, 43]	–	[35, 36]	[39]
	China	–	–	–	[38]	–	–
	Vietnam	–	–	–	–	–	[39]
	Taiwan	–	[32]	–	–	–	–

Table 2 Distribution of studies according to communication technology and power source used

	ZigBee	Wi-Fi	BLE	RFID	GSM/GPRS
Non-rechargeable battery	[31, 39]	–	[38]	–	–
Rechargeable battery	[33]	[37]	–	[37, 40]	[37]
Power grid	[35]	[43]	[43]	–	–

Most of the authors responsible for the analysed studies are from Asia representing ten studies in total. The review presents five studies with Indian authors, which represses almost 40% of the analysed systems followed by South Korea ($N = 2$). Regarding the IoT systems conducted by European authors, five studies are reported from different locations such as Bosnia and Herzegovina, Finland, Macedonia, and Germany. The studies reported in 2014 are located in South Korea and Macedonia and the two published studies in 2019 bellow to European affiliations which can represent an increase of attention on the food quality research field.

Table 2 presents the relation between the connectivity and power source used in the analysed studies. The studies present in [32, 34, 36, 41, 42] are not presented in Table 2 because the power source and/or connectivity information is not presented in the paper.

From the analysis of Table 2, it is possible to conclude that most of the systems that use non-rechargeable batteries incorporate low power consumption such as ZigBee and BLE. Furthermore, the researchable batteries are used for several communication technologies such as ZigBee, Wi-Fi, RFID, and GSM/GRPS. Numerous connectivity methods are presented in the analysed studies. The most used communication technology is ZigBee ($N = 4$), followed by RFID, Wi-Fi and BLE. The less-used communication technology is GSM/GPRS, which are used only in one study. The studies presented in [36] and [42] does not present the connectivity used in the IoT system communication processes. Typically, ZigBee, LoRa, and BLE are used for WSN architectures and RFID is used for product traceability and identification. Moreover, the BLE communication technology is implemented for data transmission with mobile devices.

Six IoT systems for food monitoring incorporate AVR microcontrollers ($N = 6$), and four systems incorporate Raspberry Pi as the processing unit. Moreover, the AVR microcontrollers used are based on Arduino and Waspmote. The studies presented in [36] and [32] does not state the microcontroller used.

Table 3 presents the data consulting methods available in the studies analysed. The most used method for data consulting is through desktop applications, followed by mobile applications. The studies presented in [35] does not provide data consulting methods for remote data consulting using only a display on the prototype for data visualization. Moreover, data consulting methods are not refereed in studies [36] and [41].

Several types of sensors are used to monitor different parameters such as temperature, humidity, air quality, air pressure, solar radiation, wind speed, wind direction, soil temperature, soil moisture, light, viscosity, liquid level, magnetic, presence, and

Table 3 Data consulting methods incorporated in the analysed studies

References	Desktop	Mobile	Web
[31]	√	√	–
[32]	√	–	–
[33]	–	–	√
[34]	–	√	–
[37]	–	√	–
[38]	–	√	–
[39]	√	–	–
[40]	√	–	–
[42]	–	–	√
[43]	√	–	–

distance. The majority of the analysed studies use temperature ($N = 9$) and relative humidity ($N = 7$) sensors. Three studies incorporate air for VOC and ammonia detection. Furthermore, one study incorporates GPS for geolocation [36], and two CMOS image sensor and a photosensor have been developed by the authors of [34] and [38], respectively.

The review conducted on real IoT applications for food quality monitoring shows that IoT implementation in this field is uncommon. However, some studies present relevant and promising results on this topic. Tervonen has proposed a WSN to for food quality control on a potatoes storage facilities [31]; a milk monitoring system has been tested and validated by Rajakumar et al. [35]; an IoT cloud-based monitoring system for wine production field is proposed by Smiljkovikj et al. [33]; Seo et al. has proposed a food contamination monitoring system based on IoT. [34]; a meat freshness monitoring system based on IoT is presented by Eom et al. [40], and an IoT food quality monitoring system based on low-cost sensors has been tested and validated by Popa et al. [39]. The before-mentioned projects can prove that IoT can be applied with promising results for enhanced food safety and quality to promote public health.

Furthermore, the literature review led the authors to identify several limitations and challenges. The implementation of IoT on the food safety field will bring several challenges related to the IoT paradigm itself, such as privacy and security problems. The development of new and more secure methods for IoT data collection, processing, and transmission will conditionate the success of the implementation of this kind of systems. Moreover, it is necessary to create standards for data processing and transmission due to a variety of different devices. The number of sensors and actuators in this domain is a critical challenge regarding the cost of the implementation of these systems for product identification and traceability.

4 Conclusion

Despite all the public health impacts, the implementation of IoT systems on the food safety and quality domain is unfortunately rare. This paper presents a literature review on the food monitoring system based on IoT, and 13 studies are analysed. Most of the research papers available on the state-of-the-art present theoretical implementations of IoT for food monitoring. However, this paper selects the studies published in previous six years only if they present a real implementation of the proposed systems. The most used sensors for food monitoring are temperature, humidity and gas sensors.

Furthermore, most of the proposed methods use AVR microcontrollers as a processing unit. Some of the presented solutions incorporate enhanced data consulting methods through mobile, desktop, and Web applications. The connectivity of these systems is provided by using one or more wireless communications technologies such as ZigBee, Wi-Fi, RFID, and BLE. The results show that most of the studies presented are conducted in Asia, particularly by Indian authors. The authors found exceptional potential in the implementation of IoT in the food safety domains. Nevertheless, several limitations regarding security and privacy must be solved to promote the proliferation of these systems.

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Optical Wave Guide: Fast and Secure Communication for Next-Generation Technology

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Abstract Optical communication is an indispensable technology for current society requirements. It satisfies the short distance and long-distance communication with the help of different mode analysis of variety type of fibers. In this paper, an analytical study has been presented that can help the next generation high-speed secure communication. The advantage is that it can act as the filter in terms of signal processing and channel in terms of communication. The waveguide can satisfy in both the way. For revolutionary communication and signal processing, it is found that optical waveguide research can satisfy future generation communication. The suitable design can be used for all optical signal processing. This article can provide insight to the researchers working in this direction.

Keywords Optical fiber · Optical communication · Waveguide · Optical waveguide · Optical signal processing

1 Introduction

Over the past decades, optical communication has established itself as the indispensable network technology for societal IP-driven traffic, resulting in a dependence of our society on this network technology. Optical waveguide is a guiding structure that guides light with the scale of optical wavelength. Many waveguide structures such as longitudinally uniform, angularly uniform, and longitudinally periodic are possible. Researchers modified different optical waveguide concepts some extent

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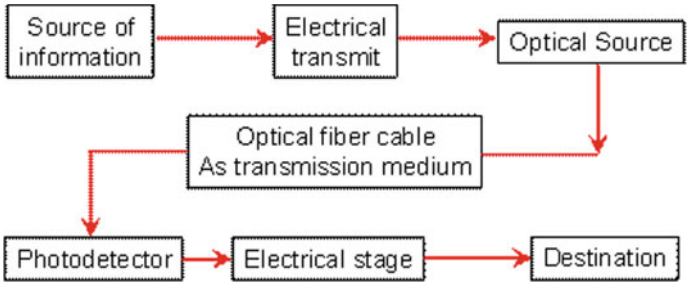

Fig. 1 Generalized optical communication system.

based on geometry, refractive index, and materials used. It may photonic crystal waveguides, slotted photonic crystal waveguide (SPCW), silicon-on-insulator-based strip and slot waveguides, silicon nanophotonic waveguides, gallium-nitride ridge waveguides, polymer optical waveguides, chalcogenide waveguides, nanoplasmoic waveguide [1–4]. For high-speed signal processing application with the development of silicon-based photonic technology optical waveguide occupied a special position in this technical era. To derive optimum performance from optical fiber glass, it is a crucial task. By adopting different techniques with an optical waveguide, many nonlinear optical effect such as phase modulation, four wave mixing and Raman scattering can be achieved [5].

The types of optical detectors may be of photodiodes, phototransistors, and photoconductors. The electrical stage receives the information and provides it to the destination as shown in Fig. 1 for the basic optical communication system.

In case of digital optical fiber communication system, information is encoded prior to drive circuit of optical source and at the receiver end, a decoder is used after amplification and equalization.

Optical fiber is simply one type of dielectric waveguide through which information is transmitted in the form of light. It consists of a transparent core with certain refractive index surrounded by cladding which is of less refractive index. The cladding supports the waveguide and protects the core from contaminated absorbing surface. Due to its thickness, substantially it reduces the radiation loss. A set of guided electromagnetic waves can define the propagation of light along the waveguide is called as modes of waveguide [6].

In high-speed communication network system, data signals, in the form of optical pulses, are traveling at the speed of light in fibers. While signal processing is still performed in electrical domain. It requires optical-electrical-optical conversion, which imposes a bandwidth limit for each transmission channel. Optical signal processing can be applied to break such bottleneck as it relies on nonlinear optical effects that have nearly instantaneous response. The following subsection describes regarding the earlier work performed in this context.

2 Related Literature

Due to two key developments in the optical domain, the 1960s mark the introduction of the optical transmission systems which now form the backbone of the worldwide communication network. One of these developments was the development of the laser in 1960 [2]. This achievement was quickly followed by the demonstration of the first Gallium Arsenide (GaAs) semiconductor laser in 1962 [3] and was particularly important, as it was the first coherent optical frequency oscillator. Accordingly, this demonstration showed the optical equivalent of the electrical oscillator. The second key development was the fiber medium, which has a long history of achievements. A key moment was 1966, when Kao and Hockham posed the idea that the optical fiber attenuation could be reduced <20 dB km^{-1}, the ocular attenuation figure, by reducing impurities [4]. At that time, the attenuation figure of optical fibers was >1000 dB km^{-1}, which were used for medical applications [5]. Among other contributions, the proposal of using optical fibers for telecommunications resulted in Kao receiving the Nobel Prize in Physics in 2009. In 1970, engineers at the Corning Glass Works (now Corning Inc.) developed the first single mode fiber (SMF) with an attenuation figure <20 dB km^{-1}. The theoretical model of the SMF was first described by Snitzer in 1961 [6], which could minimize the attenuation figure. Over the following years, the SMF drawing and purity were optimized to decrease the medium's attenuation. Currently, commercial SMFs approach the fundamental attenuation figure of ~0.148 dB km^{-1} at 1550 nm [7], where the measured attenuation is ~0.2 dB km^{-1}. This attenuation was reached in 1980 [8].

The wavelength region is subdivided into transmission windows. Since, the lasers are optical oscillators, they allow for the subdivision of the wavelength region for FDM in the optical domain, termed wavelength division multiplexing (WDM). WDM was first demonstrated in the laboratory in 1978 [9] and is currently standardized in the ITU G.694.1 standard to account for a channel spacing of 12.5, 25, 50, and 100 GHz [10]. As WDM is the optical equivalent of FDM, optical TDM (OTDM) was also proposed for optical transmission systems. However, it was never widely adopted. Due to its implementation simplicity, WDM transmission became the standard for optical transmission systems. However, the transmission distance remained short before optical-electrical-optical conversion repeaters were required. Nevertheless, this transmission distance was substantially longer than copper-based solutions that could achieve. Coherent transmission and detection were proposed to extend the transmission distance [11]. the solution for increasing the transmission distance without requiring OEOC repeaters came with the invention of the low-noise erbium doped fiber amplifier (EDFA) by Mears et al. in 1986 [12], and the EDFA demonstration in 1987 by Mears et al. [13]. This demonstration caused the development of coherent transmission to be halted as the EDFA allows low-noise optical amplification of the transmitted signal in the wavelength region. The development of the EDFA is the reason the conventional band is designated as such. By changing the wavelength of the pump laser, the long band can be amplified instead of the conventional band.

As the ITU specifications denote standardized channel spacing, the serial rate cannot increase indefinitely as two neighboring channels start overlapping in the frequency domain. In the late 1990s, all transmission systems were direct-detection, i.e., the received power denotes the binary values being transmitted. To increase the SE, coherent receivers were reintroduced in 2004 [14] and were combined with powerful digital signal processing (DSP) techniques to compensate for linear transmission impairments. Coherent transmission exploits the amplitude and phase dimensions and can, therefore, increase the SE over direct-detection transmission systems. This was a common transmission technique for radio communications, denoted as quadrature amplitude modulation (QAM). Soon after the reintroduction of coherent receivers, it was proposed to exploit the two linear polarization dimensions of the SSMF [15], which is denoted as polarization division multiplexing (PDM). The two modulated channels mixed during transmission and were unraveled at the receiver side using 2×2 multiple-input multiple-output (MIMO) equalization. Note that both polarization channels use the same frequency spectrum. Accordingly, the SE is doubled with respect to single polarization transmission. In 2010, the first real-time $\geq$100 Gbit s^{-1} carrier-1 employing 2 information channels using PDM was demonstrated using prototype equipment. Information theory and DSP became popular topics in optical transmission systems to maximize the throughput in SSMFs by compensating linear and nonlinear transmission impairments. GVD compensation in coherent transmission systems was performed in the digital domain using DSP without a penalty with respect to dispersion shifted SMFs. Therefore, DS SMFs were no longer commonly used in long-haul transmission systems. By using WDM and direct-detection receivers, a throughput of 10 Tbit s^{-1} was achieved [16].

Using coherent transmission with higher order modulation formats and simultaneously exploiting the 2 available polarizations in an SSMF, a throughput of ~100 Tbit s^{-1} was achieved [17]. All possible orthogonal dimensions were exploited simultaneously, corresponding to a theoretical throughput limit of the SSMF. To further increase the throughput of a single fiber, only one option was left unexploited: space. Therefore, the optical transmission systems exploiting the spatial dimension are termed SDM [16]. Earlier SDM work using direct-detection referred used the terminology mode group diversity multiplexing (MGDM) due to the usage of multimode fibers (MMFs).Through the aforementioned technologies, the SSMF throughput has increased substantially for research systems over the recent decades. However, since the mid-1980s, rapid growth in capacity demand has also been observed from the commercialization of optical telecommunication networks and IP-driven traffic, where modern commercial products already exploit PDM and WDM transmission. It was observed that the throughput in commercial products closely follows the throughput increase achieved in research systems. However, it was previously noted that ~100 Tbit $s^{-1}$was the theoretical limit of SSMFs [17].

For high-speed signal processing application, the silica-based waveguide coherent optical transversal filter with a tapped delay-line structure was described [18]. It was experimentally confirmed that these filters could process broad-band signals over 4 THz. At the same time, the future computer architecture ultra-fast data transfer can

be achieved by using optical switches made from optical waveguide. So, a temperature stable optical waveguide had been realized and integrated into PCB [19]. GaN is having properties of low thermo-optical co-efficient, weak material dispersion, high optical damage threshold, and chemical stability; hence, it was promising material for operation at high temp and for hybrid integration on silicon. Thus, suitable for making optical waveguide with low loss [20]. Ridge waveguides in GaN with propagation losses as low as 1 dB/cm at 1550 nm has been reported [21–23]. Large information capacity of an optical waveguide such as it must be capable of serving very hares environment condition. It exhibited a very rapid response to ultraviolet radiation at 6 mW cm^{-2}[24]. Silicon on insulator (SOI) was considered a well suited system of making compact/miniaturized optical linear as well as nonlinear devices. It has a great attraction due to compatibility with the existing CMOS technology [25]. SMF was used for broad-band signal processing around 10 GHz of bandwidth due to the good property of propagation and delay.

It is difficult to construct and reproduce effective delay-line filter using SMF until verification of the related important parameters. The dominant dispersive mechanism depends on the waveguide properties of the fiber and the spectrum of the optical source. Whereas multimode fiber can maintain the group velocity and can guide many modes at time that results the fidelity with high-frequency components but in limited range. Digital signal processing comes to rescue and is a critical technology underpinning the next generation advanced fiber-optic systems. Literally, it contributes two principal enforcements with respect to information communication. One is the implementation of spectrally-efficient modulation schemes, and the other is the guarantee of the recovery of information from the spectrally-efficient optical signals after channel transmission. However, fails to satisfy long-haul communication. Guided wave optics covers both fiber and integrated optics technology. Hence, photonics technology improves optical communication and minimizes the optical components used for communication as well as measurement applications. It has following advantages.

A. It can allows even the sharp bends.
B. It can provide large scale photonics component circuits and its integrated devices.

The waveguide can support a large number of modes, and therefore, any changes of the waveguide geometry must be made with great care bearing in mind mode conversion-reconversion phenomena. This requires a detailed study of wave transmission in multimode waveguides and the coupling effects due to irregularities; a field relatively unexploited in its analytical and experimental aspects. Despite all the planning difficulties, a waveguide when properly designed will give satisfactory service and will handle successfully a bandwidth well in excess.

All-optical signal processing is an essential feature for next generation communication. As a result, it can reduce the complexity, probability of wavelength blocking to increase the capacity. All-optical switches, logical gates, parametric amplifiers, format converters, and wavelength converters have been realized earlier, where silicon waveguides shown better performance. FWM has the ability to preserve the amplitude and phase information simultaneously. All-optical signal processing based

on FWM in silicon waveguides, including wavelength conversion, wavelength multicasting, and logic gates have been proposed. Spectral filtering is a critical operation. In optical signal processing applications, like arbitrary waveform generation and RF signal channelization, spectral filtering found critical [26, 27].

3 Analytical Characteristics of Optical Waveguide

Optical waveguides are used as components in integrated optical circuits or as the transmission medium in local and long-haul optical communication systems. These are classified according to their geometry mode structure, refractive index distribution, and material. Passive waveguides, electro optic components, transmitters, receivers, and driving electronics can be integrated into one chip using planar technology, similar to microelectronics. These parameters must be optimized before fabricating a device. With large-scale optoelectronic circuits, accurate modeling is predominant because of the numerous resources required to fabricate a chip. Optical waveguide design relies on simulating the propagation of light signals, waveguide modes, mode coupling, and loss and gain. Waveguides are the building blocks of photonic circuits. The width of a waveguide (constant or variable) is defined as perpendicular to the path along the waveguide center.

Any wave characterized by,

$$E(r, t) = A(r, t) \exp(\emptyset(r, t)) \tag{1}$$

$A(r, t)$ is the amplitude and $\emptyset(r, t)$ is the phase component of the signal.

A pulse propagating in any 3-dimension medium can have three components varying with the respective direction as

$$E(x, y, z, t) = \hat{i} E_x(x, y, z, t) + \hat{j} E_y(x, y, z.t) + \hat{k} E_z(x, y, z, t) \tag{2}$$

Similarly,

$$H(x, y, z, t) = \hat{i} H_x(x, y, z, t) + \hat{j} H_y(x, y, z.t) + \hat{k} H_z(x, y, z, t) \tag{3}$$

$\hat{i}$, $\hat{j}$, and $\hat{k}$ is the direction vector for X, Y and Z direction.

In planner optical waveguide, TE and TM modes with none vanishing $E_y H_x H_z$ and $H_y E_x E_z$ modes exists, respectively. So it can always form wave equation H_z and get transverse components E_y and H_x and $E_z(longitudinalcomponent) = 0$, i.e., TE and similarly to form wave equation E_z and get the transverse component $s H_y$ and E_x, i.e., TM mode.

In circular waveguide, the plane of polarization is not stable due to geometry. In optical fiber, the refractive index variation in r and $\emptyset$ direction as $n^2(r, \emptyset)$.

The $\overrightarrow{E}$ and $\overrightarrow{H}$ fields are

$$\overrightarrow{E}(r, \varphi, z, t) = \overrightarrow{E}(r, \varphi)\mathrm{e}^{i(\omega t - \beta z)} \tag{4}$$

$$\overrightarrow{H}(r, \varphi, z, t) = \overrightarrow{H}(r, \varphi)\mathrm{e}^{i(\omega t - \beta z)} \tag{5}$$

The transverse components $\overrightarrow{E_r}$ and $\overrightarrow{E_\emptyset}$ in terms of longitudinal component $\overrightarrow{E_z}$ and $\overrightarrow{H_z}$ by substituting Eq. (1) and (2) in the Maxwell's equations

$$\nabla \times \overrightarrow{E} = -\mu_0 \frac{\partial \overrightarrow{H}}{\partial t} \tag{6}$$

$$\nabla \times \overrightarrow{H} = \varepsilon \frac{\partial \overrightarrow{E}}{\partial t} \tag{7}$$

And by doing some mathematical manipulations it will have the form of

$$\frac{\partial^2 \overrightarrow{E_z}}{\partial r^2} + \frac{1}{r}\frac{\overrightarrow{E}_z}{\partial r} + \frac{1}{r^2}\frac{\partial^2 \overrightarrow{E_z}}{\partial \emptyset^2} + \left[K_0^2 n^2(r) - \beta^2\right]E_z = 0 \tag{8}$$

$$\frac{\partial^2 \overrightarrow{H_z}}{\partial r^2} + \frac{1}{r}\frac{\overrightarrow{H}_z}{\partial r} + \frac{1}{r^2}\frac{\partial^2 \overrightarrow{H_z}}{\partial \emptyset^2} + \left[K_0^2 n^2(r) - \beta^2\right]H_z = 0 \tag{9}$$

By solving Eqs. (8) and (9), we can get E_z and H_z. But the modes cannot be distinguished. But in case of $\emptyset$ independent, the E_z and H_z can be separated. So, in general, these are hybrid modes (HE and EH). So, any optical waveguide obey these set of equations.

Showing the dispersion characteristic, a single pulse can be analyzed propagating with Z-direction which is direction of propagation through the optical fiber (It has only one component arbitrarily) as,

$$E(z, t) = \hat{i}E_x(z, t)$$

It will obey the wave equation

$$\nabla^2 E(z, t) = \frac{1}{C^2}\frac{\partial^2 E(z, t)}{\partial t^2} \tag{10}$$

$C \rightarrow$ speed of light.

Solution of this equation becomes

$$E(z, t) = S(z, t)\exp(j(kz - \omega_0 t)) \tag{11}$$

For Gaussian pulse, at $z = 0$.

The amplitude becomes,

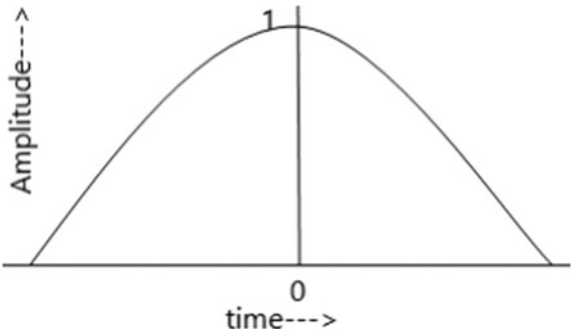

Fig. 2 Gaussian distribution sinc pulse

$$S(0.t) = A\exp\left(\frac{-t^2}{2T^2}\right) \tag{12}$$

Similarly, the EM field at $Z = 0$ from Eq. (11)

$$E(0,t) = A\exp\left(\frac{-t^2}{2T^2}\right)\exp(-j\omega_0 t) \tag{13}$$

As it is known that a *rect* pulse in time domain is always a *sinc* pulse in frequency domain. Here, sinc pulse is Gaussian distributed as depicted in Fig. 2.

The original propagation takes place in frequency domain so, the expression of pulse in frequency domain will be,

$$\tilde{E}(0,\omega) = \frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} E(0,t)\exp(j\omega t)\mathrm{d}t \text{ at } z = 0 \tag{14}$$

After a distance 'z' the pulse becomes,

$$\tilde{E}(0,\omega) = \frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} E(0,t)\exp(j\omega t)\exp(jkz)\mathrm{d}t \tag{15}$$

In time domain, the expression of pulse becomes

$$E(z,t) = \frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} \tilde{E}(0,\omega)\exp(-j\omega t + jkz)\mathrm{d}\omega \tag{16}$$

Here, 'k' is the wave number which is function of angular frequency as

$$k = k(\omega)$$

And $k(\omega) = \frac{\omega_n(\omega)}{C}$.

The refractive index is the function of optical frequency using Lorentz formula,

$$n(\omega) = \sqrt{n_0^2 + \sum_i \frac{b_i}{\omega^2 + \omega_{0i} + 2j\delta_i\omega}} \tag{17}$$

$$k_n(\omega) = \sum_{n=0}^{\infty} \frac{1}{n!} k_n(\omega_0)(\omega - \omega_0)^2 \tag{18}$$

$$k_n(\omega_0) = \frac{\partial^n(k)}{\partial\omega^n} at\omega = \omega_0 \tag{19}$$

By expanding up to ω^2 term and further simplifying, the equation may be written as,

$$E(z,t) = S(z,t)\exp(j(k(\omega_0)z - \omega_0 t)) \tag{20}$$

The amplitude of Gaussian pulse is

$$S(z,t) = \frac{A}{\left(1 + \frac{k_2(\omega_0)z^2}{T^4}\right)^{1/4}} \exp\left(\frac{(k_1(\omega)z - t^2)}{2T^2(1 + k_2(\omega_0)z^2/T^4}\right) \tag{21}$$

From the above equation, we can observe the pulse remain Gaussian but the width of the pulse increases with the decreasing amplitude of the pulse. So, intersymbol interference and absorption occurs. So, it is not sufficient for making an economical effective optical communication.

4 Remarks for Future Work

The use of optical fiber increases day-by-day in telecommunication sector, industries, defense along with for storage, and commercial applications. Due to extremely lower attenuation and interference, optical fiber has large for long-distance, high-demand applications. Simultaneously, the prices of fiber-optic communications have dropped considerably since 2000. Optical signal processing put together variety fields of optics and signal processing such as, nonlinear devices and processes, analog and digital signals. To achieve high-speed signal processing functions for line rate of fiber-optic communications, information can be encoded spatial features of an optical wave to achieve high-capacity transmission. It requires to revisit advances in the key enabling technologies that led to recent research in optical signal processing for digital signals that are encoded in one or more of these dimensions. Recent advances in high-speed optical signal processing applications in the areas of equalization, regeneration, flexible signal generation, and optical logic are to be analyzed in proper

way. Similarly, the development of waveguides for different application based on digital signal processing can be the significant research in future.

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