Lecture Notes in Networks and Systems 34

Basant Tiwari · Vivek Tiwari
Kinkar Chandra Das
Durgesh Kumar Mishra
Jagdish C. Bansal *Editors*

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Janusz Kacprzyk, Polish Academy of Sciences, Systems Research Institute,
Warsaw, Poland
e-mail: kacprzyk@ibspan.waw.pl

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Editors
Basant Tiwari
Computer Science and Engineering
Technocrats Institute of Technology
Bhopal, Madhya Pradesh
India

Vivek Tiwari
Computer Science and Engineering
DSPM IIIT
Naya Raipur, Chhattisgarh
India

Kinkar Chandra Das
Department of Mathematics
Sungkyunkwan University
Suwon
Korea (Republic of)

Durgesh Kumar Mishra
Microsoft Innovation Academy, Computer Science and Engineering
Sri Aurobindo Institute of Technology
Indore, Madhya Pradesh
India

Jagdish C. Bansal
Department of Mathematics
South Asian University
New Delhi, Delhi
India

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Preface

On May 25–26, 2017, the iMPLab Research & Innovation at Bhopal organized the first International Conference on Recent Advancement on Computer and Communication (ICRAC 2017).

In an era of sensor, high-speed wireless communication, energy-efficient device, huge data, information security, ubiquitous computing, and Internet of Things (IoT) are undergoing considerable change. The rapid influx of digital technologies is redefining communication processes, altering media structures and operations, and transforming the availability and accessibility of information. While these developments enable new social, cultural, political, and economic activities, they can also produce adverse ramifications for consumers and communities in terms of all aspects of security.

Overall, the conference hosted nearly 82 presentations by academicians from India and abroad. The speakers covered a broad range of issues and challenges in the Internet and telecommunications fields including the influence of IoT application to make things smarter; digital infrastructure developments and opportunities for further connectivity, particularly in relation to mobile and public Wi-Fi prospects; new methods for information security; advancing communication practices to facilitate social inclusion; energy-efficient sensors and other devices; and the other challenges associated with changing technologies and communication.

The papers published in the volume represent an overview of the issues explored at the conference and accentuate the diversity of both research topics and methodologies used in the communication. Moreover, they reflect salient, nuanced, and interrelated emerging issues surrounding information flow, digital participation, IoT. These papers have undergone double-blind peer review, with Indian and international academics assisting in this process. Many thanks to all of the authors for the time and effort spent developing papers for the proceedings. Hosting the International Conference on Recent Advancement on Computer and Communication first year was no small feat and certainly would not have been possible without the broad support it received. In particular, sincere thanks to all our friends, colleagues, mentors, and research scholars who helped out each day. In addition to people from industry and academia helping to promote it, assisting with the peer review process, chairing sessions, presenting research, contributing to the proceedings, and engaging with speakers in the sessions—we would not have been able to hold the event without your support and greatly appreciate the efforts and willingness of all who were involved.

Bhopal, India	Basant Tiwari
Naya Raipur, India	Vivek Tiwari
Suwon, Korea	Kinkar Chandra Das
Indore, India	Durgesh Kumar Mishra
New Delhi, India	Jagdish C. Bansal

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About the Editors

Dr. Basant Tiwari is currently serving as Professor and Head in Computer Science and Engineering Department at Technocrats Institute of Technology, Bhopal. He has rich experience in teaching undergraduate and postgraduate classes. He has many international and national publications to his credit in conferences and journals. He has also attended many national and international conferences, workshops, seminars, and symposiums all over India and abroad. His current area of research is “Pervasive Healthcare and Remote Medical Care.” He is a Senior Member of IEEE, ACM, CSI, and IACSIT. Currently, he has been honored as Bhopal Representative in IEEE M.P. Sub-section, Treasurer in ACM Udaipur Chapter, and Secretary in CSI Bhopal Chapter. He has organized various national and international conferences, delivered invited talks, and also chaired the technical sessions. He is a reviewer of various reputed international journals and books. He did his Ph.D. from Devi Ahilya University, Indore.

Dr. Vivek Tiwari is an Assistant Professor of Computer Science and Engineering at DSPM International Institute of Information Technology, Naya Raipur, India. He is alumni of Maulana Azad National Institute of Technology (MANIT), Bhopal. Previously, he worked with the universities of national repute and Caresoft Incorporation (based at Middlesex, NJ, USA) as Software Engineer. He is the recipient of Young Scientist Fellowship (MPYSC_2014_814) for the year 2014–2016 by the Madhya Pradesh Council of Science & Technology (MPCST), Government of Madhya Pradesh. He has published more than 30 research papers, book, and chapters in the areas of data mining, data warehousing, pattern warehousing, distributed computing, and cloud computing in leading international journals (Springer, Inderscience, Elsevier, ACM, and IGI Global) and conferences. He is editor in chief of book “Handbook of Research on Pattern and Data Analysis in Healthcare Settings” under the series of Advances in Data Mining & Database Management (ADMDM), published by IGI Global, USA. A research project

“Aakash for Education” of cost 5 lakh funded by MHRD, India, is in his credit. He is associated with National Mission on Education through ICT (NMEICT) supported by IIT Bombay and MHRD since 2012.

Dr. Kinkar Chandra Das obtained his M.Tech. degree in Computer Science and Data Processing and Ph.D. degree in Spectral Graph Theory from Indian Institute of Technology Kharagpur, India, in 2004. He won the French Scholarship from Ministry of France, helping him to be a part of LRI, University Paris XI, France, for 1 year. After that, he joined the Department of Mathematics, Sungkyunkwan University, in 2006, and presently, he holds the position of Associate Professor in the same university. His main areas of research interest are spectral graph theory, molecular graph theory, degree sequence of graphs, and graph coloring. He has published almost 200 research papers in these areas in reputed international journals, guided two Ph.D. students, and supervised five postdoctoral researchers, and four Ph.D. students are working at the moment. He has written a book on “The Harary Index of a Graph” with two coauthors, published by Springer, Heidelberg, Germany, in 2014. He has recently edited three monographs on Mathematical Chemistry: (i) Bounds in Chemical Graph Theory—Basics, (ii) Bounds in Chemical Graph Theory—Mainstreams, and (iii) Bounds in Chemical Graph Theory—Advances. He has been on the editorial boards of various reputed journals.

Dr. Durgesh Kumar Mishra has received his M.Tech. degree in Computer Science from DAVV, Indore, in 1994 and Ph.D. degree in Computer Engineering in 2008. Presently, he has been working as a Professor (CSE) and Director, Microsoft Innovation Centre, Sri Aurobindo Institute of Technology, Indore, MP, India. He is also a visiting faculty at IIT Indore, MP, India. He has 24 years of teaching and 10 years of research experience. He has completed his Ph.D. under the guidance of late Dr. M. Chandwani on Secure Multi-Party Computation for Preserving Privacy. He has published more than 90 papers in refereed international/national journals and conferences including IEEE and ACM. He visited and delivered his invited talk in Taiwan, Bangladesh, Singapore, Nepal, USA, UK, and France. He has authored a book on “Database Management Systems.” He had been Chief Editor of Journal of Technology and Engineering Sciences.

Dr. Jagdish C. Bansal is an Assistant Professor at South Asian University, New Delhi, India. Holding an excellent academic record, he is an outstanding researcher in the field of swarm intelligence at the national and international levels, having written several research papers in journals of national and international repute.

Impact of Various Networks Security Attacks on Wireless Sensor Localization Algorithms Based upon WSN Node's Residual Energy

Santosh Soni and Manish Shrivastava

Abstract Presently, wireless sensor network localization algorithms attracted various researchers toward research study and experiments. The location of nodes can be determined by various localization algorithms. These wireless sensor network localization algorithms are vulnerable and can be compromised for their security. There are various network security attacks like wormhole, impersonation, compromise, and duplicate attacks which degrade the performance of WSNs. In this research paper, under various network security attacks, we have tested wireless sensor network localization algorithms under certain performance matrices like mobility of WSN node's, size of packets, temperature, and node density to find out the compromised WSN node's residual energy. The simulation result shows how these localization algorithms are vulnerable to network security attacks.

Keywords Wireless sensor network · WSN localization algorithms
Network security attacks

1 Introduction

In the defense, civil, and critical types of fields, wireless sensor networks contain a lot of various features like autonomous system which can be installed in various locations and able to perform secure gathering of data, surveillance or monitoring the desired location. In this type of situations, the main aspect is security of wireless sensor network [1]. The localization plays key role in wireless sensor network and having

S. Soni (✉)
Department of IT, Institute of Technology,
Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India
e-mail: santoshsoni.77@gmail.com

M. Shrivastava
Department of CSE, Institute of Technology,
Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India
e-mail: manbsp@gmail.com

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vulnerabilities, this system may become target for any network security attacks. In this research study, we have shown that presently available localization algorithms are vulnerable to these network security attacks. The impact of network security attacks finally reduces the residual energy of wireless sensor network's node. Mainly, the gathered data and sensor motes should be positioned in space to find the exact location of an event. This position-based system is able to get execute using a localization-based approach. Localized systems are really critical issue of WSNs, because they aim to find events as well as used as the main station for routing, controlling density, tracking, and some other protocols [2]. Following are the various section of this research study:

Section 1 Introduction	Section 2 Previous Work
Section 3 WSN Localization Algorithms	Section 4 Network Security Attacks
Section 5 Simulation Setup and Results	Section 6 Conclusion and Future Work

2 Previous Work

Various research studies have been taken into account to consider the research outcome based upon certain performance matrices. Some of them are as follows:

[I] Azzedine Boukerche, Horacio A. B. F. Oliveira, Eduardo F. Nakamura, Antonio A. F. Loureiro [2] have studied and described localization system under various network security attacks with various security techniques.

[II] Ismail Güvenc., Member, Chia-Chin Chong [3] have shown various numerous localization algorithms along with certain accuracies.

[III] Nick Iliev, Igor Paprotny [4] have provided a complete review and implementations.

[IV] Svarika Goyal, Tarunpreet Bhatia, A. K. Verma [5] In this paper, different attacks are studied along with various defensive techniques.

[V] T. Meena, M. Nishanthy, Mr. E. Kamalanaban [6] proposed how to detect spoofing attacks.

[VI] Xu Huang, Muhammad Ahmed, Dharmendra Sharma [7] described various cryptographic methods defend against various network security attacks.

[VII] Asma Mesmoudi, Mohammed Feham, Nabila Labraoui [8] In general, localization techniques are classified with two types of algorithms: range-based and range-free.

3 WSN Localization Algorithms

Localization systems, which give critical location information of sensors and event occurrences, which can be the point of attacks can lead to compromise the working of a WSN [9]. There are various WSN localization algorithms like KALMAN, MCL, IMCL, MPL, and SMPL. Localization schemes usually focus on static sensor networks where the sensor nodes do not move once they are deployed, and sensor nodes. The issue of location indicates the method of searching location for sensor motes with specified coordinate techniques. For the localization of a sensor network with the GPS, certain specific motes shall be known of their place of installation mainly from already developed system or placing manually, which are known anchors (beacons). Other ones, which are specifically called unknown nodes generally used to get installed place through certain algorithms [10]. This contains of two steps: (a) measure of distance among motes and (b) typical measurement methods. Using the distance measurement methods, localization algorithms are fallen between range and free of range methods. The algorithms can be estimated based on both the coordinate estimation errors and the distance estimation errors [11, 12]. This is presumed that distance measurements between given pair of nodes that are exists within the radio range [12], which is

$$d(i,j) = d(i,j) + \varepsilon ij, \quad 1 \leq i, j \leq N, i \neq j \tag{1}$$

where N is node from network, ij is distance estimation error, and

$$d(i,j) = \surd(xi - xj)^{\wedge}2 + \surd(yi - yj)^{\wedge}2 \tag{2}$$

where (xi, yi) and (xj, yj) are the coordinates of nodes i and j, respectively. All the systems discussed in that research need a complete setup and are equipped with toward location sensing for office applications than for sensor nodes. That is why we cannot allow them in truly ad hoc WSNs [13]. Below are the two methods for sensor mote's installed place:

(a) Relative location: This is better shown by given formulas [3]:

$$\left.\begin{array}{l}\surd(x - xa)^{\wedge}2 + (y - ya)^{\wedge}2) = da \\ \surd(x - xb)^{\wedge}2 + (y - yb)^{\wedge}2) = db \\ \surd(x - xc)^{\wedge}2 + (y - yc)^{\wedge}2) = dc\end{array}\right\} \tag{3}$$

(b) Triangulation: This calculates the exact position of unknown node which is depending on the angular distance among three various pairs of anchor nodes represented by below equations [4].

$$\left.\begin{array}{l}\surd(xo1 - xa)^{\wedge}2 + (yo1 - ya)^{\wedge}2) = r1 \\ \surd(xo1 - xb)^{\wedge}2 + (yo1 - yb)^{\wedge}2) = r1 \\ \surd(Xa - xc)^{\wedge}2 + (ya - yc)^{\wedge}2) = 2r1^{\wedge}2 - 2r1^{\wedge}2\cos\alpha\end{array}\right\} \tag{4}$$

4 Network Security Attacks

Security attacks which represent distance and position computations are very specific attacks in existing localized systems. Moreover, the various parts of a localization system, develops the equal type of vulnerabilities connected along towards various systems, since it is distributed multihop algorithm. For example, these below attacks include Sybil, replay, wormhole along with duplicate attack [2, 5–7, 14].

Sybil Attack: Here, a malicious node is a set of different node and continues sending wrong information. Such wrong information can be distance, positions estimation, various hops, or beacons.

Replay Attack: Here, from beacon node, a compromised node copies a received packet and starts resending the same packet after some time. This is the clone of the initial packet, The neighboring nodes wrongly deduct that the infected node is the node which has sent out the initial packet. Here, distance computation is obtained on the basis of compromised node where the final position in the packet highly depends on the initial node, and then, position computation gets affected. Mainly, signal strength with time-based distance calculations are affected, since the packets sent by the compromised node will have a totally discrete signal strength as well as discrete propagation time [2, 5–7, 14].

Wormhole Attack: Here, the information obtained by single infected node is sent to other side of the network and cloned by other infected node on the different side of the network. The given path between mentioned two attackers is a wormhole in the manner that a packet coming on one side is copied and forwarded on the different side of the network, representing as if it came from different neighboring node. Such kind of attack is shown in. Finally, these attacks can deeply destroy an insecure localization system through setting completely different and erroneous reference points in the position computations [2, 5–7, 14].

Compromise Attack: This is having three stages: physically compromising the sensors, deploying the compromised sensors, and compromised nodes after starting attacks [1, 15].

5 Simulation Setup and Result

WSN localization estimation is the process of getting the final position of sensor nodes; such position is based upon estimation but not right. Because GPS got high cost and calibrated outdoors only, here some localization algorithm looks to be perfect in calculating the exact position of sensor nodes [16]. The used WSN localization simulation tool is based upon two layers, a core simulator layer and a localization layer. Here, Table 1 presents various WSN localization simulation parameters information:

Simulation Results: Simulation results are specified in Table 1. The graph in Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 and Tables 2, 3, 4, 5 show the performance of localization algorithms in form of WSN node's residual energy against various network security attacks.

Table 1 WSN localization simulation parameters

Simulator	WSN Localization Simulator
WSN localization Algorithms	Kalman, Monte Carlo, improve Monte Carlo, mobility prediction localization, secure MPL
Network security attacks	Wormhole, Sybil, compromise and replay
Mobility of WSN nodes	10, 20, and 30 m/s
Packet size	256, 512, and 1024 Bytes
Temperature	20°, 25°, and 30°
WSN node density	50, 100, and 150
Sensor's mobility model	Modified random waypoint
Anchor's mobility model	Modified random waypoint
Number of anchor nodes	150
Sensor model	Mica2
Propagation model	Two-ray ground
Simulation time	150 s

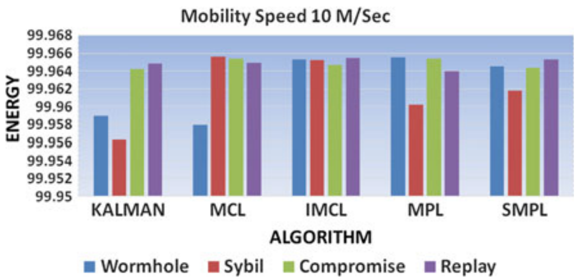

Fig. 1 Performance of WSN localization algorithms versus network security attacks under mobility speed 10 M/S

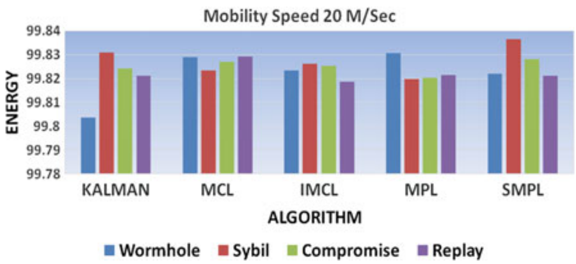

Fig. 2 Performance of WSN localization algorithms versus network security attacks under mobility speed 20 M/S

Fig. 3 Performance of WSN localization algorithms versus network security attacks under mobility speed 30 M/S

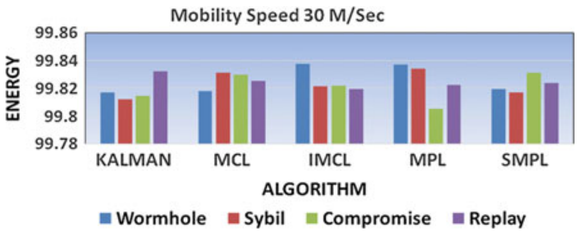

Fig. 4 Performance of WSN localization algorithms versus network security attacks under packet size 256 Bytes

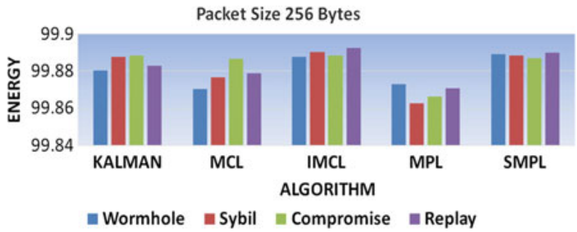

Fig. 5 Performance of WSN localization algorithms versus network security attacks under packet size 512 Bytes

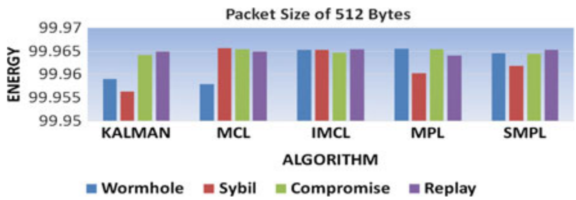

Fig. 6 Performance of WSN localization algorithms versus network security attacks under packet size 1024 Bytes

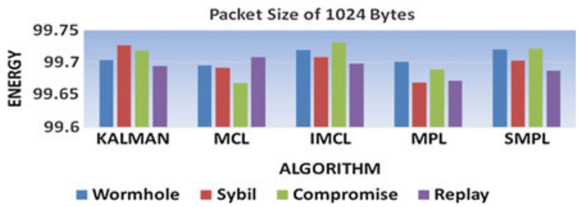

Fig. 7 Performance of WSN localization algorithms versus network security attacks under 20° temperature

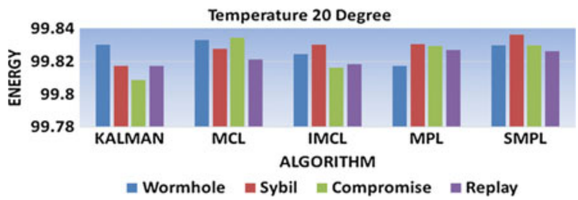

Fig. 8 Performance of WSN localization algorithms versus network security attacks under 25° temperature

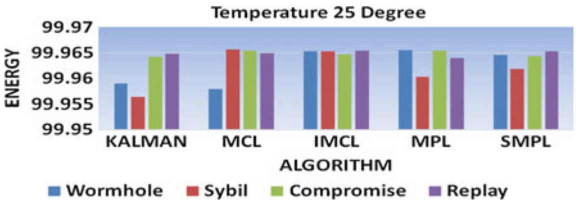

Fig. 9 Performance of WSN localization algorithms versus network security attacks under 30° temperature

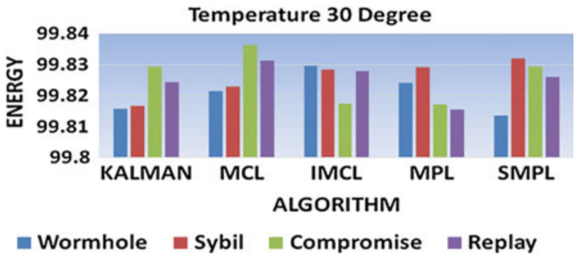

Fig. 10 Performance of WSN localization algorithms versus network security attacks with the node density of 50 nodes

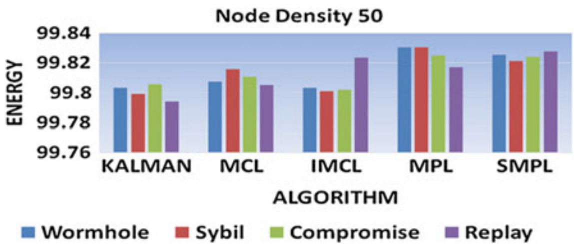

Fig. 11 Performance of WSN localization algorithms versus network security attacks with the node density of 100 nodes

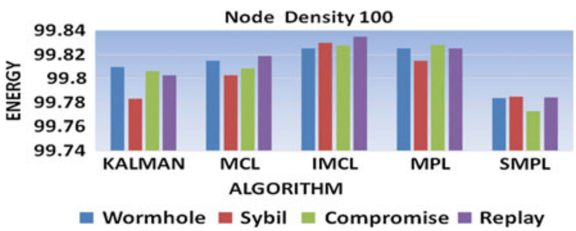

Fig. 12 Performance of WSN localization algorithms versus network security attacks with the node density of 150 nodes

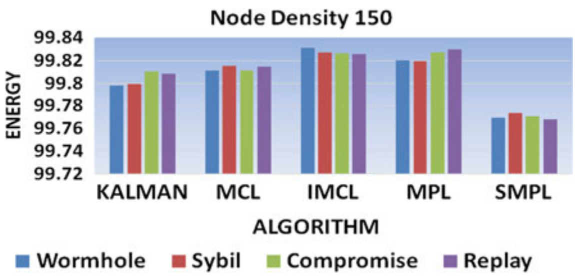

Table 2 Vulnerability of WSN localization algorithm against various network security attacks under the performance matrices of mobility of WSN nodes

	Wormhole	Sybil	Compromise	Replay
1. Kalman	Vulnerable	Vulnerable	Not vulnerable	Not vulnerable
2. MCL	Vulnerable	Not vulnerable	Not vulnerable	Not vulnerable
3. IMCL	Not vulnerable	Not vulnerable	Not vulnerable	Vulnerable
4. MPL	Not vulnerable	Vulnerable	Vulnerable	Not vulnerable
5. SMPL	Not vulnerable	Vulnerable	Not vulnerable	Vulnerable

Table 3 Vulnerability of WSN localization algorithm against various network security attacks under the performance matrices of packet size of WSN nodes

	Wormhole	Sybil	Compromise	Replay
1. Kalman	Vulnerable	Vulnerable	Not vulnerable	Vulnerable
2. MCL	Vulnerable	Not vulnerable	Vulnerable	Not vulnerable
3. IMCL	Vulnerable	Not vulnerable	Vulnerable	Vulnerable
4. MPL	Not vulnerable	Vulnerable	Not vulnerable	Not vulnerable
5. SMPL	Not vulnerable	Vulnerable	Vulnerable	Vulnerable

Table 4 Vulnerability of WSN localization algorithm against various network security attacks under the performance matrices of temperature

	Wormhole	Sybil	Compromise	Replay
1. Kalman	Vulnerable	Vulnerable	Vulnerable	Not Vulnerable
2. MCL	Vulnerable	Not vulnerable	Not vulnerable	Vulnerable
3. IMCL	Not vulnerable	Not vulnerable	Vulnerable	Not vulnerable
4. MPL	Vulnerable	Vulnerable	Not vulnerable	Vulnerable
5. SMPL	Vulnerable	Vulnerable	Not vulnerable	Vulnerable

Table 5 Vulnerability of WSN localization algorithm against various networks security attacks under the performance matrices of WSN node density

	Wormhole	Sybil	Compromise	Replay
1. Kalman	Vulnerable	Vulnerable	Not vulnerable	Vulnerable
2. MCL	Not vulnerable	Vulnerable	Vulnerable	Vulnerable
3. IMCL	Vulnerable	Vulnerable	Not vulnerable	Vulnerable
4. MPL	Not vulnerable	Vulnerable	Not vulnerable	Vulnerable
5. SMPL	Not vulnerable	Vulnerable	Vulnerable	Vulnerable

6 Conclusion and Future Scope

Finally, this research study has shown the nature of vulnerability and impact of WSN localization algorithms which is summarized in Tables 2, 3, 4, and 5. Mainly, localization algorithms show basic help and support toward various location-based protocols along with different implementation areas. Accuracy of localization is deeply integrated to the QoS of WSNs [17]. In a nutshell, we can say that Kalman algorithm is vulnerable to wormhole and Sybil attacks. MCL, IMCL, and SMPL algorithms show good performance against Sybil attack. Now researchers can use these findings to develop/improve more secure WSN localization algorithms against various network security attacks. MPL algorithm shows good performance against compromise attack. In the future, we will study the security techniques/methods to better improve the further performance of localization algorithms against network security attacks.

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Fitting a Neural Network Classification Model in MATLAB and *R* for Tweeter Data set

Syed Muzamil Basha and Dharmendra Singh Rajput

Abstract Nowadays, the interest among the research community in sentiment analysis (SA) has grown exponentially. Our paper aims to find the prediction error occurred when we perform SA on tweets. The data set considered for the demonstration has 1129 tweets, and output parameters having predictor identifiers. Artificial neural networks (ANNs) are designed with ten hidden layers and one output layer. Additionally, trained the designed system with the help of MATLAB software to find the prediction error and also, derived sentiments using ggplot2 package in *R*.

Keywords SA · ANN · ggplot2 · *R*

1 Introduction

This instruction file for *A* classifier *C* is a mapping, $C : R_n \rightarrow N_{\mathrm{Lc}}$, where R_n is multidimensional space and N_{Lc} is the set of vectors with different labels assigned for a specific class (C) problem and is termed as

$$N_{\mathrm{Lc}} = y \in R_c; \quad y_i \in \{0, 1\}\forall_i, \quad \sum_{i=1}^{c} y_i = 1.$$

By default, the nature of all the traditional classification algorithms is binary, which can be further enhanced to address multi-class problems. The goal of classification is to accurately predict the target class for each case in the data having 134 tweets as training data collected from http://www.sananalytics.com/lab/twitter-sentiment. This data set contains 5513 human-categorized reviews based on topic in the form of

S. M. Basha (✉) · D. S. Rajput
Vellore Institute of Technology University, Vellore 632014, India
e-mail: muza.basha@gmail.com

D. S. Rajput
e-mail: dharmendrasingh@vit.ac.in

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tweets. Each entry contains tweet id, tweet text, tweet creation date, topic used for sentiment, sentiment label: *{positive (p), Neutral (N), Negative (Ne), Others (O)}*. The entire classification of reviews was done by an American male who is fluent in English. Niek J. Sanders njs@sananalytics.com, http://linkedin.com/in/niekjsanders.

2 Related Work

The author [1] has proposed an algorithm, addressing multi-class problems by considering seven different data sets and made an extensive comparison of time and accuracy in training the model with classical Kozas model, whereas the author in [2] also addressed the multi-class problem in the application area called ConveNets with all possible scenarios. In [3], the author proposed a new version of convolution neural network multi-scale spatial partition network, which can handle both text and image data. In [4], the author has proposed a classifier which can achieve fine-granularity aesthetic quality prediction with an accuracy of 87.1%. In [5], the author made an attempt to improve the classification performance of fuzzy minimum and maximum algorithm using hyper-box expansion rule. In [6], author proposed deep neural network system (DNN) that uses hidden Markov model toolkit to generate transformed MFCC features from BNF extractor. In [7], the author addresses the problem of feature selection from noisy data by combining two techniques discrete wavelet transform and probabilistic neural network. The author in [8] developed an ANN model using a back-propagation learning rule and achieved higher classification accuracies for both the training (95%) and testing (82%) data sets. In [9], the author addresses the problem of classifying eight different heartbeat conditions using arrhythmia classification method and achieved 92.74% classification rate, whereas in [10] the author made use of image data and classified human gender and age using local gabor binary pattern histogram and yield an accuracy of 94.17%. In [11], the author uses multi-crop polling operation for feature selection on image data in identifying the proper lung functioning. In [12], the author built their own ANN to classify pollutants made up of sixty-one input neuron, three output neurons with three hidden layers. In [13], the author makes use of deep convolution neural network and support vector machine in classifying EEG signal images and achieved the average accuracy 92.24%. In [14], the author combined convolution neural network with extreme learning machine for hyperspectral imagery without spectral distortion. In [15], the author made an investigated on multi-distribution deep neural network in intonation classification of English language and yield the classification accuracy rate of 93.0%. In [16], the author modified version of the particle swarm optimization algorithm is used to train the radial basis function network for classification of the electroencephalogram signal for epileptic seizure identification, proposed method produced a maximum accuracy of 99%. In [17], the author set up an artificial neural networks model using standard merceological parameters to classify NIR data. In [18], author uses 47 images of teeth and uses wavelet Fourier descriptor in extracting features of teeth with support vector machine, achieved classification accuracy of 94% and repeated the same for about 30 CT cases.

3 Methodology

Let us consider, the input data collection as $X = \{I_1, I_2, \ldots, I_n\}$ and its associated set of label vectors $Y = \{L_1, L_2, \ldots, L_n\}$. For a two-dimensional classification problem, a possible GONN classifier is represented by a single GONN tree (GONN T (x)). For any simple pattern assume x, the single GONN tree can be constructed for two classes as in Eq. 1:

$$\left\{ \begin{array}{ll} \text{class 1} & \text{GONN}(X) \geq 0 \\ \text{class 2} & \text{GONN}(X) < 0 \end{array} \right\} \tag{1}$$

By using relative mean squared error (MSE) of the GONN, one can easily evaluate the fitness value of proposed algorithm as given in Eq. 2.

$$F_c = \frac{1}{1 + \frac{1}{x}\sum_y^x (D_y - A_y)} \tag{2}$$

where X is the length of training data set, D_y is the expected output on y and A_y is the GONN expected output, when Y is given as input.

3.1 Identifying a Collection of Input Parameters and Corresponding Collection of Output Parameters

We can start neural network toolbox in MATLAB with nnstart command. The GUI of ANN tool can be displayed. The screen wizard to select input data set and target data set. The target data is prepared based on the class labels. The target data can have many number of vectors. Each vector should consist of either 0 or 1. We have selected 15% of total input data set samples for validation, another 15% for testing. Remaining 70% input data set will be for training. Training is the process to adjust the network weights and bias according to its error. NN toolbox provides wide variety of training algorithms, each having their own learning inbuilt function. Validation is the process to measure the process generalization and to halt the training when generalization stops improving. Testing is the process to measure the performance of network during and after training. This will never affect on training.

To extract the wanted columns from the data set, the below given code is used in order to generate required output file (.txt) comma as separator. The generated output file has only the classified field called class obtaining values {0, 1}.

3.2 Structure of ANN

The hidden layer parameter is set to 10. Hidden layer: it is a neuron in feedforward network that connects as input to another layer. The hidden layer processes the weights and biases using sigmoid function.

Output layer: it is another neuron that will take the input from hidden layer and process with softmax function.

Output: it is set to 1. The out neuron is defined itself based on the target vector.

3.3 Training the System with the Help of MATLAB Software

To show the wizard of training, the network using scaled conjugate gradient back-propagation process. The performance of network will show based on cross-entropy and confusion matrices. Representing the algorithm details and numbers of iteration made to train the entire system.

4 Results

Figure 1 represents the best validation performance which occurrs at epoch 17. Figure 2 shows the confusion matrices of network. The bottom matrices will define the accuracy of the network. Here we got 73:7% for classified correctly and 26:3% are misclassified. If the network result is not satisfactory, then network can retrain by adjusting network size. Cross-entropy is to be evaluated for each class of output variables as in Eq. 3.

$$\text{Entropy} = -\,\text{training\_rate} \times \log(\text{Output}) \tag{3}$$

The aggregate cross-entropy performance is the mean of the individual values as in Eq. 4:

$$\text{Performance of Model} = \frac{\text{sum(Entropy Values)}}{\text{nume1 (Entropy)}} \tag{4}$$

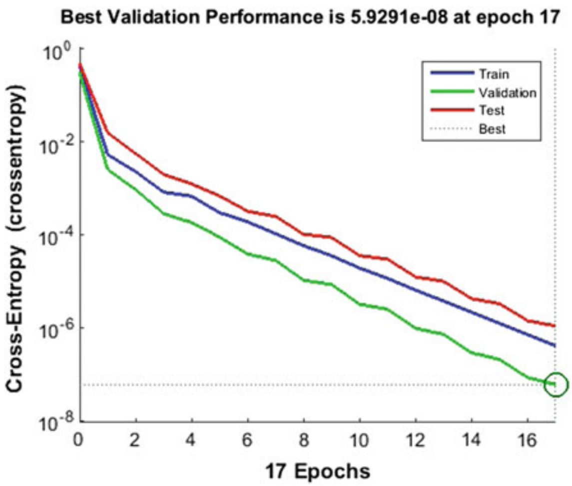

Fig. 1 Best validation performance

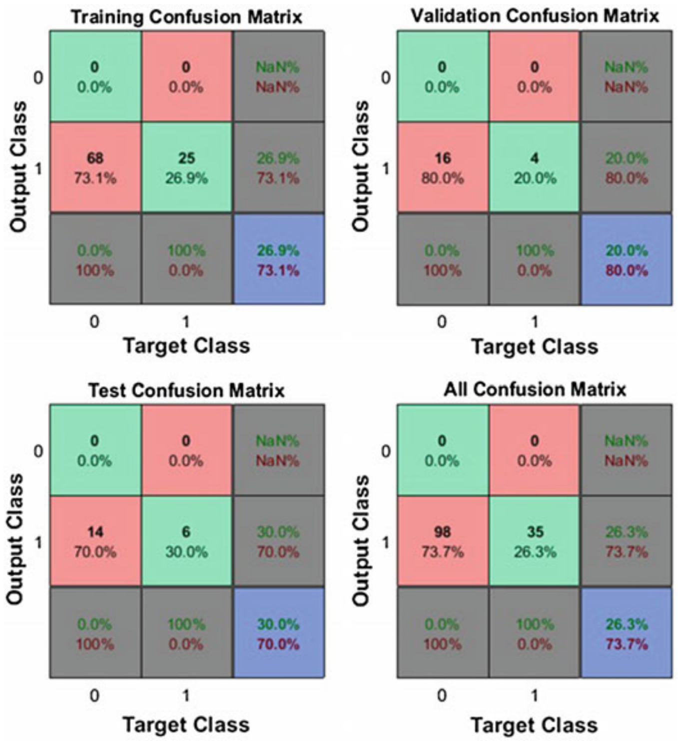

Fig. 2 Confusion Matrix

As a special case, when $N = 1$, i.e. when output consists of only one variable that can be interpreted as binary variable. The output variable consists of more than one variable that can be computed as in Eq. 4.

$$\text{Entropy} = -\,\text{training\_rate} \times \log(Y) - (1 - \text{training\_rate}) \times \log(1 - Y) \quad (5)$$

Confusion matrices: one can easily interpret the plot of confusion matrix, as rows representing the output class and columns representing target class, whereas the diagonal cells show rate of prediction.

The cell in the bottom right of Fig. 2 shows the overall accuracy as 73.7% and classification error as 26.3%.

Plot ROC: plotroc (targets, outputs) The more the curve nearer the left and top edges indicated the efficiency of classification.

Epoch: it is used to indicate the number of times vector is trained for each update in their associated weights. The gradient ascent algorithm is used to update the weights of each vector to improve the classification accuracy.

4.1 *Sentiment Analysis with Machine Learning*

The term "*great*" occurrs 225 times which is a positive sign on the review of the product. We plot the *wordcloud* of the same tweets. Fig. 3 is a plot of sentiments derived from the tweets.

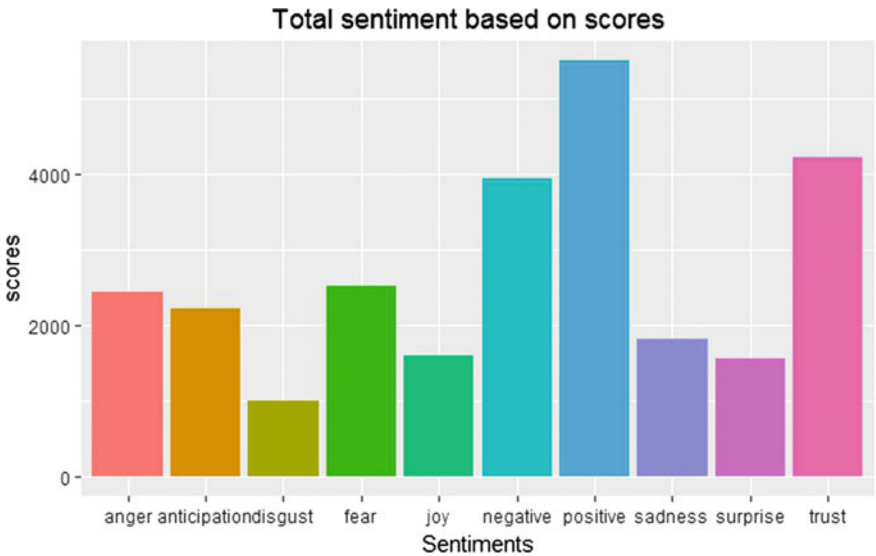

Fig. 3 Total sentiment based on scores

– http://datascienceplus.com/fitting-neural-network-in-r/
– http://datascienceplus.com/sentiment-analysis-with-machine/learning-in-r/

5 Conclusion

The finding in our research is that multi-class classification, the artificial neural network (ANN) model is designed with ten hidden layers and one output layer. Trained the designed system with the help of MATLAB software and found the prediction error of 26.3%. In future, we would like to find scope for improvement in prediction on multi-variant data using ANN.

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A Novel Approach for Blast-Induced Fly Rock Prediction Based on Particle Swarm Optimization and Artificial Neural Network

Navdeep Kumar, Balmukund Mishra and Vikram Bali

Abstract Fly-rocks are the excessive rock fragments. There random throw from a blast can travel a large distance which may be beyond the blast safety area. This process of the blasting operation results in human injuries, fatalities, and structural damage. In this research work, a method is proposed to predict the fly-rocks. This approach is built on the mixture of particle swarm optimization and artificial neural network. Here ANN is used to predict fly-rock distance. Generally, ANN is used as one of the forceful areas of research in advanced and varied applications of science. ANN has the ability to right to map the input to output patterns. Also, it utilizes all influential parameters in case of prediction of fly-rock distance. But, there are still some limitations concerned to ANN, i.e., the rate of slow learning and getting stuck in local minima. This research work offers a mix PSO-ANN predictive model for fly-rock prediction. The results of the developed model are compared to the results of ICA-ANN, BP-ANN, empirical equation, and multivariate regression analysis (MRA). The parameters for comparison are root mean square error, coefficient of determination (R^2), and least cost. These parameters are firstly calculated by comparing testing and training data from ANN. These parameters are then compared with that of the existing methods, i.e., ICA-ANN, BP-ANN, empirical equation, and multivariate regression analysis (MRA). MATLAB R2013a is used as an implementation platform using general MATLAB toolbox.

Keywords Artificial neural network · Imperialist competitive algorithm
Flies rock · Blasting

N. Kumar (✉) · B. Mishra · V. Bali
Computer Science Department, P.I.E.T Samalkha, Panipat, India
e-mail: navdeepkumarsharma01@gmail.com

B. Mishra
e-mail: balmukund.mishra92@gmail.com

V. Bali
e-mail: vikram.cse@piet.co.in

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1 Introduction

One of the crucial components of the surface mining is blasting. It serves as the most important role in dividing [1] burden and disclosing coal and in other mineral deposits [2]. The boundaries of the blast area are determined by the blaster, and the fly-rock is not probable to travel outside the blast zone. For the period of blasting, all employees must be detached from the blast part. Also, all entries to the blast area must be guarded. If someone is essential to visit classified the blast area, a proper blasting safety should be taken [3].

2 Imperialist Competition Algorithms

It is new overall search [4] experiential that uses colonization [5] and imperialistic competition process and uses expansively to solve different types of optimization problems [6]. This algorithm starts with some early countries. Each singular of the population is called country. Population is divided into two parts, colonies and imperialist state. The competition between imperialists to take ownership of the colonies of each other forms this algorithm. In this competition, the weak empires collapse slowly and finally one imperialist and other country is its colony [7]. After dividing all colonies among imperialists and creating the initial empires, these colonies move to their important imperialist. This movement is simple model of assimilation policy that was assumed.

2.1 Initial Empires Optimization Procedure

Starts with initializing the entities section which are called countries [8]. In this problem, a country has 1 * N variables range. This array is defined as follows:

$$\text{Country} = [A1, A2, A3, \ldots, AN\text{variable}]$$

In this the particle which need to best solution. In a country, each parameter can be considered as a human-related characteristic such as culture and language, in which this makes an attempt to find the best combination of these characteristics. Cost function country is as follows:

$$F(\text{Country}) = [A1, A2, A3, \ldots, AN\text{variable}]$$

The technique of ICA optimization [9] starts with size of countries (N country) and select a powerful countries as the N imperialist, remaining of the countries are measured as a colonies (N colony). The colonies are distributed into imperialists based on power to make original empires. Therefore, the normalized cost of each imperialist is defined as follows:

$$c_n = c_n - \max(c_i)$$

In this, c_n is the cost of nth imperialist and c_n is its normalized cost. The normalized power of each imperialist is as follows:

$$\rho_n = \frac{C_n}{\sum_{i=1}^{N\,\mathrm{imp}} C_i}$$

The number of initial colonies for each empire is as follows:

$$N.Cn = \text{round}\,\{p_n \cdot N\text{colony}\}$$

in which $N.Cn$ is the initial colonies of nth empire and N colony is the total number of initial colonies [10].

2.2 Assimilation, Revolution, and Uniting

In this step, assimilation and revolution are the processes. Assimilation is the movement of colonies toward the imperialists where imperialists attempt to accept their colonies and make part of them. This process is simulated by affecting all colonies to the imperialist along different axis. Unite alike empires when distance between two imperialists becomes minus than the threshold distance. In this scenario, these imperialists are united and a new empire is formed.

3 Artificial Neural Network

Mathematical model that works on the basis of simulating the human brain. In other words, a relationship between desired input data and output data. ANNs require training to learn and accordingly map a relationship from the data. The capability of ANN [11] that learn the samples and increase the performance. Learning is the property that makes ANN dissimilar to other networks. This ability comes from training algorithm [2].

The output of the neurons in the input layer becomes input for the neurons in the hidden layer, and the same scenario applies to connection between hidden and output layers.

The full steps for implementation are as follows:

1. Reading and inputting of data

2. Extraction of last column (*Y*) and rest of the data (*X*) separately
3. Calculation of number of rows and columns of extracted data
4. Normalization of extracted data
5. Finding of minimum and maximum value from the extracted matrix *X*
6. Finding minimum and maximum value from the extracted matrix *Y*
7. Declaration of a loop according to number of column of *X*
8. Normalization of *X* matrix column wise
9. Normalization of *X* matrix column wise
10. Generation of feed-forward back-propagation network using number of rows of *X* matrix
11. Training of network using PSO method
    - Extraction of all the elements of network one by one
    - Computation of total number of elements in the network
    - Creation of one's matrix according to total number of elements
    - Inputting of PSO algorithm's parameters, i.e., size of swarm and maximum number of iterations, cognition coefficient social coefficient
    - Generation of initial population according to size of swarm and computation of best position and best cost of particle using ANN
    - Optimization of cost and position of the particles at each iteration
    - Updation of particle velocity using cognition coefficient and social coefficient
    - Updation of position using updated velocity of particle
    - Updation of the cost using updated position of the particle and ANN
    - Final updation of the position and cost of particle
    - Display and accumulation of best cost at each iteration
    - Plotting of all the best cost
12. Simulation of trained network using testing and training data matrix and getting of testing and training simulated optimized object
13. Calculation of mean square error by comparison of optimized object matrix with initial *Y* matrix testing and training objects
14. Display of initial and final optimized training data
15. Display of initial and final optimized testing data
16. Display of coefficient of determination (R^2) for training data
17. Display of coefficient of determination (R^2) for testing data.

4 Experimental Results

Platform using general MATLAB [12] and Artificial neural Network toolbox. In this research work, a method is proposed to predict the fly-rocks. This approach is based on the combination of particle swarm optimization (PSO) and artificial neural network (ANN). Here ANN is used to predict fly-rock distance. But, there are still some limitations concerned to ANN, i.e., the measured speed of learning and getting stuck in limited jots [13]. PSO can be used to overcome these shortcomings. PSO is generally utilized in the various optimization engineering problems. This research work presents a hybrid PSO-ANN predictive model for fly-rock prediction. The results of the developed model are compared to the results of ICA-ANN, BP-ANN, empirical equation, and multivariate regression analysis (MRA). The parameters for comparison are root mean square error, coefficient of determination, and minimum cost. These parameters are firstly calculated by comparing testing and trained data from ANN. These parameters are then compared with that of existing methods, i.e., ICA-ANN, BP-ANN, empirical equation, and multivariate regression analysis (MRA). The value of these parameters has been given in Table 1. Figures 1, 2, 3, 4, 5, and 6 are the snapshot of comparison of ANN output and actual input of training data w.r.t. number of nodes in unseen layer.

Table 1 Comparison of RMSE and minimum cost

Method/parameters	RMSE (root mean square error)	Coefficient of determination (R^2)	Minimum cost
PSO-ANN (proposed)	0.0393	0.9927	0.0030
ICA-ANN	6.582	0.981	0.067
BP-ANN	13.478	0.919	NA
MRA	23.877	0.743	NA
Empirical	109.064	0.118	NA

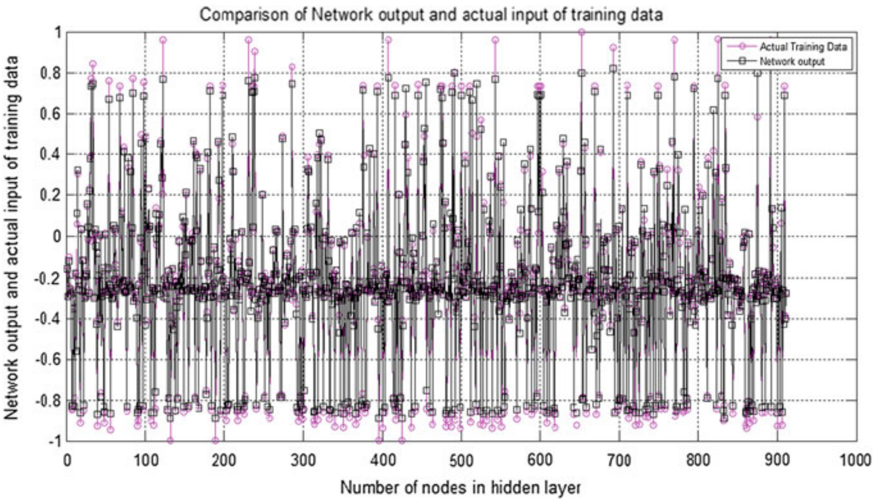

Fig. 1 Comparison of ANN output and actual input of training data w.r.t. number of nodes in hidden layer

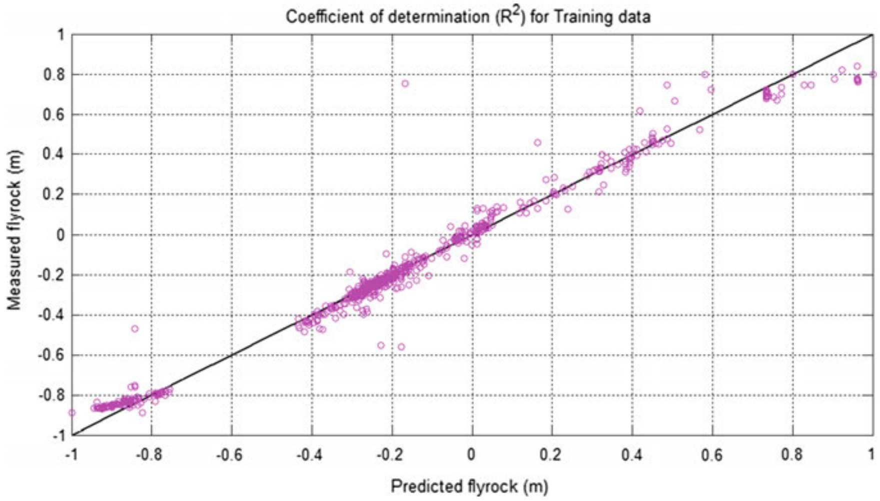

Fig. 2 Fly-rock distance versus predicted fly-rock distance in meters according to ANN testing data

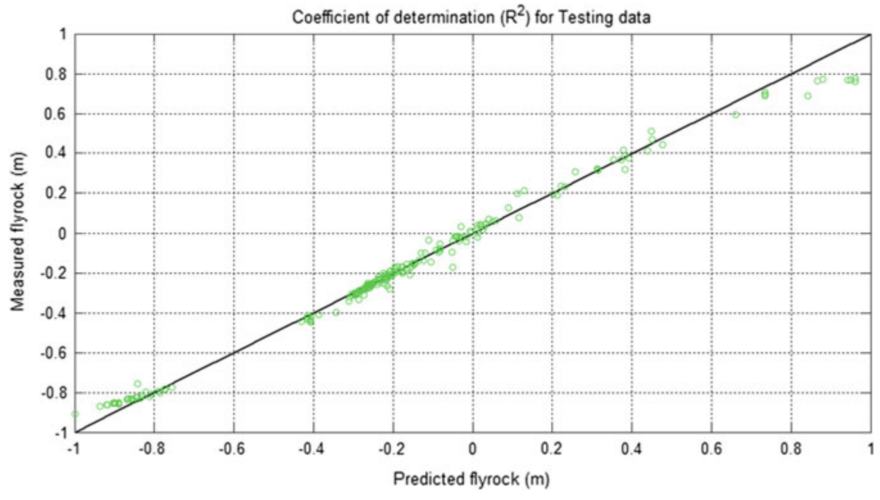

Fig. 3 Fly-rock distance versus predicted fly-rock distance in meters according to ANN training data

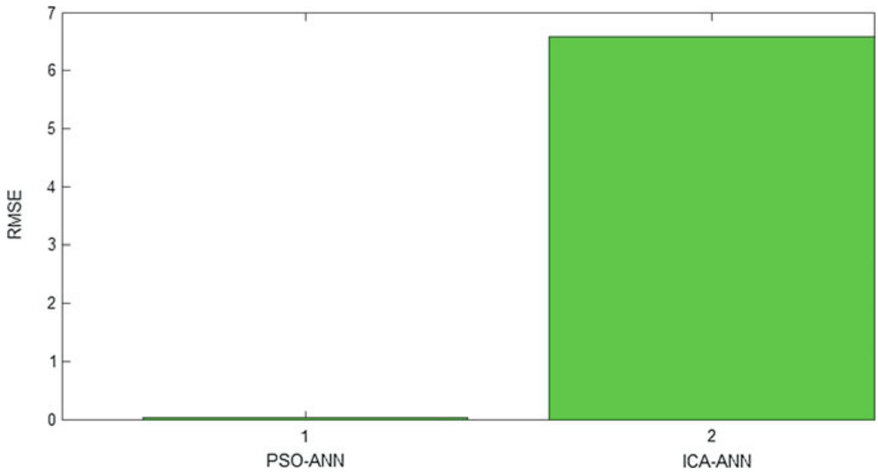

Fig. 4 Bar chart showing comparison of RMSE for ICA-ANN and PSO-ANN

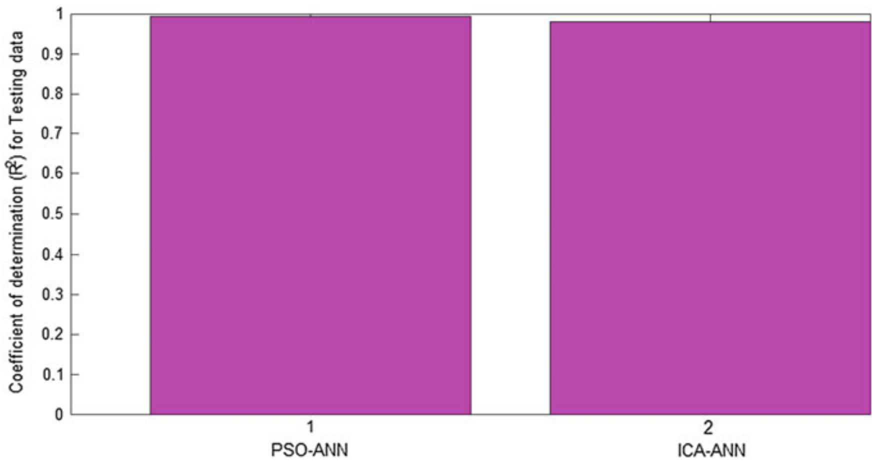

Fig. 5 Bar chart showing comparison of coefficient of determination (R^2) for testing data for ICA-ANN and PSO-ANN

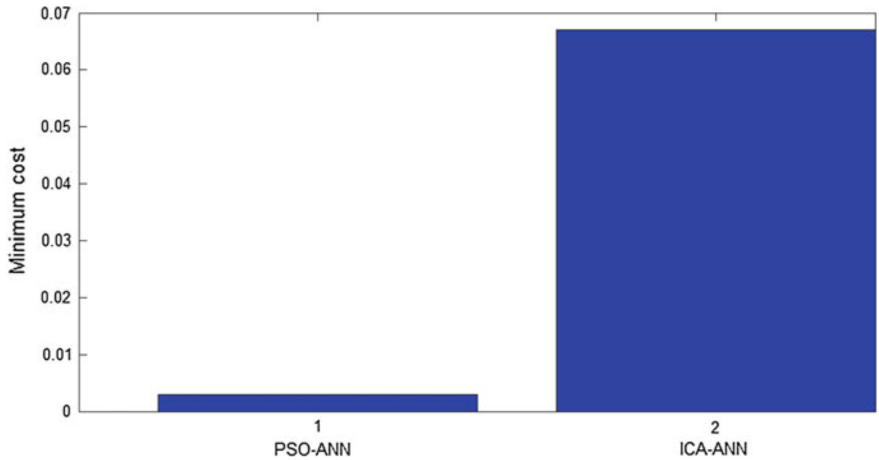

Fig. 6 Bar chart showing comparison of minimum cost value for ICA-ANN and PSO-AN

5 Conclusion

A predictive model based on the arrangement of PSO and ANN is developed to predict fly-rock which is made by blasting. An exactly recorded and collected data are utilized to train the PSO-ANN predictive model. Hole depth, load to spacing ratio, reducing length, burden per delay, powder factor, rock density are considered as input limitations. Fly-rock distances are assigned as the output parameter. It can be concluded from the experimental results that the proposed model is well able to expect fly-rock distance with high mark of correctness. The proof of previous statement is the snapshots of measured fly-rocks for testing and training data in last chapter. Measured fly-rocks are very much closer to that of predictive fly-rocks. Also, for comparison purpose, the results of proposed method are compared with existing methods such as ICA-ANN, BP-ANN, empirical equation, and multivariate regression analysis (MRA). Also, it is surveyed that the existing predictors provide very quick and simple prediction, whereas the proposed PSO-ANN model exhibited higher prediction performance model compared to other methods.

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Algorithms for Synchrophasor-Enabled Digital Relay in Differential Protection Schemes

Anurag S. D. Rai, Reeta Pawar, Durga Sharma, Shaurabh Sen and Sanjeev Kumar Gupta

Abstract The synchronized phasor measurement system along with differential protection scheme becomes popular, which provides in-zone fault detection and mitigation by continuous monitoring. Point-to-point monitoring of electrical parameters using synchrophasor technique and inheriting the differential protection in digital relay improve the protection of system. Differential protection involves communication wires or communication band channels. With the improvement of GPS and communication technology day by day, measurement through PMU is also enhanced by enabling protection of transmission line and cables by synchrophasor-based digital relay. Algorithms that are step-by-step methodology need to develop solution here; in this chapter, algorithm for synchrophasor-enabled relay is discussed as for each operation different algorithms are required, so was here different algorithms, and there perception to digital protection was taken. The behavior of the measured phasor is between the 1 PPS point and the response. Non-steady-state (transient) conditions will vary with the algorithms used.

A. S. D. Rai (✉) · R. Pawar · S. K. Gupta
Department of Electrical and Electronics Engineering,
AISECT University, Chiklod Road, Bhopal 464993, Madhya Pradesh, India
e-mail: rai.anurag71@gmail.com

R. Pawar
e-mail: reetapawar2010@gmail.com

S. K. Gupta
e-mail: sanjeevgupta73@yahoo.com

D. Sharma
Department of Electrical and Electronics Engineering,
Dr. C. V. Raman University, Kota, Bilaspur 495113, Chhattisgarh, India
e-mail: drgshrm@gmail.com

S. Sen
Department of Electrical and Electronics Engineering,
Swami Vivekananda College of Engineering, Indore 452020, Madhya Pradesh, India
e-mail: shaurabh.sirtex@gmail.com

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Keywords Synchrophasor · Synchrophasor-enabled digital relay
Off-nominal frequency operation of PMU · Relay algorithms

1 Introduction

PMUs are sensing device, which sense the phasor of electrical transmitting quantity enabling the measurement by collecting data through Global Positioning System with high precision. When phasor measurement is done periodically, it will be termed as synchrophasor measurement, as it enables synchronized measurement voltage and current quantity along with difference of phasor at constant frequency of operation [1]. The data which was universally collected by the utilization of PMUs' at grids revitalizing satellite and GPS navigation a large point to point online monitoring network is setup for collecting data and there analysis from Wide Area Measurement System. Each network had some hierarchy, here PMUs followed by PDCs and the lateral one followed by next-level PDCs [2]. The topology and its broadness of hierarchy depend upon the strategy for control and operation, along with locating the PMUs in the power system grid. PMU is an upcoming tool by proper utilization of it congestion management, and monitoring over physical–economical constraint can be done, also helping in black out mitigation and future operational planning [3].

1.1 Synchrophasor

As the modern power systems are expanding, grids are working in the their maximum operating limits, and thus, further operation of grid with excess power led to thermal limit violations. A continuous monitoring of power at power corridors is required and, for this conventional technology, is not further sufficient. Synchronized phasor measurement led to new technique allowing the measurement through distance and centralized way by point-to-point measurement through PMU-enabled devices [4]. These devices are compatible with analog measurement unit, as nowadays analog-to-digital conversion becomes quite easier and compact. In this measurement technique, frequency remains constant letting the comparison of phase of different electrical quantity with their respective reference frames, which truly helps in taking point-to-point measurement [5]. Standards for every technique are referred as it makes it globally accepted, and here, also standards are followed so that synchrophasor-enabled device and substation equipment remain interfaced [6]. The phasor diagram for the reference wave will be expressed mathematically as:

$$\vec{V} = \frac{V}{\sqrt{2}} \angle 0 = \frac{V_m}{\sqrt{2}} e^{j0} \tag{1}$$

Signal with amplitude of V_m and phase angle of ϕ leading, phase angle of the measured waveform is given by measuring the occurrence of its peak with respect to the rising edge of the 1 PPS signal. Synchrophasor combines the concept of phasor with that of synchronization in time [6]. The synchrophasor technology has become possible because of the ability, through GPS, to precisely refer to $t = 0$ instant, all over the power system, and all times, the concept of phasor is a strictly steady-state concept. However, in practice, we encounter situation where the amplitude as well as phasor angle is continuously varying according to a low-frequency signal. The IEEE Standard for synchrophasor now covers both the steady-state and transient conditions [7].

1.2 Application of PMU in Power Systems

(1) **State Estimation**: Improved computational ability in addition to PMU is deployed to measure the phasor of electrical quantity with reference to phasor at accuracy of one microseconds.
(2) **Oscillation Detection and Control**: PMUs could be used as the eye of the power system to detect oscillations early enough before they lead to critical consequences.
(3) **Voltage Stability Monitoring and Control**: Voltage stability improvement and its controlling utilizing synchronized phasor measurement units are improvising as fast response, better and effective controlling. This is possible through the following applications:
    - Voltage stability and rotor angle stability assessment during load shedding.
    - Controlling and monitoring of wide area.
(4) **Protection of Power Systems**: A number of severe protection problems have been resolved by PMUs. PMUs are having fast response time, leading to efficient operation of protection system. The latency of remote measurements for such protection functions is not really a significant issue.

1.3 Synchrophasor-Enabled Digital Relay

The architecture of a synchrophasor-enabled digital relay: It can be seen that it has been evolved from the block diagram of the digital relay Fig. 1, by adding the GPS clock a phasor locked and a phasor-locked oscillator to the 1 PPS signal given by the Global Positioning System clock. The GPS also provides the DSP

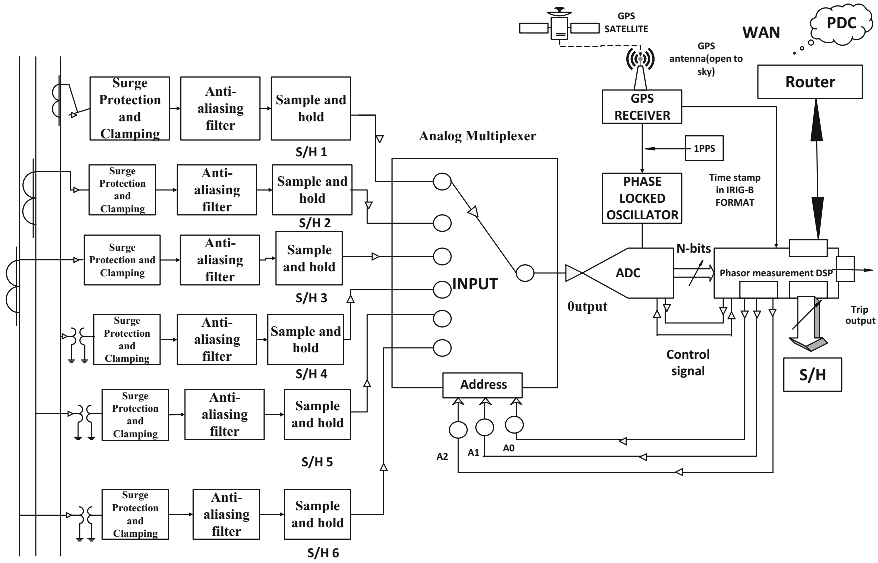

Fig. 1 Block diagram of a synchrophasor-enabled relay or phasor measurement unit

microprocessor with the time stamp using IRIG-B protocol [8]. A phasor measurement unit will have very similar organization. To difference between Synchrophasor enabled digital relay and a PMU just computes the Phasor, time stamps than, assembles the data frames and either store them (record them) or transmits them to a remote entity which may be a Phasor data concentrator or a digital computer, whereas a digital protective relay is tasked with taking a trip/ restrain decision after computing the Synchrophasor [9].

2 Proposed Methodology

2.1 Off-Nominal Frequency Operation of PMU

We need to give careful thought to the effect of sampling frequency on the phasor computation, because in the real-life power system the signal frequency is almost never exactly equal to the nominal frequency of 50 Hz [9]. If we lock the sampling frequency to the nominal frequency of 50 Hz, as we do in synchrophasor, we will end up with inaccurate measurement due to the leakage effect. This inaccurate measurement will have to be corrected or “compensated” by accounting for the actual signal frequency [6]. If we wish to get rid of this error (rather than compensating it), then we will have to lock the sampling to the actual power system

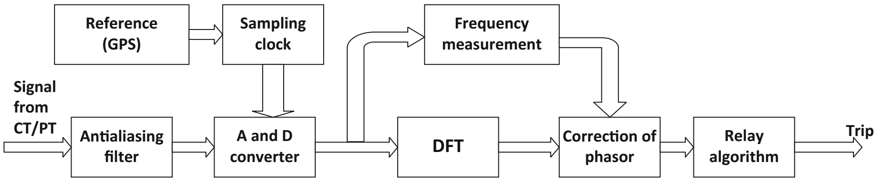

Fig. 2 Sampling locked with a fictitious 50 Hz signal via GPS

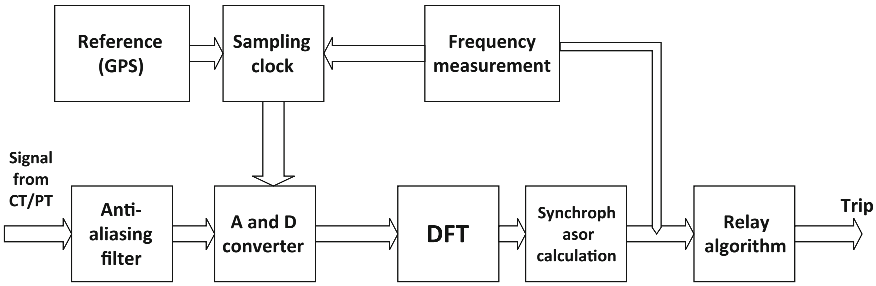

Fig. 3 Sampling locked with system frequency

frequency by actually measuring it. Thus, in both cases, extra work than that indicated by the DFT algorithm is needed. We keep the sampling frequency locked to factious cosine wave whose positive peak is synchronized with 00 h: 00 min: 00 s on January 1, 1970 (Figs. 2 and 3).

2.2 Relay Algorithms

The algorithms for digital protection of power systems: One may feel awe and wonder at the variety of approaches that the researchers have taken. It seems that the search for algorithmic solution to problems in the area of power system protection is an unending one. Inventions and discoveries made in other fields like communication, statistics, artificial neural networks, fuzzy logics, genetic algorithm, and expected systems have fueled research in this area. It should note that other methods of estimating phasor have been discussed in the literature. However, to the best of our knowledge, Mann and Morrison, Differential Equation Algorithm, based Phasor estimation in this chapter [9].

2.2.1 Algorithm for Mann and Morrison

A relay voltage and current are as follows:

$$v = V_{\mathrm{m}} \sin(\omega t + \theta_v) \tag{2}$$

$$i = I_{\mathrm{m}} \sin(\omega t + \theta_i) \tag{3}$$

The phasor relation between voltage and current is as follows:

$$\theta = \theta_v - \theta_i \tag{4}$$

We keep on varying our frame containing RMS values of voltage and current; thus, variation of phase angle between voltage and current led to the computation of the apparent impedance taken from the relay location. The algorithm represents step-by-step procedure and provides mathematical and computational solution with simplicity. However, on examining Mann and Morrison method, it was investigated that it had waveform which is undistorted fundamental sine wave, and frequency is also constant and does not have variable nature (Fig. 4).

2.2.2 Differential Equation Algorithm

In this line is modeled R-L series circuit, which is lumped while computing the shunt capacitance and other line parameters which are distributed are neglected. Thus, with the help of differential equation, the impedance of fault location can be fed to relay by voltage and current variations (Figs. 5 and 6).

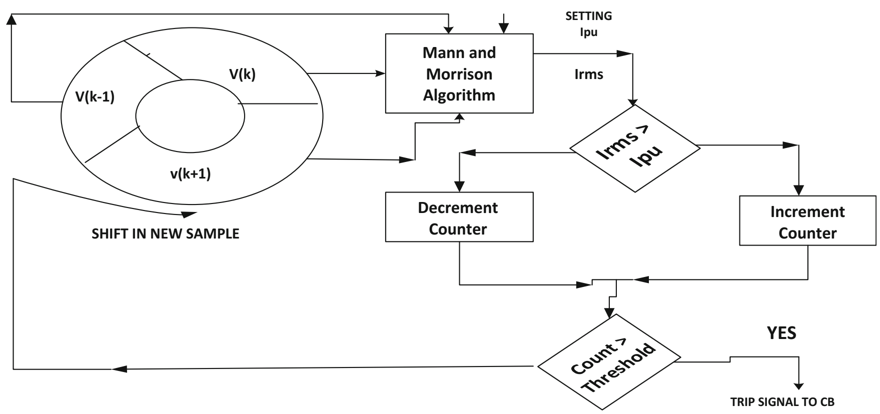

Fig. 4 Instantaneous OC relay based on Mann and Morrison algorithm

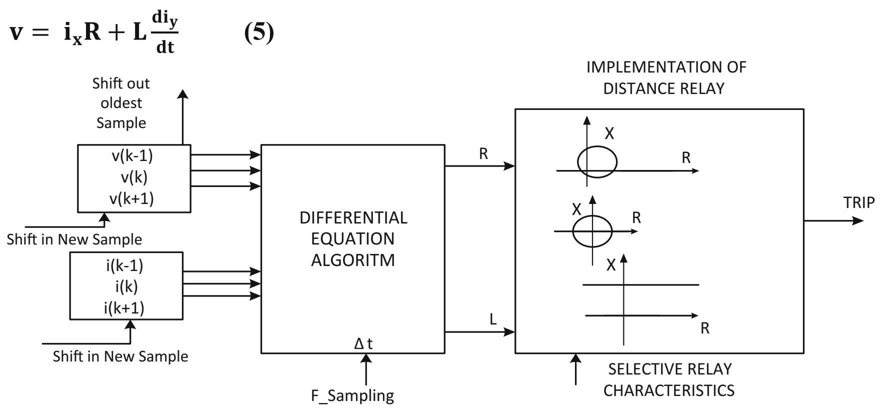

Fig. 5 Block diagram showing inputs to differential equation algorithm and block for implementation of specific distance relay

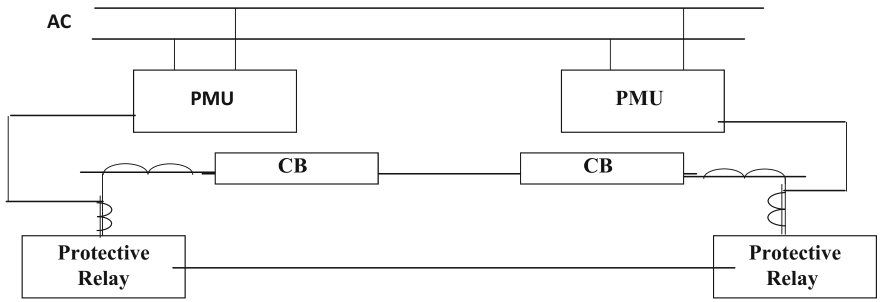

Fig. 6 Framework of conventional measurement using reference voltage

$$v = i_x\mathrm{R} + \mathrm{L}\frac{\mathrm{d}i_y}{\mathrm{d}t} \tag{5}$$

3 Results and Discussions

In this MATLAB script, we demonstrate the effect of off-nominal frequency upon the discreet Fourier transform magnitude calculation when the DFT computation is based on the sample drawn at multiples of nominal frequency. In this script, a 50, 45, and 55 Hz signal is sampled at 4 × 5 Hz. Author kept the amplitude of signal constant, but changed its phase from 0° to 360°. As expected, the 50 Hz signal traces out ellipses. Thus, off-nominal frequency operation of DFT whose sampling is locked to nominal frequency gives rise to error in phasor calculation (Figs. 7 and 8).

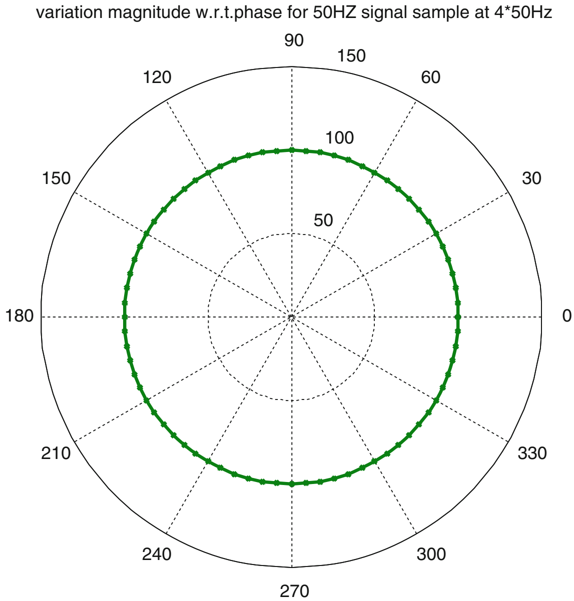

Fig. 7 Variation of magnitude w.r.t phase for 50 Hz signal sampled at 4 × 50 Hz

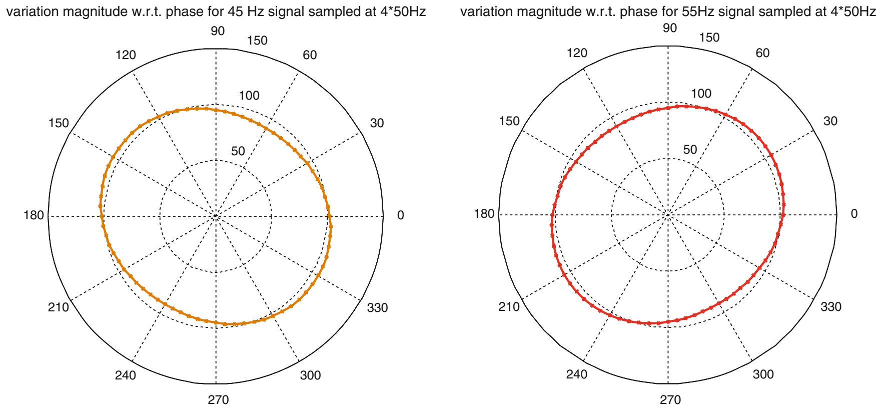

Fig. 8 Variation of magnitude w.r.t phase for 45 and 55 Hz signal sampled at 4 × 50 Hz

Algorithm is based on undistorted sine wave signal frequency [10]. Whereas, algorithms' are classified into Time-domain and Frequency-domain system based on the need and simplification of solution. As we are using undistorted sine wave for analysis purpose, then basic Mann and Morrison algorithm can be used, which is utilized here also [9].

Table 1 Mathematical results for Mann and Morrison: MATLAB output at relay location

S. No.	Actual value at relay location	MATLAB output at relay location	Percent error
(1) V_m	141.4214	140.3572	0.7524
(2) actual_angle	30.0000	29.9664	−0.1120
(3) mean_angle		29.9664	

3.1 *Mann and Morrison Algorithm*

Figure 6 shows voltage v and voltage derivative $\frac{dv}{dt}$, estimated $V_{peak,}$ and estimated phase between voltage and current at relay location (Table 1).

Computation of one derivative requires three samples. Now, we cannot base the trip decision on the signal estimation (which involved only three samples). Authors have to continuously keep estimating the peak and phase angle and hence the phasor, in order to be sure about what way the phasor is really going (Fig. 9).

Thus, there is error, both in magnitude and in phase. It can be seen that error in magnitude is only 0.7524% which is less than 0.1%, while the error in phase angle is 0.0336°. Thus, Mann and Morrison algorithm is suitable for measuring voltage and phase angle at relay location [9].

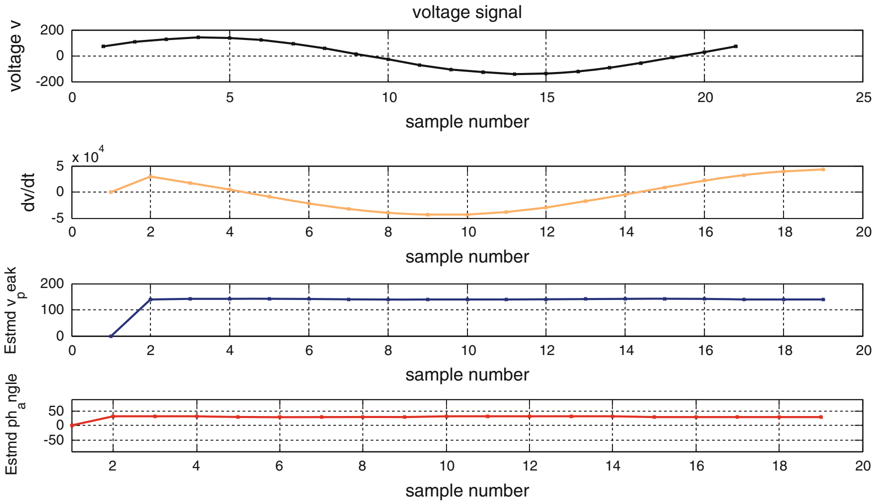

Fig. 9 Voltage, v, and voltage derivative $\frac{dv}{dt}$, estimated V_{peak}, and estimated phase between voltage and current at relay location

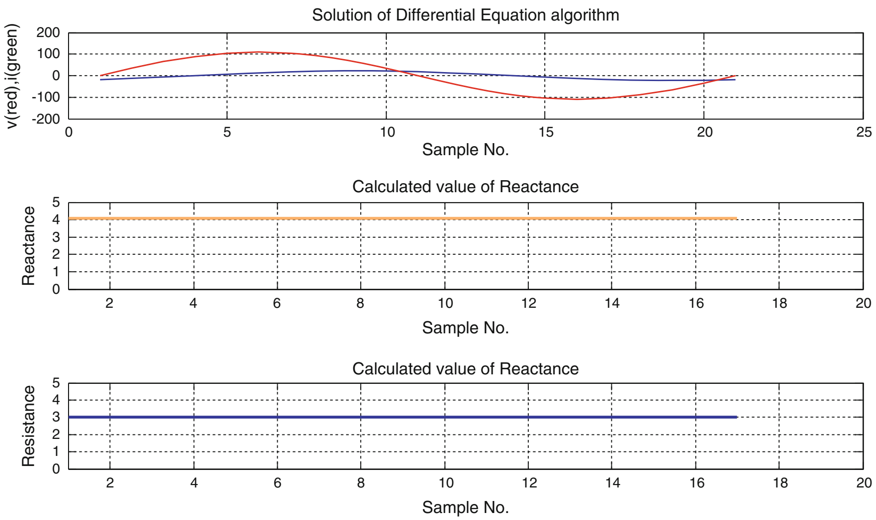

Fig. 10 Voltage, current, reactance, and resistance at relay location

Table 2 Mathematical results: MATLAB output at relay location

S. No.	Actual value at relay location	MATLAB output at relay location	Percent_Error_
(1) Reactance	4	3.33436	1.6641
(2) Resistance	3	3	0

3.2 Differential Equation Algorithm

If faulted line modeled with differential equation Algorithm. Thus there is error, both in Reactance and in Resistance. It can be seen that error reactance is only 1.6641%, while the error in resistance is 0%. Thus, differential equation is suitable for modeling R-L series circuit in relay location (Fig. 10; Table 2).

4 Conclusion

In this chapter, algorithms are discussed for digital protection of power systems. One may feel awe and wonder at the variety of approaches that the researchers have taken. It seems that the search for algorithmic solution to problems in the area of power system protection is an unending one. Inventions and discoveries made in other fields like communication, statistics, artificial neural networks, fuzzy logics, genetic algorithm, and expected systems have fueled research in this area. It should note that other methods of estimating phasor have been discussed in the literature; However, to the best of our knowledge, Mann and Morrison, Differential Equation Algorithm.

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A Prototype for Grievance Redressal System

Shaligram Prajapat, Vaibhav Sabharwal and Varun Wadhwani

Abstract A grievance is a discontent or dispute which could arise at any level in any organization. If the organization is an academic institution, then this issue becomes more sensitive and important. Students are the most vulnerable entities at educational institutions often fail to express and sometimes fail to seek proper support for the issues they face arising at numerous levels. Thus, on analyzing the prevailing state of redressed mechanisms of grievances at some of the prestigious colleges of Madhya Pradesh, it came as a revelation that none of them had a completely formulated grievance redressal mechanism to address the arising conflicts in the lives of the students. In wake of the above-mentioned problem as an implication, a prototype of grievance redressal has been worked out which could comply well with the solution provision for the arising conflicts for students. In this paper, we focus on the development and the execution of the above-mentioned prototype which could be incorporated to adhere to the grievance redressal for students. This paper puts deep insight into incorporating all those problem areas which were found on the basis of the analysis phase plus some additional necessary areas.

Keywords Grievance · Redressal · Prototype · Grievance redressal system (GRS)

S. Prajapat (✉) · V. Sabharwal · V. Wadhwani
International Institute of Professional Studies, Devi Ahilya University, Indore, India
e-mail: shaligram.prajapat@gmail.com

V. Sabharwal
e-mail: vaibh.sabh@gmail.com

V. Wadhwani
e-mail: varunwadhwani324@gmail.com

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1 Introduction

A grievance is an oppressive state of things caused due to any wrong or hardship suffered by an individual which forms legitimate grounds of complaint and the complaint demands a remedial action. Grievance redressed mechanism is a part of the prevalent machinery of any administration. Redressal of the grievances is considered as a parameter to measure the efficacy of an organization. No organization can claim to be responsive and user-friendly unless it has established a well-versed system of grievances/complaints redressal. A redressal mechanism would cover complaints of not only a refusal to the return of documents or certificates, any irregularities in the admission process, but also complaints regarding harassment and victimization including harassment.

A typical grievance redressal system (GRS) is shown in Fig. 1, and it works functions for several purposes including ensuring a democratic campus environment, acquainting all the faculty and students about their rights thus ensuring qualitative as well as the quantitative development of the organization. Moreover, considering the nature of and the severity of the grievances, the due inquiry is made by the members of the cell, followed by giving punishment if anyone is found guilty.

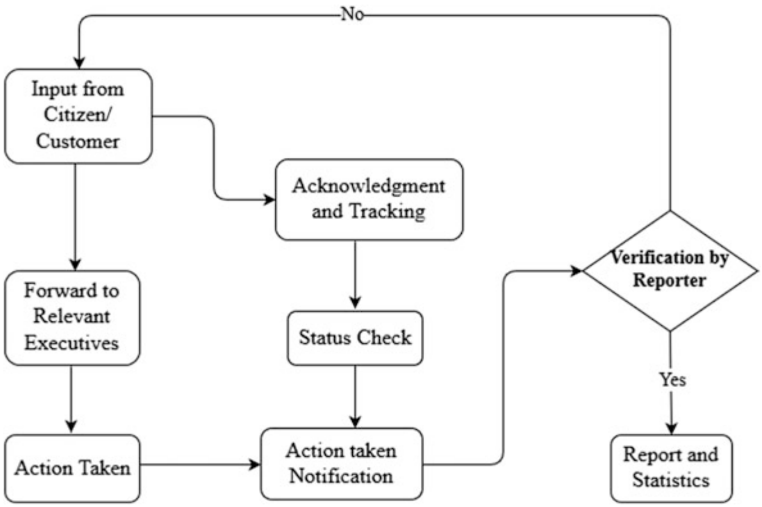

Fig. 1 Generalized model for grievance redressal

2 Related Work

In the literature, time to time reporting is available regarding demand and usage of GRS for various domains such as e-governance, public administration, Municipal Corporation, ragging offenses in student community, and sexual harassment in an organization. The key observations during the literature survey are enlisted below.

In [1], analysis of various online services provided by, specifically four Indian states, has been presented and the importance of online grievances redressal mechanism is highlighted to combat corruption in the bureaucracy. Various metrics associated with the GRSs have been taken into account, and a scale has been devised. The performance of the states into consideration has been measured on the scale.

Dipankar [2] explores the utility of complaint registration system in India. Fear of revealing the identity makes complainant go anonymous or pseudonymous. It becomes a tough job for the authorities to know the authenticity of the complainant. Therefore, the solution is presented so that complainants can complain being intrepid, at the same time allowing the authorities to examine the originality of the complaints.

In [3], redress procedures are said important for basic fairness. Effective functioning of the system is possible when both demand and supply sides work well. It is also pointed out that grievances and complaints redressal regarding basic service delivery are not sufficiently developed in many countries and deserve further analysis, investigation, and subsistence.

The success of an e-governance system, online public grievance redressal system (OPGRS), from the perspective of the citizens of India in [4] is examined using an integrated IS success model. The model includes the elements like system quality, information quality, service quality, perceived usefulness, perceived ease of use, perceived satisfaction, perceived risk, and behavioral intention. It is hence emphasized as a useful tool for a transparent and corruption free country.

The study in [5] inferred that in grievance administration role of insurance ombudsman is very important and constant increase in the number of complaints received by various ombudsmen across India shows that the policyholders are gaining their confidence and trust in the institution of Insurance Ombudsman.

The studies displayed in [6] expand on suggestions and outcomes of systems to handle feedback and open criticism related to services provided to and managed for the inhabitants of different cities.

Designed to make government–citizen relationship more effective and transparent, the implications described in [7] are that new forms of GRSs result in an e-based divide between those who utilize newer forms of grievance redressal for quality improvements in service provision and adverse incorporation of those who still work through 'negotiated spaces' to realize a basic level of service provision. In [8], there is an emphasis on developing a value-based work culture in educational institutes. Also, there are some ways suggested to structure a preventive measure and fair procedure to develop a better and reliable organizational culture in educational institutions free from issues related to sexual harassment and exploitation.

Challenges associated with the automation of non-profit organizations (NPOs) and non-governmental organizations (NGOs) is addressed in [9] along with guidelines to automate them easily.

In [10], practice of ragging in educational institutions of South Asia has been highlighted and ways to curb the menace of ragging have been explored. Similarly in [11], there is a study of sexual victimization of college women and its methodologically sound assessment is given.

Our work includes the ideologies mentioned in the papers in some or other way. We have used and reconfigured them according to the needs of the educational institutions of India.

We have analyzed the working of current systems, what facilities being provided to the students, and how their grievances are being redressed in various educational institutes and found where they lag or fall behind. Using the analyzed facts and information, we propose some additional features and attributes to fill the aperture in the current system.

There have been various researches done and papers available on GRSs but all of them are for public sectors companies, municipal corporations, and e-governance systems or contain only one or two of the problems faced by the students in the educational institutions but none of them include each and every domain of grievances related to students.

In addition to that, many systems lack in proper channelization of complaints to solve them in time with proper understanding and solution. There is also a need for more transparency and guaranteed solutions.

Proper channelization means a structured way or passage to forward complaints by categorizing them according to their nature, intensity, and urgency and passing them to the concerned authorities in that way. There has no work been done specifically in the domain of problems faced by students in the educational institutions, especially in India. So, there is a need for developing a system that is robust, transparent, and fair and allows fast and reliable solutions to each and every problem faced by the students.

Thus, the communication gap between the students and the system may be managed by an automated system of GRS, where students generally are unaware of their rights and hence do not know what to do and what action to take at the time of difficulty or trouble. This lack of information and unawareness among the students is only due to the hazy way of working. At times, students do not want to reveal their identities due to the severity of complaints or afraid of being harmed, and there is no such provision available in the current systems of various educational institutions in India.

3 Approach for Handling the Presented Issue

To design and implement GRS, the entire process is divided into study and analysis phase and design phase. The former phase includes the development of questionnaire made to know the facilities and problem encountered by the student in different institutions. In the design phase, identification of the entities and their relationships is done along with designing numerous UML diagrams of the proposed system. The logical model of the system has been designed, normalizing the relations. Data flow diagram of the whole system has been constructed. Flowchart of each process of DFD is constructed for better flow of data and its verification (included in project report). The proposed model is the physical design of the system defining the software and hardware requirements.

The coding phase may be considered as a deployment stage for GRS. The design of the system is implemented through actual code. Proper validation of data is used. Proper validation on important fields is provided. The user does not need to have the knowledge of the code, and the output is defined user-friendly.

Testing phase can also be followed on various test cases and data set. Testing could be done by taking different use cases. A record is updated every time a student enters details. Update when a complaint is registered. Records are managed when a student checks the complaint status.

4 Modeling of Grievance Redressal System

The modeling of proposed GRS system requires a completely automated system, thus helping the user retrieve the information as soon as possible. The backup plans are provided in the form of the database helping avoiding data in case of catastrophic situations. Hence, the system is reliable to perform in adverse situations. The system is scalable and can be expanded and customized to meet the needs of the firms for which it will be implemented. Moreover, the system provides a user-friendly interface with a realistic view.

The system provides search facilities to search a specific entry matching in the database, and this system consists of an auditor as a supreme body to monitor the entire system's performance. The system consists of an administrator and a collector within whom the tasks can even be passed at the time of encountering someone not proficient in handling the given task, and thus the system works smoothly without further delays. Victim's authentication is done beforehand in order to avoid the nuisance which might arise in the manual system.

The aim of the proposed GRS (prototype in Fig. 2) is to address the issues present in the current system, implement validation techniques (with respective stakeholders, as shown in Fig. 3) that will help reduce the margin of error in operations, providing adequate data backup facilities in order to ensure system restart even after a calamity and ensures consistency. It is a foolproof system that simulates and replaces the present manual system.

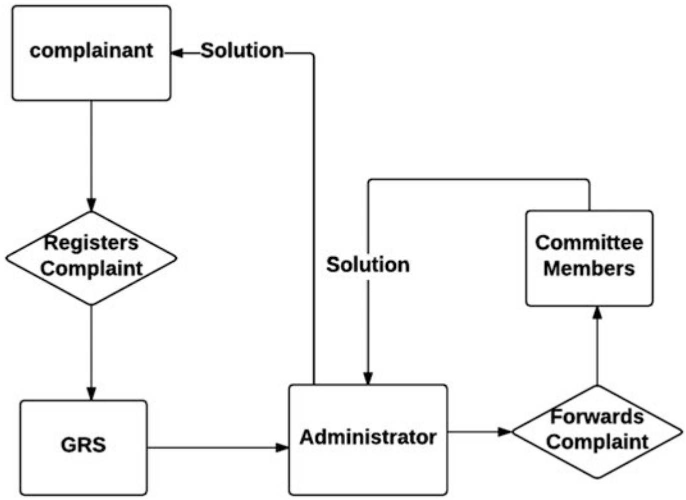

Fig. 2 Prototype of the proposed system

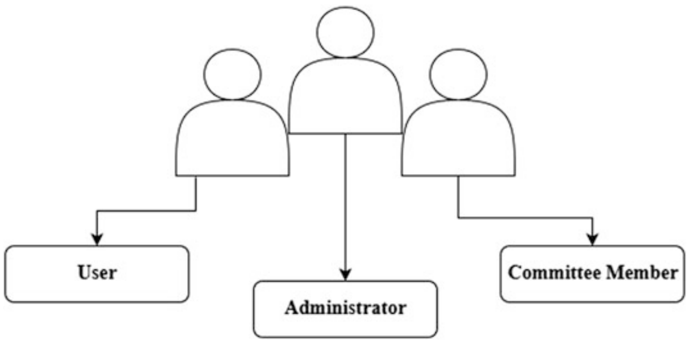

Fig. 3 Stakeholders involved in the GRS

5 Conceptual Flow of Data in GRS

To develop a working GRS, the flow of data from one component of the system to other is depicted by Fig. 4.

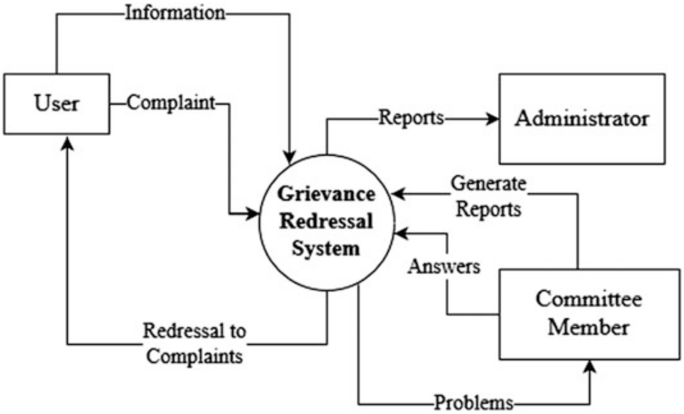

Fig. 4 Context flow of grievance redressal system

6 Pros and Cons

The pros and cons of the proposed GRS system primarily includes human negligence since the system, though an automatic prototype to redress the complaints of the students/victims, will be handled by humans who could be negligent at times in forwarding complaints to the respective committee member or while providing solutions to the respective administrator.

Another shortcoming includes a poor network which could persist at times; as a result, the system of forwarding and resolving the complaints in the form of sending back the answers to the respective administrators and then to the respective students could get delayed, the proposed GRS system being based on simple mail transfer mechanism.

7 Future Enhancements

The GRS working on the pretext of the grievance redressal for the students currently works as a Web application among the various members and the targeted audience. To extend this further to fulfill various requirements, following enhancements are suggested:

(1) Though many future enhancements of the system worked upon are possible, the prime focus includes the development of a mobile application in order to increase the mobility of the application since the future demarcates the usage of mobile applications and as seen portable devices are ubiquitous which will facilitate the receiving of all the notifications in the cell phone by the members

and students associated with the application further increasing the reliability of the system and the rate of problem-solving.

(2) The mobile application is targeted to enhance the user experience by providing the user with additional features for uploading the pictures the proofs in the form of audio or video files, which might enhance the case solving ability especially in such cases with a high rate of severity.

(3) A toll-free helpline could be made available on a 24 $\times$ 7 basis for the victims in order to lodge complaints at emergency hours or to seek counsel in case of catastrophes.

(4) Above all, a tracker could be added as a part of the future perspectives in order to track the performance of various committee members involved into the process on the pretext of the provided feature of the report generation.

8 Conclusion

This paper is an attempt to highlight the fact that there are hardly such systems prevailing curtailing to the complaint redressed for students enrolled in numerous organizations. This paper has demonstrated a proposed GRS system for the grievance redressed of students covering various domains of complaints which could be lodged easily and thus leading to easy and sure solutions or redressed to the problems being faced by a student on a regular basis. The technologies used comprise of HTML and CSS to design a user-friendly graphical user interface, PHP, and SQL to keep track of the records at the back end. This system would be suitable for any organization for the resolution of complaints and thus lead to a qualitative and quantitative development of the organization.

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Design and Development of Symmetric Cipher for Text Data

Aumreesh Kumar Saxena, Vijay Bhandari, Aasif Hasan, Sitesh Kumar Sinha and Piyush Shukla

Abstract Security of information is a prime concern in today's world, and cryptography is one of the solutions. To enlarge the authenticity and confidentiality of the data, there is a continuous development in cryptography with higher efficiency. With this continuation, we propose 16-byte block cipher symmetric key cryptography algorithm which is suitable for various types and sizes of text data. The beauty of the proposed algorithm is the use of logical (XOR and circular shift) operation. Experiments are showing the proposed algorithm to be safe, effortless and hard to crack.

Keywords Cryptography · Symmetric key · Asymmetric key · Security Encryption · Decryption

1 Introduction

In the increasing connected world of modern information technology system, cryptography has become the essential component because it provides confidentiality and security to the data or information in public communication medium like

A. K. Saxena (✉) · V. Bhandari
SIRTS Bhopal, Bhopal, India
e-mail: aumreesh@gmail.com

V. Bhandari
e-mail: vijaysirt@gmail.com

A. Hasan
DU, New Delhi, Delhi, India

S. K. Sinha
AISECT, Bhopal, India
e-mail: siteshkumarsinha@gmail.com

P. Shukla
UIT RGPV Bhopal, Bhopal, India
e-mail: pphdwss@gmail.com

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Internet [1]. Cryptography is mainly used for the e-commerce transactions and secure electronic mails [1]. It is the branch of computer science which deals with the use of mathematical operations for encryption or decryption of the data [2]. In this, the plain text which is also known as unencrypted data is encrypted to produce cipher text [2]. This cipher text is sent to the receiver where it will be decrypted using decryption algorithm and converted into plain text again [1, 2]. The encryption and decryption of the data totally depend on the type of cryptography scheme used [1, 2]. In formula, it is written as follows:

$$C = E_{\mathrm{k}}(P)$$
$$P = D_{\mathrm{k}}(C)$$

where

P plain text,
C cipher text,
E the encryption method,
D the decryption method, and
k the key.

There are many cryptography algorithms in use nowadays, producing cipher for the security and confidentiality of the data. The two most common cryptography algorithms are shown in Fig. 1 [3].

The symmetric key cryptography is the mechanism in which there is only one private common key shared and used to encrypt and decrypt the data [4]. Only one key is used to convert plain text into cipher text and decrypt again to plain text. In Fig. 2 the symmetric key cryptography scheme is shown [4, 5].

In the symmetric key cryptography system, both sender and receiver share a key [4, 5]. The key is kept secret to maintain the confidentiality and security of the data. The key size in bits depends on the algorithm used in symmetric cryptography system [5]. In asymmetric key cryptography system, two keys are used; first is the public key which is used for encryption of the plain text by the sender, and second is the private key which is kept secret by the receiver to decrypt the data which has been received [6]. The sender encrypts the data using the receiver's public key, and then, the receiver decrypts that received data through its private key [6]. Figure 3 shows the asymmetric key cryptography system, where Pub K refers to public key

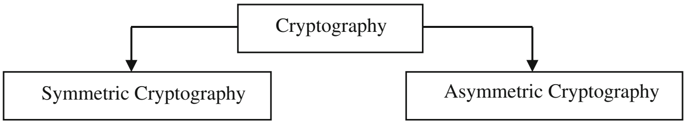

Fig. 1 Cryptography

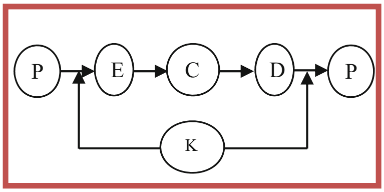

Fig. 2 Symmetric cryptography

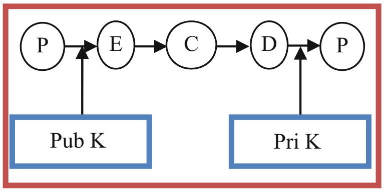

Fig. 3 Asymmetric cryptography

and Pri K refers to private key. The most common function for the cryptography algorithms are confidentiality, authentication, integrity non repudiation and key exchange [2, 4]:

2 Related Work

Many researches and studies have been done related to symmetric key cryptography. The symmetric cipher algorithm can be implemented in the following two ways. Firstly, the plain text in the form of file is sent to the database, where every single count of character is stored [7]. For every character in the plain text file the binary digit '1' is used for the number of times it is occurred in the plain text and the '0' is used for the previously recognized character then all the 0's and 1's are concatenated using '@' operator at last [7]. Another way for encryption of the presented algorithm is that for every character of the plain text, a three-digit number is used which is unique and then arranged in the ascending order in the database [7]. For the next digit, insert '1', and for the previous digit, insert '0'. Then, the received binary data are converted into ASCII code after dividing that received binary data into seven bits for compressing the data [7]. The proposed work of symmetric cryptography algorithm [8] has been divided into three stages: the substitution phase, the key generation phase, and the algorithm phase. In this proposed algorithm the plain text is converted to cipher text using advanced substitution mechanism in step 1 [8] then this cipher is again encrypted in step 2 [8] and in step 3 [8] the encrypting text is produced. This is a three-step encryption technique which is very time-consuming. Another approach of symmetric key cryptography algorithm is presented in [9] in which template generation, key generation and key regeneration, all the three components, are used for the fingerprint capturing. Generation of key for encryption as well as decryption is used respectively for the fingerprint analysis. The folding and bitwise circular shift operation method is done in another proposed work in a content-based algorithm. The plain text is encrypted two times in presented algorithm. The encryption of the plain text is done leaving the space and calculating the ASCII value for every character, and then again, the encryption is done by taking the random value which produces the encryption key using the folding method [10]. The another proposed work in which the plain text are converted into upper case and perform three stage of encryption in asymmetric cryptography algorithm where in step-1 all blank spaces are converted to '$' and '#' [11]. Even spaces are converted to '$' and odd spaces into '#', in step-2 all alphabets are switched to complementary alphabets for example A with Z and B with Y and so on in step-3 Second alphabet will be switched which is not blank to the generated code which is calculated as follows n = ASCII (char) and $n = n + (\mathrm{Key})^2$ and last append the char to encoded sequence [11]. Comparative analysis of existing symmetric cryptography algorithms are shown in Table 1.

3 Proposed Work

There are two cryptography techniques which are available for encryption and decryption; first is symmetric key, and second is asymmetric key cryptography. The symmetric key algorithms are 1000 (approx) times faster as compared to asymmetric key algorithms. Usually, symmetric key technique is used for data encryption/decryption in stream cipher mode or block cipher mode, whereas asymmetric key technique is used for key encryption/decryption. An important difference between block cipher mode and stream cipher mode is that block cipher encrypts a collection of plain text as one block whereas stream ciphers convert one character of text directly into a character of cipher text. Proposed symmetric key algorithm is based on symmetric block cipher cryptography concept. Here, the plain text is encrypted in the form of block using the 128-bit symmetric key. The key should be same for both the encryption and decryption. Figure 4 shows the architecture of proposed algorithm.

3.1 Encryption

The proposed encryption is shown in Fig. 5 where the 16-byte block of plain text is divided into four blocks of four bytes. Logical operation XOR and circular shift operation are performing on every block of the plain text with corresponding block of 4 bytes key (see fig. 5) which is 16 bytes long.

Table 1 Comparative analysis of existing symmetric cryptography algorithms

S.No.	Title and authors	Technique	Key size	Text size	Encryption time	Decryption time	Constraint
1	Kaushik, Al., Gupta, K.,: Ask Cipher For Small Amount of Data-2014 [7]	Symmetric key cryptography	Not fixed	7463 bytes	8 s	8 s	It is good for small amount of data
2	Gomathi, S.,: A Cryptography Using Advanced Substitution Technique and Symmetric Key Generating Algorithm-2014 [8]	Substitution symmetric key cryptography	Not fixed	X	X	X	Encryption done in two phase and one time pad key used
3	Barman, S., Chattopadhyay, S.,: Fingerprint Based Symmetric Cryptography-2014 [9]	Feature extraction and symmetric key cryptography	Not fixed	X	X	X	Storage for fingerprint for individual text
4	Chandraa, S., Mandalb, B., Alamc, Sk., Siddhartha Bhattacharyyad.,: Content based double encryption algorithm using symmetric key cryptography-2015 [10]	Content-based symmetric key cryptography	Not fixed	X	X	X	Presently worked on only eight-bit binary data
5	Anand, A., Raj, A., Kohli, R., Bibhu, Dr. V.,: Proposed Symmetric Key Cryptography Algorithm for Data Security-2016 [11]	Symmetric key cryptography	Not fixed	X	X	X	Presented algorithm are comparing with low level as well as classical algorithm

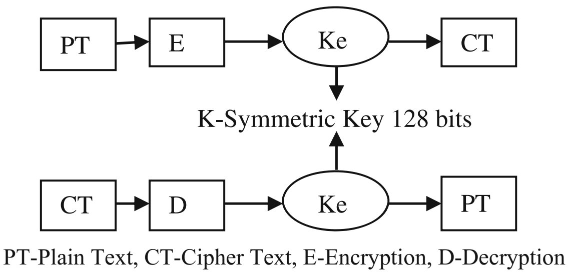

Fig. 4 Architecture of proposed algorithm. PT plain text, CT cipher text, E encryption, D decryption

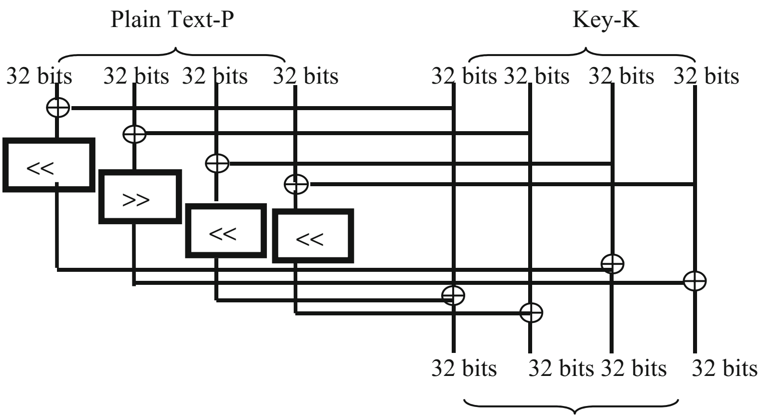

Fig. 5 Proposed encryption

The steps of the proposed encryption algorithm are as follows:

1. Input plain text (P) of 128 bits.
2. Input Key (K) of 128 bits.
3. Divide plain text (P) and Key (K) into four parts like P-1 to P-4 and K-1 to K-4, respectively.
4. Apply XORing between P-1 and K-1 to produce output new P-1. Similarly XORing between P-2 & K-2, P-3 & K-3 and P-4 & K-4 to produced new output to P-2 to P-4 respectively.
5. Apply two-bit circular shift (left and right) operation on produced results in Step 4. Left circular shift on P-1 & P-3 and right circular shift on P-2 & P-4.
6. Now once again apply XORing between P-1 to P-4 of step-5 and K-1 to K-4 where P-1 XORing with K-3, P-2 XORing with K-4, P-3 XORing with K-1 and P-4 XORing with K-2 to produced C-1, C-2, C-3 and C-4 as a cipher text respectively.

7. Combine C-1, C-2, C-3, and C-4 into cipher text (C).
8. Repeat process eight times.
9. Exit.

3.2 Decryption

During decryption 16 bytes block of cipher text is divided into four blocks of 4 bytes and 16 bytes key is divided into 4 keys of 4 bytes each. Then perform XOR and reverse circular shift logical operation on the corresponding pair of 4 bytes cipher text and keys. Figure 6 shows the proposed decryption.

The steps of the proposed decryption algorithm are as follows:

1. Input cipher text (C) of 128 bits.
2. Input Key (K) of 128 bits.
3. Divide cipher text (P) and Key (K) into four parts like C-1 to C-4 and K-1 to K-4, respectively.
4. Apply XORing between C-1 and K-3 to produce output new C-1. Similarly XORing between C-2 & K-4, C-3 & K-1 and C-4 & K-2 to produced new output to C-2 to C-4 respectively.
5. Apply two-bit reverse circular shift (left and right) operation on produced results in Step 4. Reverse left circular shift on C-1 & C-3 and reverse right circular shift on C-2 & C-4.

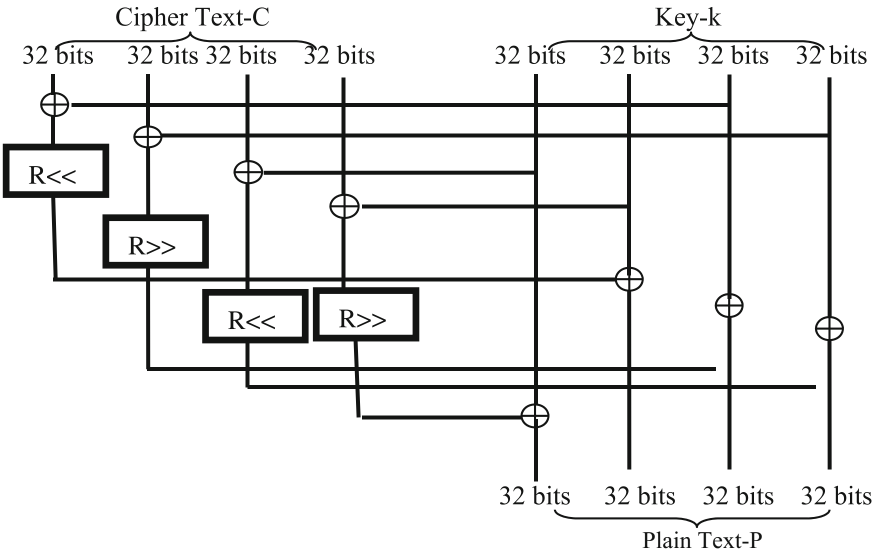

Fig. 6 Proposed decryption

6. Now once again apply XORing between C-1 to C-4 of step-5 and K-1 to K-4 where C-1 XORing with K-2, C-2 XORing with K-3, C-3 XORing with K-4 and C-4 XORing with K-1 to produced P-1, P-2, P-3 and P-4 as a plain text respectively (see fig. 6).
7. Combine P-1, P-2, P-3, and P-4 into plain text (P).
8. Repeat process eight times.
9. Exit.

4 Results

In this work, the proposed secret key algorithms are implemented on Pentium® dual core CPU E5200 @ 2.50 GHz with 2 GB RAM on window platform, and their performance is evaluated by encrypting input files of varying sizes and contents. The proposed secret key algorithms are implemented in an identical language 'Java,' with their standard requirements. The performances of the proposed algorithms are shown in Tables 2, 3, 4 and Figs. 7, 8, 9. The proposed algorithm is cost-effective, efficient, and secure due to its simplicity. In cryptography technique, the avalanche effect is the enviable assets of cryptographic algorithms; usually

Table 2 Avalanche effect of proposed algorithm

File size (KB)	File type	PA (%)
1	TXT	50
5	TXT	50
25	TXT	58
50	TXT	60
100	TXT	68

Table 3 Enc/Dec time of proposed algorithm

File size (KB)	File type	PA
1	TXT	0.45
5	TXT	1.00
25	TXT	1.57
50	TXT	3.25
100	TXT	3.75

Table 4 CPU utilization of proposed algorithm

File size (KB)	File type	PA (%)
1	TXT	65
5	TXT	67
25	TXT	75
50	TXT	80
100	TXT	87

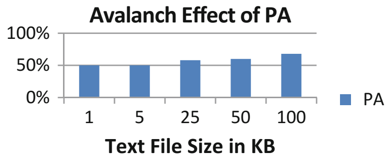

Fig. 7 Avalanche effect of proposed algorithm

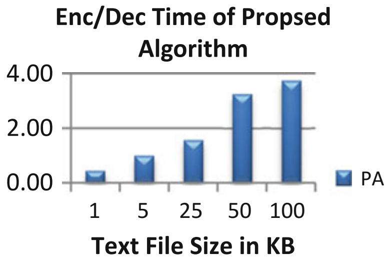

Fig. 8 Encryption/decryption time of proposed algorithm

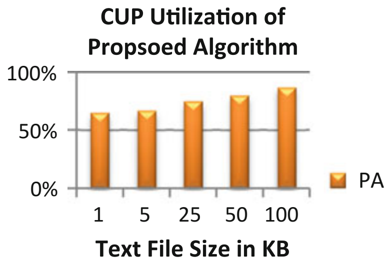

Fig. 9 CPU utilization of proposed algorithm

block ciphers technique and cryptographic hash functions technique wherein if when an input (Key or Text) is changed slightly (for example, flick a solitary bit) the output (cipher text) changes drastically (e.g., almost half the output bits flick) [12, 13]. By changing the single bit in the key more than 50% of the bits changes in cipher text, Avalanche Effect of Proposed Algorithm which is shown in Table 2 with corresponding graphical analysis of avalanche effect of proposed algorithm, are shown in Fig. 7.

Due to high avalanche effect, we can say that a proposed secret key algorithm is very secure. Moreover, the efficiency of the proposed algorithm is evaluated and execution time is one of the prime attributes to evaluate efficiency. Execution time is the time in which the proposed algorithm is converting plain text into cipher text. There are two ways to evaluate execution time of proposed algorithm; first is encryption time and second is decryption time of proposed algorithm which is shown in Table 3, and corresponding graphical analysis of encryption/decryption time of proposed algorithm is shown in Fig. 8. It is clearly shown in Fig. 8 that with the increase in size of the files, execution time (encryption and decryption) is also increasing. CPU utilization of the proposed secret key algorithm is evaluated which is shown in Table 4, and corresponding graphical analysis of CPU utilization of proposed algorithm is shown in Fig. 9. Normally CPU utilization refers to the usages of processing resources by computer's or we can say that the quantity of work knobbed by a CPU. CPU utilization depends on the quantity of work and computing tasks managed by computers. Some tasks need heavy CPU utilization, while others need less. On an average 75% of CPU utilization is showing by the proposed algorithm.

5 Conclusion

The proposed secret key algorithm will speed up the operation performed to produce cipher text. For the XOR logical operation and circular shift logical operation, the instruction set support is added. The proposed secret key algorithm has been analyzed on various file sizes. More than 50% avalanche effect has been analyzed during encryption and decryption process. The simulated result shows that the encryption time and CPU utilization are directly proportional to data and its size. It is clearly shown that with the increase in size of the files, CPU utilization is also increasing. The proposed secret key algorithm is easy in implementation due to its simple architecture and very difficult to crack because of its 16-byte key size, so it can be useful in commercial and other areas where data security and confidentiality are must. This proposed secret key algorithm can be further enhanced to suit the need of the user.

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Comprehensive Method of Knowledge-Based Approach for Word-Sense Disambiguation

Pornima Gidhe and Leena Ragha

Abstract We share our knowledge, thoughts, and information on the Web through our Natural Language (NL). Most of the words in NL are ambiguous and change the meaning of a sentence. Humans can disambiguate the meaning through perceived intelligence, but it is challenging task for a system. Many researchers are working on Word-Sense Disambiguation (WSD) which is used to get correct sense out of context to make the sense of a text understandable by machine/application. We focus on Knowledge-Based (KB) approaches which rely on knowledge resource like WordNet. We compared KB algorithms such as Lesk, Walker, and Conceptual Density with the help of common dataset of sentences. Comparative analysis is done to find the limitations of individual algorithms based on the analysis; we propose a comprehensive method of KB approach.

Keywords Knowledge based · Word-sense disambiguation (WSD)
Natural language processing (NLP)

1 Introduction

Nowadays, we communicate with each other on the Web using regional languages and lot of text data is generated. This text data is used by Natural Language Processing (NLP) which combines the strength of artificial intelligence, computational linguistic and computer science to make the system intelligent like humans. Word is the basic element of sentence and paragraph; it is present in NLP applications like sentiment analysis, machine translation where word ambiguity needs to be resolved. Most of the words in NLP are ambiguous due to multiple meanings, called as lexical ambiguity. For example, the word "object" is having senses like

P. Gidhe (✉) · L. Ragha
Computer Engineering Department, RAIT Mumbai, Mumbai, India
e-mail: pornimagidhe@yahoo.com

L. Ragha
e-mail: leena.ragha@gmail.com

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"physical object" and "aim." WSD techniques are divided into three approaches. Knowledge-Based (KB) Approach: Rely on knowledge resources like WordNet [1, 2], thesaurus. KB approach encompasses of Overlap-Based (OB) approaches which require a Machine-Readable Dictionary (MRD) [3]. Machine Learning (ML)-Based Approach: Rely on train model [4] and use tagged or untagged corpus [5, 6]. Hybrid Approach: KB and ML approaches [3] are combined. ML and hybrid approaches do not contain global dataset, and the performance is inferior. KB methods are based on Knowledge-Based dictionary which contains global dataset so it gives better performance; thus, we are focusing on Knowledge-Based (KB) approach.

Subsequent sections are organized as follows: In Sect. 2, we have done survey about literature. It gives overview of work done in this field. Section 3 gives overview of WSD techniques. Section 4 is about comparative analysis of WSD techniques. In Sect. 5, we have proposed a method to overcome the limitations of KB techniques. Finally, Sect. 6 concludes this study.

2 Literature Review

Literature survey shows that lot of work is still going on in WSD using various techniques.

George A. Miller et al. gave WordNet. It is an online lexical database for English language [7] which includes POS and organized into synonym set. Satanjeev Banerjee et al. use glosses of words for disambiguation [8]. WSD specific WordNet of polysemy words [9] is given by Udaya Raj et al. which organizes polysemy words as well as single-sense words. WordNet for Assamese language which is topical-based approach and thesaurus with tagged category is developed by Purabi Kalita et al. with modified version of Assamese WordNet. WSD algorithms, namely Lesk [10], Walker [11] and WSD using Conceptual Density [12], use WordNet for disambiguation. For Indian script, IndoWordNet [13, 10, 11] is used by researchers. Lesk algorithm is used for English word disambiguation by Radhike Swaheny et al. This algorithm is modified using dynamic context window [10] which requires hand coding, hand tagging of lexicons or training dataset; thus, Enko Agirre et al. gave a solution in the form of a fully automatic method, i.e., WSD with Conceptual Density [12] which depends on CD formula. The WordNet was originally designed for English language. WordNet is having limitations for other regional languages [7] and needs exclusive modifications to suit the regional language. WordNet lacks a cross-categorical semantic relation [12] which may increase performance of CD. Modified Lesk [8] uses dynamic context window, but window size is not mentioned and it increases processing time. Conceptual Density approach works on hypernymy [12], but it will not work on file/document level. It is observed that all three algorithms disambiguate different types of cases. In the next section, we will solve different cases using Word-Sense Disambiguation (WSD) techniques.

Table 1 Dataset of ambiguous examples

Case 1: On burning coal we get **ash**
Case 2: The money in this **bank** fetches an interest of 8% per annum
Case 3: They were riding side by side down the south **bank** of the creek, to develop interest and get command on riding in slimy land
Case 4: The actors were awesome in **play**, group members delivered a message of team spirit

3 Word-Sense Disambiguation (WSD) Techniques

Manually we have created a dataset (Table 1) of ambiguous cases. KB algorithms are applied on it to find the efficiency and downside of each algorithm.

We applied each WSD algorithm on the ambiguous cases to understand the power of disambiguation and the effect which is explained above.

3.1 Lesk Algorithm

It is an overlap-based approach. It looks for overlap between sense bag which contains the words in the definition of a candidate sense of the ambiguous word and context bag which contains the words in the definition of each sense of each context word [10, 14]. Consider Case 1 from Table (1), i.e., Case 1: On burning coal we get ash.

Here, ash and burn are overlapping words from Table (2); therefore, Sense 1, i.e., ash as a residue is selected and ambiguity of ash is removed. Now consider Case 2 from Table (1), i.e., Case 2: The money in this bank fetches an interest of 8% per annum.

From Table 3 we can say the clue word money does not resolve the ambiguity of a word bank as it gives two different senses for bank, i.e., Sense 1 and Sense 2. So, ambiguity remains.

Table 2 Different senses for word "ASH" from WordNet

1. Ash (the residue that remains when something is burned)
2. Ash, ash tree (any of various deciduous pinnate-leaved ornamental or timber trees)

[a]Context bag: burning, ash
[b]Sense bag: burned, ash

Table 3 Different senses for word "BANK" from WordNet

1. Bank depository financial institution, banking company(accepts deposits and channels the money into leading activities) he cashed a check at the bank
2. Bank savings bank(coin bank), (money box) (a container usually with a slot in the top for keeping money at home) the coin bank was empty

[a]Context bag: bank, money, interest
[b]Sense bag: bank, money from Table (3)

3.2 Walker Algorithm

Walker is a Thesaurus-Based approach [11]. For a target word, thesaurus category is formed using possible sense. Clue words are selected from the sentence. It categorizes clue words into different senses with the help of WordNet. If clue word is overlapping with the sense ontology, then sense score is incremented by +1. The sense having higher score will be selected in a correct sense. Consider Case 2 and Case 3 from Table (1), i.e., Case 2: The money in this bank fetches an interest of 8% per annum.

Case 3: They were riding side by side down the south bank of the creek, to develop interest and get command on riding in slimy land.

Table (4) says ambiguity of word bank is resolved by selecting high score Sense 1, i.e., Finance. Table (5) gives equal score for both sense; thus, ambiguity of Case 3 remains.

Table 4 Case 2: Walker's algorithm Step 2

Clue words from Case 2	Sense 1: Finance	Sense 2: Location
Money	+1	0
Interest	+1	0
Fetch	0	0
Annum	+1	0
Total	3	0

Table 5 Case 3: Walker's algorithm Step 2

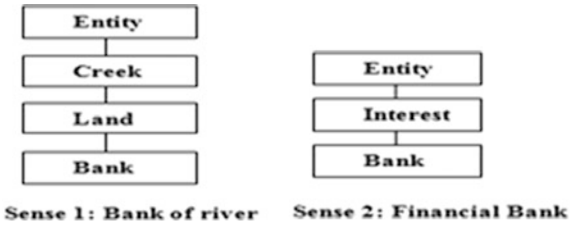
Clue words from Case 3	Sense 1: Finance	Sense 2: River/location
Land	0	+1
Interest	+1	0
Total	1	1

3.3 Conceptual Density Algorithm

Conceptual Density generates hyponymy with the help of WordNet [12]. Working: Senses are retrieved for an ambiguous word from WordNet. For each sense, the hierarchy is generated by considering relatedness. Relatedness is measured in terms of conceptual distance (CD) [15]. The concept with highest CD is selected.

$$\mathrm{CD}(C, M) = \frac{\sum_{i=0}^{m-1} (\mathrm{nhyp}) i^{0.2}}{\text{decendence of c}} \tag{1}$$

Fig. 1 Different hierarchies for the word Bank



where C = concept, nhyp = mean no. of hyponyms, and M = no. of sense of the word. Consider Case 3 and Case 4 from Table (1), i.e., Case 3: They were riding side by side down the south **bank** of the creek, to develop interest and get command on riding in slimy land. Case 4: The actors were awesome in **play,** group members delivered a message of team spirit.

With the help of hierarchy given in Fig. 1, CD of Sense 1 = 1.24 and Sense 2 = 1; thus, high score Sense 1, i.e., Bank of River is selected, solved the ambiguity of Case 3. From Fig. 2, CD of Sense 1 = Sense 2 = 1; thus, ambiguity of Case 4 remains.

From subsequent study of cases with WSD techniques, we compared the three WSD methods in Sect. 4.

4 Comparative Analysis

From Table (6) comparative analysis, we find that Lesk can handle cases which contain polysemous words and less ambiguous context. The cases that we handled by Lesk can be handled by Walker as it is based on thesaurus. The cases handled by Walker are handled by Conceptual Density in a better way as it is extension of Walker. Still Conceptual Density has some limitations like if cases have same number of clues or hyponym then it gives equal CD value and ambiguity remains. To disambiguate such cases, we proposed a combined solution in Sect. 5.

Fig. 2 Different hierarchies for the word Play

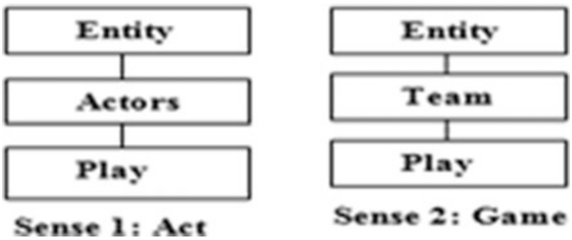


Table 6 Comparative analysis of WSD techniques

Technique	Basic overview	Dataset	Accuracy	Pros	Cons
1. Lesk approach	Looks for the overlapping word from context bag and sense bag to find the correct sense	First 2 examples from 1	The ambiguity of 1 context out of 4	Gives good performance when a context has less number of ambiguous words and polysemous words	If words in a context bag have overlapping senses in more than one sense bag, then it fails
2. Walker's algorithm	Use thesaurus to find the correct sense category by calculating score	First 3 examples from 1	Resolve the ambiguity of 2 contexts out of 4	Resolve the cons of Lesk and considers both the polysemous and synonymy words	Looks for overlapping words from the context bag and does not consider hyponym
3. WSD using Conceptual Density	It selects the sense based on the relatedness of that word sense to the context by measuring CD	All the examples from 1	Resolve the ambiguity of all the contexts	1. Considers hyponym to generate sense tree 2. Does not require tagged corpus and resolve the cons of Walker	Senses have equal number of clues or hyponym; it gives equal CD value

5 Proposed Method

From all the cases, we have studied and understood that Conceptual Density is the extension of Walker's algorithm; thus, our proposed method is concatenation of Lesk and Conceptual Density which increases the quantifiability of cases by conquering the limitations of each algorithm. Consider Case 4: The actors were awesome in **play,** group members delivered a message of team spirit.

Working: Step 1: Create context bag by considering target word, collocating word, and all the clue words from the sentence. Context bag: actors, play, group, team, team spirit. Step 2: Select the senses for target word from WordNet. Check for overlapping words and add those in the sense bag. Step 3: Now retrieve the senses for remaining words present in context bag. Update the sense bag with overlapping words. Sense bag: actors, play, group, team, and team spirit. Step 4: Generate hypernymy based on relatedness of words from sense bag and context bag for each sense. Step 5: Find Conceptual Density, i.e., CD value for each sense. Step 6: The sense having higher CD value will be selected as correct sense.

From Fig. 3, Sense 1 having CD value = 1.34 and Sense 2 = 1.14; thus, our method has correctly disambiguated the word play as act, i.e., Sense 1 is selected.

Fig. 4 describes the working system of WSD when individual method fails to solve ambiguity of words. When Lesk fails, then Conceptual Density is able to

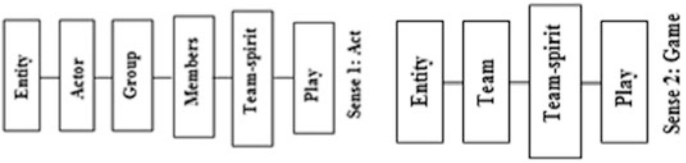


Fig. 3 Different hierarchies for the word Play [13]

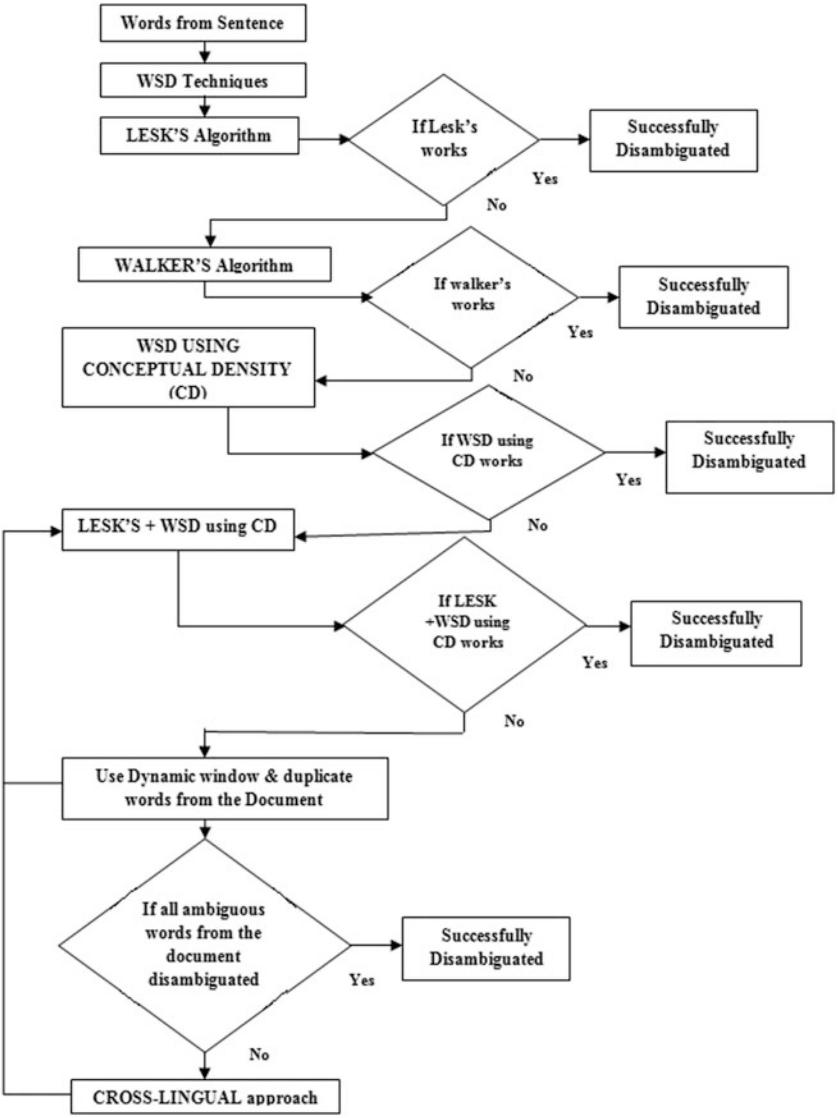


Fig. 4 Flow diagram for WSD

solve the ambiguity. When all the algorithms fail, then our proposed method, i.e., Lesk's + Conceptual Density will work. To work on document, we can consider dynamic context window. Still if ambiguity remains, then we can go for cross-lingual.

6 Conclusion

NLP is the trendy topic and WSD is a part of NLP. Many things are yet to be explored in WSD domain. We performed comparative analysis of KB algorithms using our dataset to understand the strength and weakness of each algorithm. Lesk performs well for polysemous words, but if context have more than one sense bag then it fails. Walker solves the cases handled by Lesk using thesaurus approach, but it does not consider hyponym. Conceptual Density fails to disambiguate when senses give same CD value; such complications are handled by proposed method.

The individual thinks different and based on thinking, sentences are formed. So it may happen that our proposed method may not give results to some of the cases, but the method accurately disambiguates the cases from our dataset.

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Reversible Data Hiding by Utilizing AES Encryption and LZW Compression

Akshay Kumar Joshi and Sanjay Sharma

Abstract The Increase of digital media transfer made the modification of the image very easy. So one major issue of proprietorship is raised, as copying and transferring are very soft practices. Here this paper has to resolve proprietorship problem by embedding the digital data with encryption. In this work, embedding of data is done applying the LZW algorithm. Then robustness is provided by using the AES algorithm. Finally by using spatial technique, embedding of digital data is done in encrypted image. Experiment is done on real dataset image. Evaluation parameter values show that proposed work has maintained the SNR and PSNR values with high robustness of the data.

Keywords Color format · Digital watermarking · Frequency domain LSB

1 Introduction

As Internet facility is growing drastically, users are attracted by various service providers day by day. Some of them are online shops, digital marketing, social network, registrations, etc. This easy access lead to violate the proprietorship easily, as users can stolen others work and make digital print with their name. But this technology gives rise to new problem of piracy or in other words proprietary get easily stolen. In order to overcome this issue, many techniques were suggested and proprietary of the digital data is preserved [1, 2]. So to overcome this, different techniques are used for preserving the proprietary of the owner. Out of many

A. K. Joshi · S. Sharma (✉)
Computer Science & Engineering, OIST, RGPV, Bhopal, Madhya Pradesh, India
e-mail: sanjaysharmaemail@gmail.com

A. K. Joshi
e-mail: Joshia253@gmail.com

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approaches, digital data embedding which is also known as digital watermarking plays an important role. In order to provide proprietorship of the data owner, digital data was embedded into the image, video, or data as in [3, 4]. As some of the available software can remove those watermark or change to new one, invisible copyright was highly required.

In few of approaches, inclusion of third party was done by most of the researcher where secret message is held by one while carrier signal is held by other [5, 6]. Here embedding is done in fix part of the image where information can be hidden. Similarly at the receiver side, extraction of the digital data from the received image is done.

2 Related Work

In [4], digital data was embedded in the selected portion of the image where edge region was select for embedding. Here paper has developed a new approach of finding pixel-representing edges. By utilizing Dam and BCV approach, image was segmented into edge and non-edge regions. The drawback of this work that it was done on binary image, means data hiding can be done by this method for binary image. This leads to another imitation that is embedding of data should be in binary form. With above issues, image was highly robust against different type of attacks like filter, noise.

In [7], author has extended the work done in [4] by increasing the overall capacity of the embedding data space. Here in Dam and BCV technique, author starts looking at the surrounding of the edge region pixel. So overall capacity of the data hiding was drastically increased in this paper. Here even after embedding more data, embedded image was robust against different type of attack as well.

In [8], self-embedding concept was proposed by the authors where image itself generates the data for embedding while in order to protect data in network fountain, codes were developed for lost packed regeneration. As in fountain codes more than one required packet format was send in the network, which helps in regenerating the missed or corrupt data packets. This work has great limitation was that after embedding of data the image is not available in original format before extraction. So main purpose of this work is transferring the data packet from sender to receiver only.

In [9] concept of image watermark self generation was used, in this image is utilized in this way so it can generate its own watermark information. This paper focuses on the image development where spatial area was utilized for inserting the digital data as a carrier object. At the same time, similar information is required at the receiver which helps in finding the digital data back. But to cover both intra-codeblock and inter-codeblock method is utilized.

In [10], author adopts KSVD technique for embedding the digital data. Hereby utilizing the DES algorithm, encryption of the digital data was done. Here one dictionary was maintained at the receiver and transmitter end for reducing the size of carrier signal. In this work, after embedding some vacant space between the data was utilized for the data embedding. This work gives freedom for extraction of image or digital data or both in any order.

3 Proposed Methodology

Center of attention in this work was to hide digital data in the image. Whole work was done in two steps of embedding digital data and extraction of digital data. In proposed work, the color image is first divided into three different color channels, which are Red, Green, and Blue. Each color channel is encrypted and compressed in row-wise fashion by using AES encryption and LZW compression. Secret information which is hidden into the cover image is first encrypted and then embedded into the compressed encrypted image (Fig. 1).

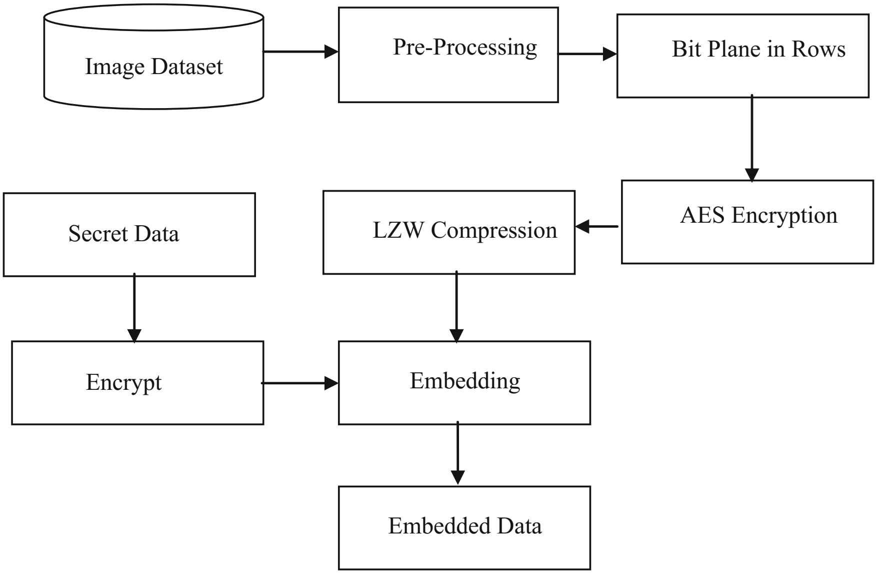

Fig. 1 Block diagram of proposed work

3.1 Preprocessing

Collection of different number on fixed range represents a type of image format. So reading pixel values of that image matrix is done in this step of the proposed model [11, 12]. Such that for the grayscale format, it is in the range of 0–255.

3.2 Bit Plane in Rows

In this step, all the color channels Red, Green, and Blue are divided into row-wise as per the matrix. Now each row is converted into its equivalent binary value. As single vector was created in this work for each row, pixel value of each color channel is consecutive to the pixel value of same row in the same color channel for each row in all three channels.

3.3 AES

In this encryption algorithm, four stages are performed in each round. These steps are common for both encryption as well as decryption algorithm where decryption algorithm is inverse of the encryption one. Now common step for all kind of data is that each data needs to be converted into 16 element set of input. Here each input needs to be in integer data type. So each round consists of following four stages.

- Byte substitution (one S-box used on every byte)
- Shift rows (permute bytes between groups/columns)
- Mix columns (subs using matrix multiply of groups)
- Add round key (XOR state with key material).

3.4 LZW Compression

In this technique trick is that string-to-codeword mapping is created dynamically by the encoder also recreated dynamically at the decoder no need to pass the code table to decoder. It is a lossless compression algorithm degree of compression hard to predict depends on data, but gets better as codeword table contains more strings.

step 1. Initialize table with single character strings
step 2. STRING = first input character
step 3. WHILE not end of input stream

a. CHARACTER = next input character
b. IF STRING + CHARACTER is in the string table

    i. STRING = STRING + CHARACTER

c. ELSE

    i. Output the code for STRING
    ii. Add STRING + CHARACTER to the string table
    iii. STRING = CHARACTER

step 4. END WHILE
step 5. Output code for string

3.5 Embedding

Row is first encrypted because of the AES encryption and then compressed by LZW compression, and this process of compression compresses the row and provides space to accommodate the secret data in that place. At the stage of embedding, we take the compressed row to hide the secret data and used as separator.

3.6 Extraction Steps

In this extraction steps, receiver can extract data and image by using above block diagram (Fig. 2).

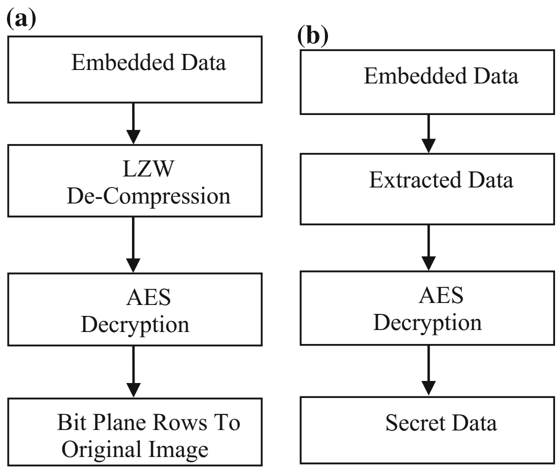

Fig. 2 Block diagram of data extraction at receiver end, where **a** represents extraction of original image while **b** represents extraction of original data

3.7 Extraction of Image

Here first LZW compressed data was extracted from the packet. In order to differentiate image values and hiding data in the packet, zero is used as a separator. So values before 0 are considered as the image data. Now this image data is first decompressed by LZW algorithm. So resultant series is row of cover image. In similar fashion, all the rows are extracted from the compressed data files. Now all extracted value in form of row is decrypted by AES algorithm having same key values. In this way, all the planes in form of rows are combined to make single image for output of the image.

3.8 Extraction of Data

This section of proposed work is for data extraction at receiver side. Here first embedded data was extracted from the packet. In order to differentiate image values and hiding data in the packet, zero is used as a separator. So values after 0 are considered as the image data. Now all extracted value is decrypted by AES algorithm having same key values. Now ASCII values are converted into corresponding characters.

3.9 Algorithm

Input: CI (Cover Image), HD (Hiding Data)

Output: EP (Embedded Packet)

- CI ← Preprocessing(CI)
- Loop 1:3 // for Each C (Channel) {Red, Green, Blue}
- C ← CI
- Loop 1:n // n : number of row in channel C
- R ← C[n]
- ER ← AES_Encryption(R) // ER: Encrypted Row
- CR ← LZW_Compression(ER) // CR: Compressed Row
- P ← CR // P packet
- EndLoop
- EndLoop
- While P is blank AND count <=:m // m number of characters in hiding data
- EHD ← AES encryption(HD) // EHD : Encrypted hiding data
- EP ← EHD[count] // EP : Embedded Packet
- count = count + 1
- EndWhile

4 Experiment and Results

This section presents the experimental evaluation of the proposed work. All algorithms and utility measures were implemented using the MATLAB tool. The tests were performed on 2.27 GHz Intel Core i3 machine, equipped with 4 GB of RAM, and running under Windows 7 Professional.

4.1 Dataset

Experiment is done on the standard images such as Mandrilla, Lena, Tree. These are standard images which are derived from http://sipi.usc.edu/database/?volume=misc. System is tested on day-to-day images.

4.2 Results

From Table 1, it is obtained that under ideal condition, proposed work is better as compared to the previous work in [10] under PSNR evaluation parameters. As compression algorithm has regenerated images in color format only, so this parameter is high as compared to the previous value.

From Table 2, it is obtained that under ideal condition, proposed work is better as compared to the previous work in [10] under SNR evaluation parameters. As compression algorithm has regenerated images in color format only, so this parameter is high as compared to the previous value.

Table 1 PSNR-based comparison between proposed and previous work

PSNR-based comparison		
Images	Proposed work	Previous work
Mandrilla	35.5347	9.3
Tree	34.3451	10.425
Lena	32.09	9.2113

Table 2 SNR-based comparison between proposed and previous work

SNR-based comparison		
Images	Proposed work	Previous work
Mandrilla	16.3864	2.46871
Tree	16.8352	2.4174
Lena	16.293	2.63165

Table 3 Execution time-based comparison between proposed and previous work

Execution time comparison		
Images	Proposed work	Previous work
Mandrilla	44.6171	62.8
Tree	50.7853	65.5632
Lena	38.6011	68.263

Table 4 Embedding capacity-based comparison between proposed and previous work

Embedding capacity comparison		
Images	Proposed work	Previous work
Mandrilla	5120	6413
Tree	5120	6042
Lena	5120	6219

From Table 3, it is obtained that under ideal condition, proposed work is better as compared to the previous work in [10] under execution time evaluation parameters. As proposed work regenerates dictionary from the same data, so execution time for the same is less as compared to the previous work.

From Table 4, it is obtained that under ideal condition, proposed work is better as compared to the previous work in [10] under hiding position evaluation parameters. As proposed work regenerates dictionary from the same data, so execution time for the same is less as compared to the previous work.

5 Conclusion

Here proposed work has efficiently embedded data in the carrier image while security of the carrier is also maintained by encrypting using AES algorithm. Embedding is done in reserved positions which are obtained by LZW compression. Proposed algorithm will recover or reverse complete data at receiver end. Results show that the proposed work is producing the results which maintain the image quality as well as robustness. In future, work can be improved for other attacks such as geometry of image.

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Microstrip Antenna Array Design for Generalized Spatial Modulation—Multiple Input Multiple Output (GSM-MIMO) Applications

Raj Rajeshwari Lunawat, Debashis Adhikari and Priyanka Tupe Waghmare

Abstract An array of patch antenna aims at improving the gain of the antenna as well as improves the radiation in different directions. By selecting two antennas out of four in 4 * 1 array, the power can be increased to a great extent, and by this switching technique of the antenna in the array, the transmission of bits is done in an efficient way. In this, the 4 * 1 array of rectangular microstrip antenna along with single RMSA is designed and simulated to get proper gain and radiation pattern at around 2.54 GHz frequency.

Keywords Switching · Patch antenna · RMSA · Array · 4 * 1 array Ansys HFSS · Improved gain and bandwidth

1 Introduction

Spatial modulation is a technique in which selection of single antenna is done from a group of transmitting antennas in order to transmit the information bits. This increases the system efficiency but has error probability issues. To overcome this issue, Generalized Spatial Modulation (GSM) came into existence. In GSM, a combination of two or more antennas is selected at a time to transmit the data. This concept helps to minimize the error probability, and the system efficiency is also increased. Let us consider that the number of transmitting antennas is N_t and the number of active antenna chosen to transmit the data at any instant of time is N_p. Therefore, the available number of combinations to select N_p antennas out of N_t will be given by $C_{N_p}^{N_t}$, where C is the symbol used for combination.

R. R. Lunawat (✉) · P. T. Waghmare
Department of Electronics & Telecommunications,
Symbiosis Institute of Technology, Pune, India
e-mail: raj.lunawat@sitpune.edu.in

D. Adhikari
Department of Electronics & Telecommunications,
MIT Academy of Engineering, Pune, India

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But the combination used will be in the power of two, so the permitted combination will be $N = 2^{\left\lfloor \log_2 C_{N_p}^{N_t} \right\rfloor}$. The information bits through first part of the system model is given as $l_1 = \left\lfloor \log_2 C_{N_p}^{N_t} \right\rfloor$, while the second part is $l_2 = N_p \log_2 M$, where M is the set of constellation points. Hence, the transmitted part will be addition of both the parts $L = l_1 + l_2 = \left\lfloor \log_2 C_{N_p}^{N_t} \right\rfloor + N_p \log_2 M$. For example, if $N_t = 4$ and $N_p = 2$, then the total number of combinations will be 6, but the acceptable combinations will be only 4. The length of information bits will be $l_1 = 2$ bits and $l_2 = 4$ bits for $M = 4$ which makes $L = 6$ bits [1]. But in this paper, all possible six antenna combinations have been simulated.

In this paper, the design of an array with the design of each possible combination of selecting two antennas out of four in 4 * 1 array along with the simulation and obtained results is shown. The array is designed by selecting proper parameters of the patch antenna. The design and analysis are done using Ansys HFSS software. The design is based on the selection of proper dimensions of the substrate, ground plane, patch, cut-out, feed line and the source required for feeding the antenna.

2 Methodology and Software Used

Ansys HFSS software provides best way to model the patch antenna and helps to analyse the radiation pattern, S-Parameters, polar plot, etc., very efficiently. The steps followed for the design of the antenna are to first model the design based on the parameters listed below [2]. For designing of the patch antenna, we must know about the dielectric constant ε_r, operating frequency f_0 and height of the substrate h. After selecting the above parameters as per the requirement for the desired application, the other necessary parameters for the design of patch antenna can be selected using the equations stated as under [3].

A. Width of the patch [4]:

$$\mathrm{W} = \frac{C_0}{f_0}\sqrt{\frac{2}{\varepsilon_r + 1}} \tag{1}$$

C_0 = speed of the light; f_0 = operating frequency; ε_r = effective dielectric constant of substrate.

B. Length of the patch [5]:

$$L_e = L + 2\Delta L = \frac{\lambda_0}{2\sqrt{\varepsilon_0}} \tag{2}$$

$\Delta L = h/\sqrt{\varepsilon_e}$; λ_0 = wavelength; ε_0 = dielectric constant.

C. Effective dielectric constant of the patch [4]:

$$\varepsilon_e = \left(\frac{\varepsilon_r + 1}{2}\right)\left(\frac{\varepsilon_r - 1}{2}\right)\left(\frac{1 + 10h}{W}\right)^{-1/2} \tag{3}$$

h = height of substrate.

D. Length of the ground plane [5]:

$$L_g = 6h + L \tag{4}$$

E. Width of the ground plane [5]:

$$W_g = 6h + W \tag{5}$$

F. Length of the feed = decided on the basis of length to be elongated from the patch to the edge of the substrate [6]
G. Width of the feed selected on the basis of characteristic imp of transmission line (50Ω).

These basic equations stated above helps in deciding all the basic dimensions of the single patch antenna. The design and analysis of single patch antenna help in the implementation of the patch antenna array with all the known and calculated dimensions. The antenna parameters are thus studied obtaining the simulated results. The design is done using Ansys HFSS 2015.

2.1 *Design Considerations*

Knowing all the above parameters and doing calculations, the required design of patch antenna at 2.5-GHz frequency is made and it is simulated to obtain the results. This design is then used to further move towards the design of 4 * 1 patch antenna array. Table 1 shows all the dimensions calculated and used in the design of the single patch antenna and patch antenna array in the design (shown in the simulated results section). The required operating frequency is f_o = 2.54 GHz, but these results after simulation using this operating frequency are obtained at less than 2.54 GHz.

The above calculations are used to implement single patch antenna and 4 * 1 patch antenna array. The array needs to have proper dimensions and results, so that the switching circuit can be implemented in that array to have the ultimate aim accomplished.

Table 1 Dimensions for single patch and patch antenna array

Calculated patch dimensions	Single patch	4 * 1 array
Dielectric substrate	Rogers RT/duroid 5880 (2.2)	FR4 Epoxy (4.4)
Length of substrate (L_s) (mm)	53.63	82.11
Width of substrate (W_s) (mm)	61.89	657.68
Height of substrate (h) (mm)	2.54	2.54
Length of patch (L_P) (mm)	38.39	27.57
Width of patch (W_p) (mm)	46.65	55.91
Length of ground plane (mm)	55.65	82.11
Width of ground plane (mm)	61.89	657.68
Length of feed (L_f)	7.62 mm	As per required elongations to reach till the edge
Width of feed (W_f) (mm)	1.885	1.885
Length of source (L) (mm)	1.885	1.885
Width of source (h) (mm)	2.54	2.54
Length of the air-box (L_b) (mm)	70	100
Length of the air-box (W_b) (mm)	85	460
Height of the air-box (H_t) (mm)	15	15
Gap between the antennas in the array (G)		59.5 mm ($\lambda/2$ between each antenna)

3 Simulated Design Details with the Results

Ansys HFSS software is used to design the array of 4 * 1 patch antenna array, and the design is simulated to obtain the results. The array is then implemented by selecting two antennas out of four at a time. Thus, it will have six possible combinations of selection of two antennas out of four in the array. Each possible combination is simulated. The results are studied in order to have the implementation of switching circuit in the array as the results of each combination are known well.

3.1 Single Patch Antenna Design with Results

The single patch antenna is designed using the parameters mentioned in Table 1. The effect of dimensions of the patch by changing is observed carefully on the simulated results. This is the first step towards to design the array and getting the proper knowledge about the parameters of the patch antenna to be analysed.

The above result in Fig. 1 shows that the S-Parameter plot is at −25 dB at 2.5 GHz, and bandwidth is shown using the marker points $m1$ and $m2$ which is around 900 MHz. The 3D-polar plot in Fig. 2 shows maximum gain of about 5 dB (Fig. 3).

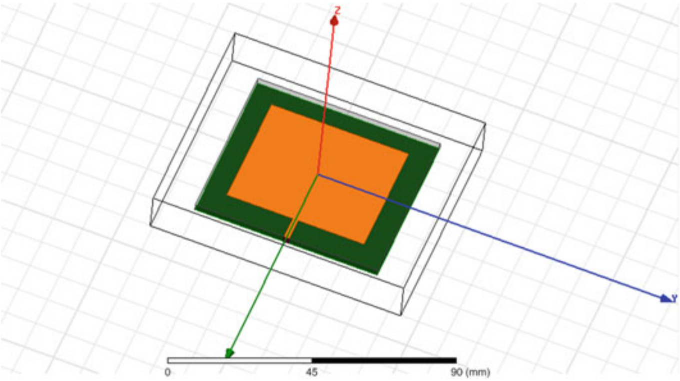

Fig. 1 Single patch antenna design

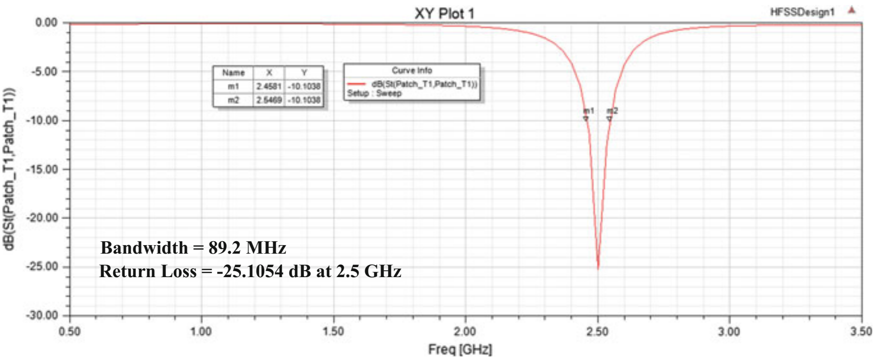

Fig. 2 Single patch antenna *S*-Parameter plot

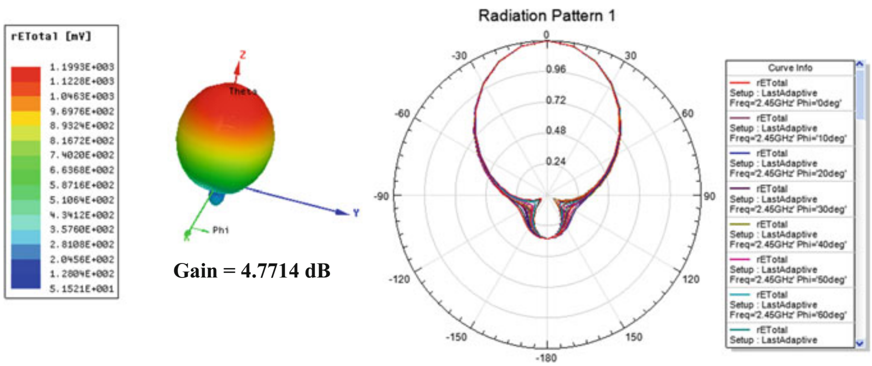

Fig. 3 Single patch antenna 3D-polar plot and radiation pattern plot

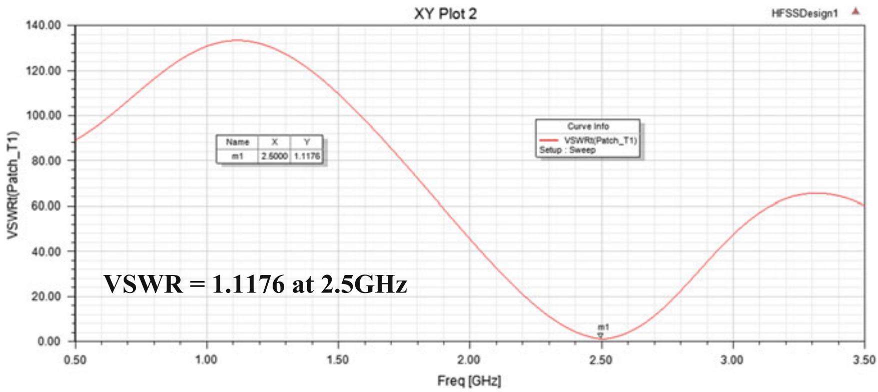

Fig. 4 Single patch antenna VSWR plot

The VSWR plot shown in Fig. 4 shows that the VSWR of the simulated antenna is 1.1176.

*3.2 4 * 1 Array Patch Antenna Design with Results*

The 4 * 1 array is implemented on the basis of single patch antenna designed, and dimensions are calculated as shown in Table 1. The array is basically designed to get improved antenna parameters. The array results are simulated and analysed so that it can be proceeded further for implementation of the switching circuit. The design of 4 * 1 patch antenna array simulated results is shown below.

The above result in Fig. 5 shows that the *S*-Parameter plot is at −46.39 dB and the bandwidth is shown using the marker *m*1 and *m*2 which is around 950 MHz.

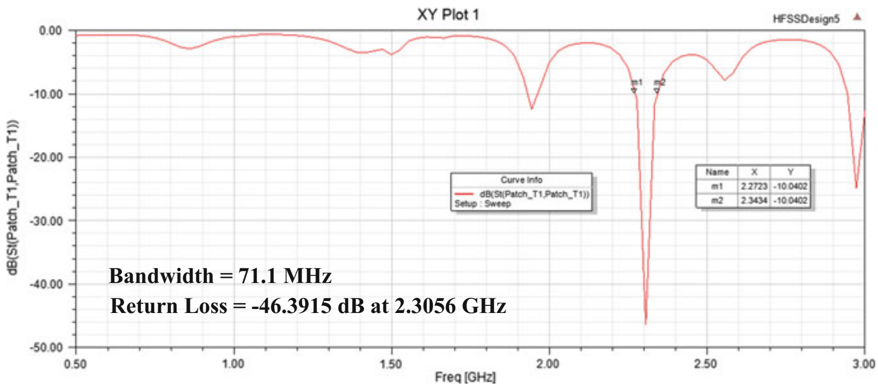

Fig. 5 4 * 1 array patch antenna *S*-Parameter plot

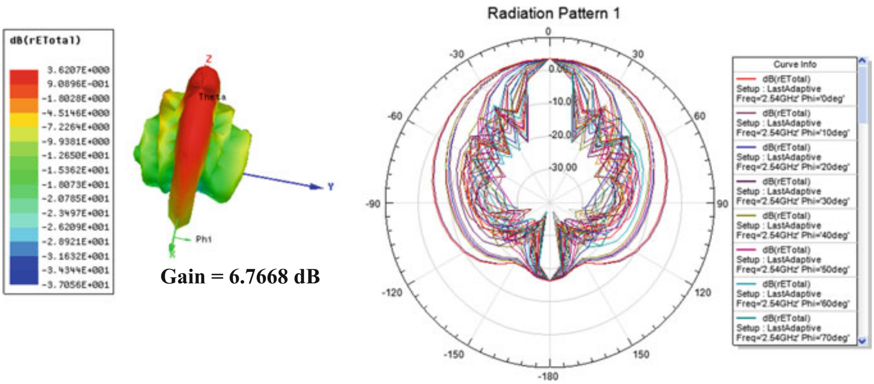

Fig. 6 4 * 1 array patch antenna 3D-polar plot and radiation pattern plot

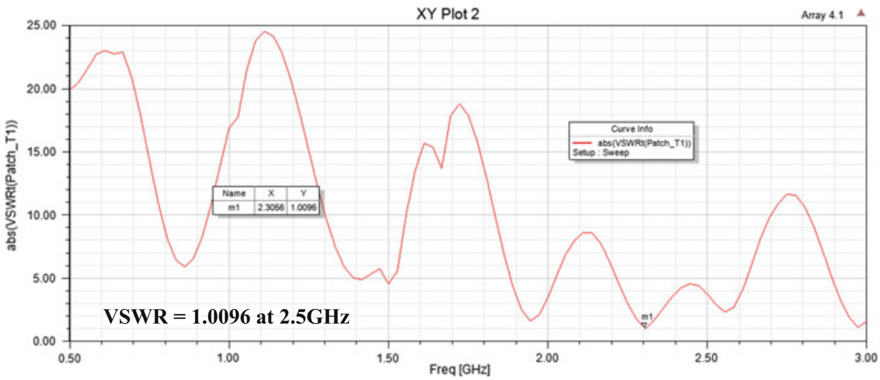

Fig. 7 4 * 1 array patch antenna VSWR plot

The 3D-polar plot in Fig. 6 shows maximum gain of about 9 dB. The VSWR plot in Fig. 7 shows that the VSWR of the deigned antenna is 1.0096.

4 Combination of Antenna Selection Simulated Results

The 4 * 1 array patch antenna is then used for the selecting of two antennas at a time out of four with all the possible combinations, viz. (1,2), (1,3), (1,4), (2,3), (2,4) and (3,4) antennas out of all four antennas in the array. The implemented designs of each combination are simulated, and simulated results are shown in Figs. 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19.

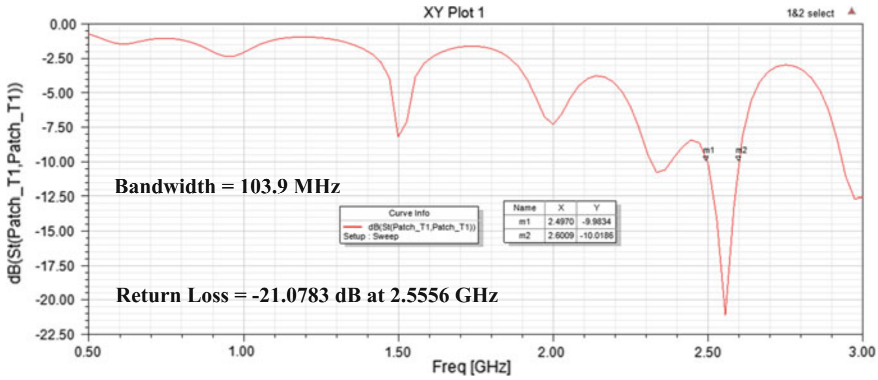

Fig. 8 1&2 antennas selected in 4 * 1 array patch antenna *S*-Parameter plot

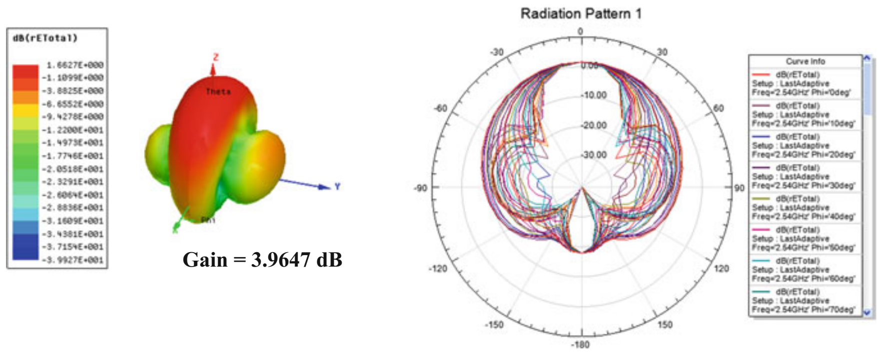

Fig. 9 1&2 antennas selected in 4 * 1 array patch antenna 3D-polar plot & radiation pattern plot

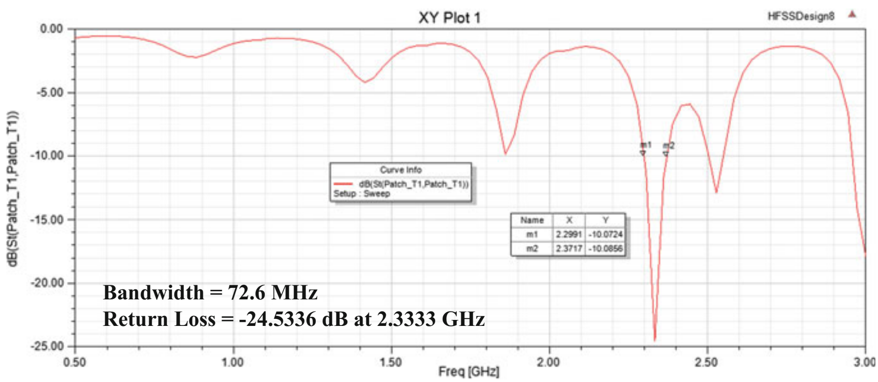

Fig. 10 1&3 antennas selected in 4 * 1 array patch antenna *S*-Parameter plot

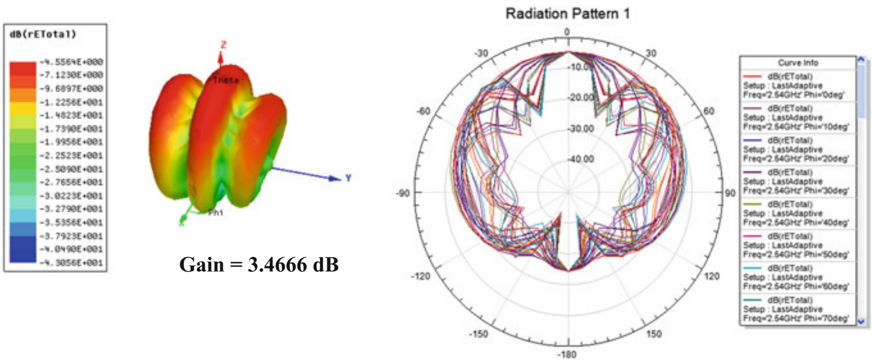

Fig. 11 1&3 antennas selected in 4 * 1 array patch antenna 3D-polar plot and radiation pattern plot

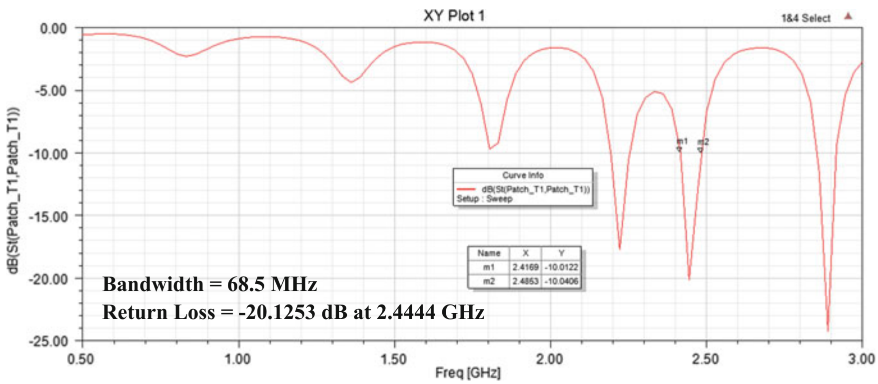

Fig. 12 1&4 antennas selected in 4 * 1 array patch antenna *S*-Parameter plot

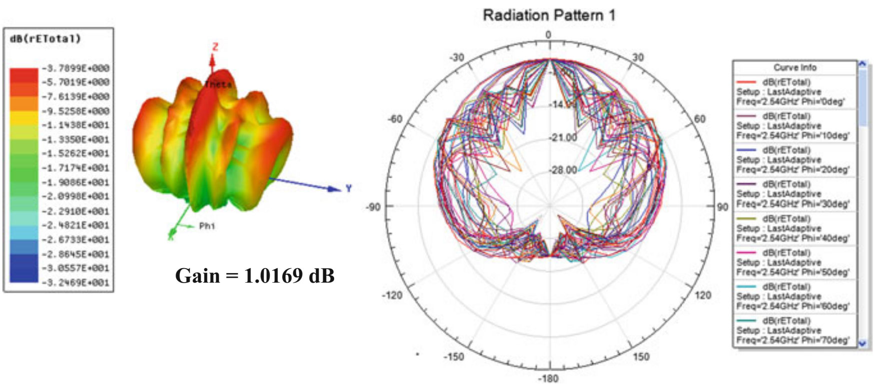

Fig. 13 1&4 antennas selected in 4 * 1 array patch antenna 3D-polar plot and radiation pattern plot

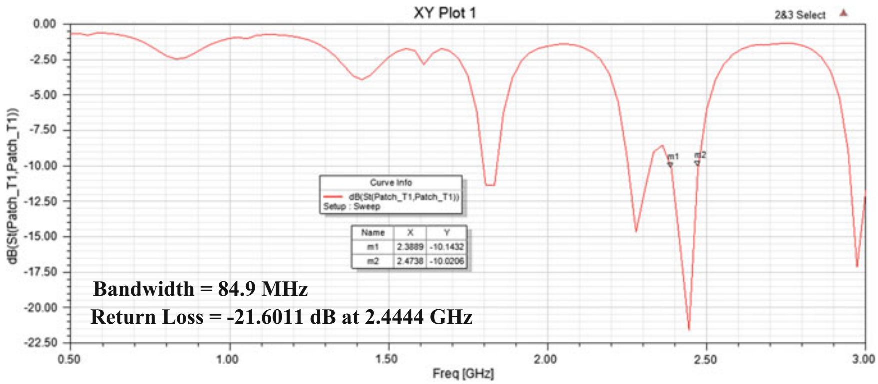

Fig. 14 2&3 antennas selected in 4 * 1 array patch antenna *S*-Parameter plot

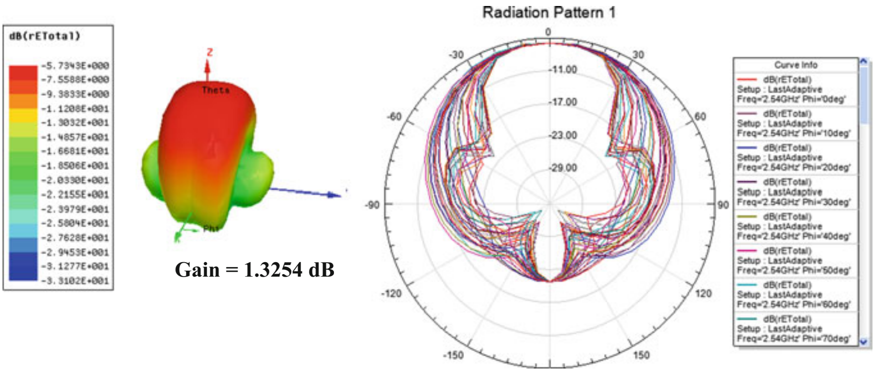

Fig. 15 2&3 antennas selected in 4 * 1 array patch antenna 3D-polar plot and radiation pattern plot

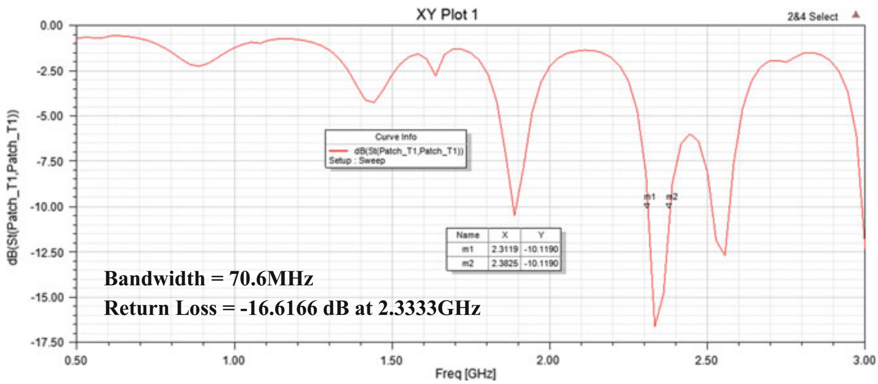

Fig. 16 2&4 antennas selected in 4 * 1 array patch antenna *S*-Parameter plot

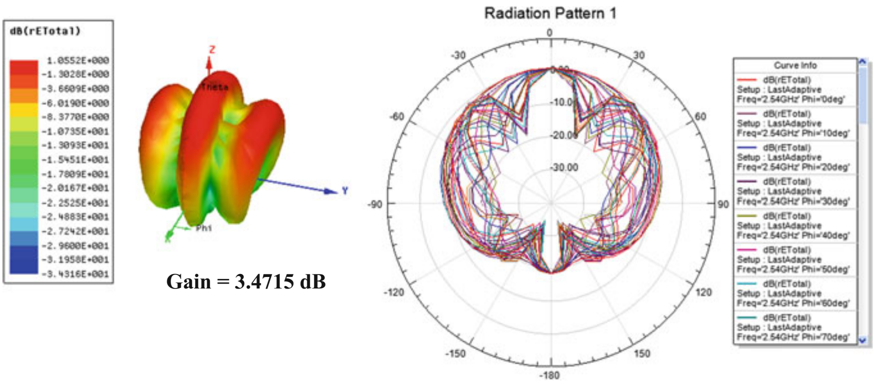

Fig. 17 2&4 antennas selected in 4 * 1 array patch antenna 3D-polar plot and radiation pattern plot

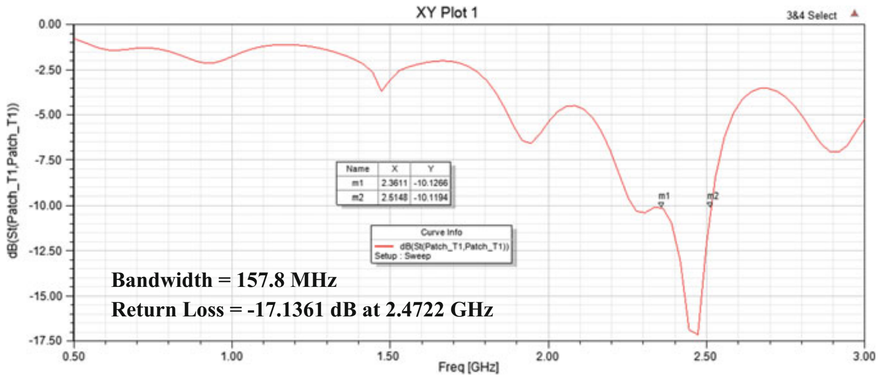

Fig. 18 3&4 antennas selected in 4 * 1 array patch antenna *S*-Parameter plot

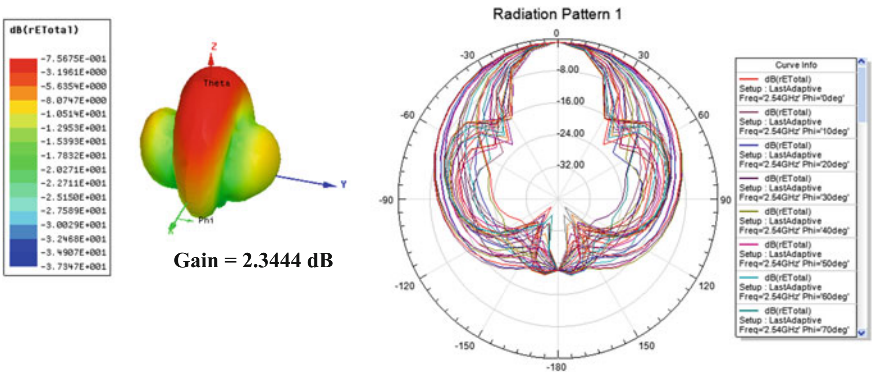

Fig. 19 3&4 antennas selected in 4 * 1 array patch antenna 3D-polar plot and radiation pattern plot

All the above implemented design gives good results in gain, bandwidth and efficiency as per the theoretical standard results [7]. The switch can now be implemented in the array in order to select two antennas out of four in the array. The above design for the 4 * 1 patch antenna array as shown in Fig. 5 is chosen in this way so as to have equal length for the division of power from the source even when two antennas out of four are selected randomly at a time.

The design of two antennas selection out of four in the 4 * 1 patch antenna array is done in order to study the changes on antenna parameters when two antennas out of four will be selected with the help of the implemented switch.

5 Conclusion

The switching technique to be implemented in the array will give the efficient transfer of bits, and thus the selection of two antennas out of four in the array is simulated. The simulated results are studied to implement the switching circuit in the 4 * 1 patch antenna array. When the switching of antenna occurs, two antennas are selected randomly out of four; however, the design is for four antennas working simultaneously in 4 * 1 patch antenna array. For two antennas to be selected, the proper switching circuit network needs to be implemented in the array. The switching circuit must be implemented such that the design gives required results of *S*-Parameter, radiation pattern and VSWR even if two antennas are selected randomly at a time.

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Wireless Assistive Communication System for Speech Impaired Person

Vaijayanti Gajul, Pranita Sharangdhar, Shanta Shinde and Smita S. Pawar

Abstract Speech is a necessary element for every human being, importance of which is summed up into two: expression and conception. People suffering from speech disability are apprehensive while communicating with normal people and even to involve in community interaction. This paper proposes development of a wearable assistive vocalizer, designed as two distinct modules communicating wirelessly, with Gesture Sensing Module placed on wrist of person and speech synthesizing module provided with portability to either mount around waist or connect to any audio device. Every gesture is assigned one word message that is transmitted employing Amplitude Shift keying modulation at 433.92 MHz radio frequency. The error probability for receiving multiple messages that were transmitted consecutively is plotted to analyze wireless response of system.

Keywords MEMS accelerometer · Flex sensor · Manchester encoding

1 Introduction

Assistive Technology came into existence with the aspiration of developing devices to compensate for physical disability and improve quality of life [1]. Augmentative and alternative communication (AAC) devices are special assistive devices designed for speech disabled people for generating voice. The major aspect of implementation of idea presented in paper is to enhance the AAC technology by

V. Gajul (✉) · P. Sharangdhar · S. Shinde · S. S. Pawar
MIT Academy of Engineering, Pune, India
e-mail: vaijayantigajul@gmail.com

P. Sharangdhar
e-mail: pranitasharangdhar13@gmail.com

S. Shinde
e-mail: shantashinde@gmail.com

S. S. Pawar
e-mail: sspawar@entc.maepune.ac.in

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extending features like modularity (wireless connectivity between modules), and portability which will raise comfort of use. Data Glove is used which enables us to practice sign language without being connected to a PC [2].

Oral communication is most effective way of communicating one's ideas, emotions and thoughts. Speech disability includes both type of people who are completely and partially aphasiac. A person may or may not be speech impaired by birth. Elderly population can become susceptible to speech disorders by disease of larynx, or as a side effect of stroke or cancer [3].

1.1 Speech Disability Statistics

See Table 1.

1.2 A Survey for Gesture Recognition Techniques

The goal was to study different technologies involved in recognizing physical human gestures since the method of communication adopted by deaf-dumb people to interact with each other is Sign Language that employs use of gestures made by hands, face and body. Sign Language practiced by speech disabled people varies in different countries. India being culturally diverse country, the gestures vary up to large extent even within a single state. This raised a crucial need for development of a common sign language across the country which led to establishment of Indian Sign Language Dictionary [4]. Technologies that employ recognition of gestures are broadly classified into two types: Vision based and Sensor based [5].

The drawback of vision based solution is the level of complexity of algorithms implemented in capturing a movement. MicroElectroMechanical Sensor is a sensing technology consisting of electronic parts (such as capacitors, diodes etc.) and mechanical parts (such as mass-spring system, strain gauge) of size of order of microns which are capable of movement with or without application of external force [6]. MEMS sensors can be easily placed on gesture formulating human body parts like hand and arm. Bending of fingers possess significant role in performing gestures by hands. Flex sensor is one of the examples of bend sensors structured in thin and elongated design and hence can be attached along the length of fingers to

Table 1 Disability statistics 2011 Indian Census [15]

Disability	Total	Male	Female
Total	26,810,557	14,986,202	11,824,355
In speech	1,998,535	1,122,896	875,639

sense bending motion. This project takes into consideration the gestures performed by hands of person, thus a combination of accelerometer and flex sensors is implemented.

2 System Model

The system is designed in two communication modules: a transmitter module and a receiver module. Transmitter section is comprised of Data Sensing Module, Data Processing Module and Data transmitting Module, while the Data Processing Module in Receiver section is incorporated with a Data Receiver and Speech Synthesizer. If the two modules would be integrated as one complete device, the interaction of user would be restricted only up to one-to-one communication. The modularity of the system provides the flexibility of community interaction by means of coupling the receiver section to suitable audio amplifier.

2.1 Block Diagram

The system model as shown in Fig. 1 consists a Data Sensing Module that captures the gesture performed by hand movements of the person which is then processed by a microcontroller that allocates a message for corresponding gesture which is then wirelessly communicated to receiver section where the message is given voice. Data sensing module is basically a data glove which is to be worn by the person performing gestures, the transmitter module is placed on the wrist connected to data glove by means of wires, while the receiver module is placed on a belt which can be worn at waist.

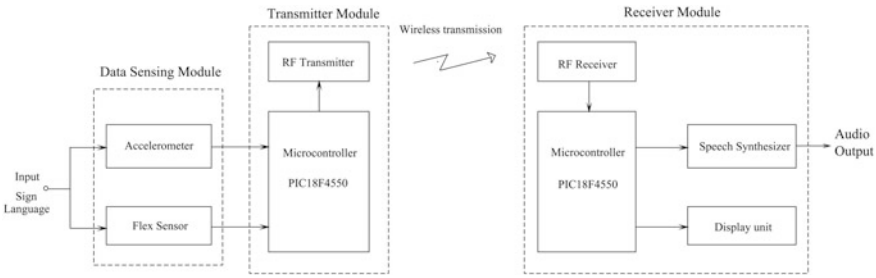

Fig. 1 Block diagram of system

2.2 Data Sensing Module

Data Glove is mounted with accelerometer, at back of hand, and flex sensors along the length of fingers. Analog Devices' IC, ADXL335, is a differential capacitance based model accelerometer measuring the change in acceleration, tilt of object in three axes i.e. *X*, *Y*, *Z*. When even a slight movement is subjected to accelerometer, the floating capacitor plate gets displaced resulting in an electrostatic force proportional to change in capacitance between fixed and moving plate. The total force exerted by single plate is addition of two oppositely directed forces. The analog output for a single axis is proportional to this net force [6]. The position of accelerometer on hand is placed in a manner that *X*-axis should be sensitive to pitch, *Y*-axis to yaw, while *Z*-axis sensitive to direction parallel to g-force exerted by earth. The sensor values are tabulated in Tables 2 and 3.

Bend sensors reconciles with the flexile structure of human body that embellishes wearable technology. Flex sensor used is made up of conductive black plastic ploy bag whose resistance changes proportional to bending of fingers. One finger position can be captured as two states i.e. bent and relaxed [7]. The voltage supplied to one pin of flex is $V_{\text{flex}} = 5$ V, It has an internal resistance of $R_1 = 25$ kΩ—straight position (specified in datasheet), the other pin is connected to analog port of microcontroller as well as grounded via a resistor of $R_2 = 10$ kΩ. The output analog voltage V_{analog}, obtained by voltage divider formula [8], is varied by varying flex resistance, R_1, due to bending motion and rest two external parameters, V_{flex} and R_2, being constant.

Table 2 1g force: *X*, *Y* and *Z* analog voltage equivalent to electrostatic force

g-force exerted	Axis	*X*-out (V)	*Y*-out (V)	*Z*-out (V)
+1g	*X*	1.31	1.52	1.55
+1g	*Y*	1.53	1.32	1.53
+1g	*Z*	1.52	1.55	1.31
−1g	*X*	1.72	1.53	1.54
−1g	*Y*	1.56	1.71	1.55
−1g	*Z*	1.53	1.52	1.69

Table 3 Voltage values of flex sensor for bending at various angles in both direction

Angle (°)	Direction	Flex output (V)
0	Straight	2.6 ± 0.5
45	Forward	2.1 ± 0.2
90	Forward	1.7 ± 0.2
45	Backward	2.72 ± 0.2
90	Backward	2.75 ± 0.2

2.3 Transmitter Module

The design of transmitter module should be compact for the system to become compatible as a wearable device. The microcontroller used for data processing is PIC18F4550. The major reason behind picking up this particular controller is the 10-bit ADC resolution provided to digitize the sensor data [9]. The process of assigning a message to the captured gesture is programmed on transmitter module processor. Radio Frequency (RF) Transmitter, operating at 433.92 MHz is being employed for transmission of messages. The communication is of simplex type. RF being a low power transmitter, a string transmission results in high Bit Error Rate (BER). Hence, a message is substituted with a short symbol. Manchester encoded form of this symbol is sent to RF transmitter where it is modulated by the technique of Amplitude Shift Keying(ASK) and further transmitter wirelessly. It is represented graphically in Fig. 2. A dedicated short range communication is accomplished via Manchester encoding technique that provides dc balance and enhances signal reliability [10].

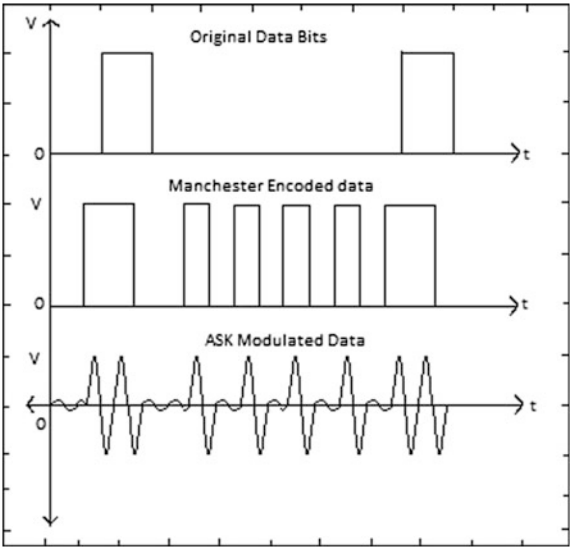

Fig. 2 Symbol A is transmitted as a substitute for a message. Binary representation is 01000001. The first plot represents the original data bits to be sent, second plot is encoded form of Data bits, the third plot represents ASK modulation carried out by RF Transmitter

2.4 Receiver Module

Receiver module consist a RF receiver (433.92 MHz) and PIC18F4550 microcontroller responsible for decoding the message from symbol. Once original message is retrieved, speech is synthesized. The text to speech module is of type The IC used in speech synthesis is PIC24FJ64GB002. The EPROM of IC is programmed with phonemes of English Language [11]. A string is sent to PIC24 IC via UART protocol, phoneme of each letter is accessed from EPROM memory and passed to speaker for being expressed in audio output.

2.5 Data Flow of System

The algorithm, as in Fig. 3, starts with receiving the gesture co-ordinates at analog port of controller [12]. There should be an appropriate amount of delay while taking data from sensors to avoid detection of unwanted gesture while transitioning from one desired gesture to other. This reduces the error in gesture recognition. To establish communication between transmitter and receiver it is necessary to send a synchronization wave before transmitting each symbol. This ensures secure communication between transmitter and receiver pair [13].

3 Result and Analysis

The values of sensors for assigned message are tabulated in Table 4. The hardware unit is shown in Fig. 5. Basic gestures are captured and audio output is achieved successfully. Each message is transmitted ten times continuously and a graph is plotted representing the effectiveness of system, which is shown in Fig. 4.

Static gestures can be combined to form a meaningful sentence. The Text-to-Speech module is of type Concatenative, since it provides a natural speech compared to other types [14].

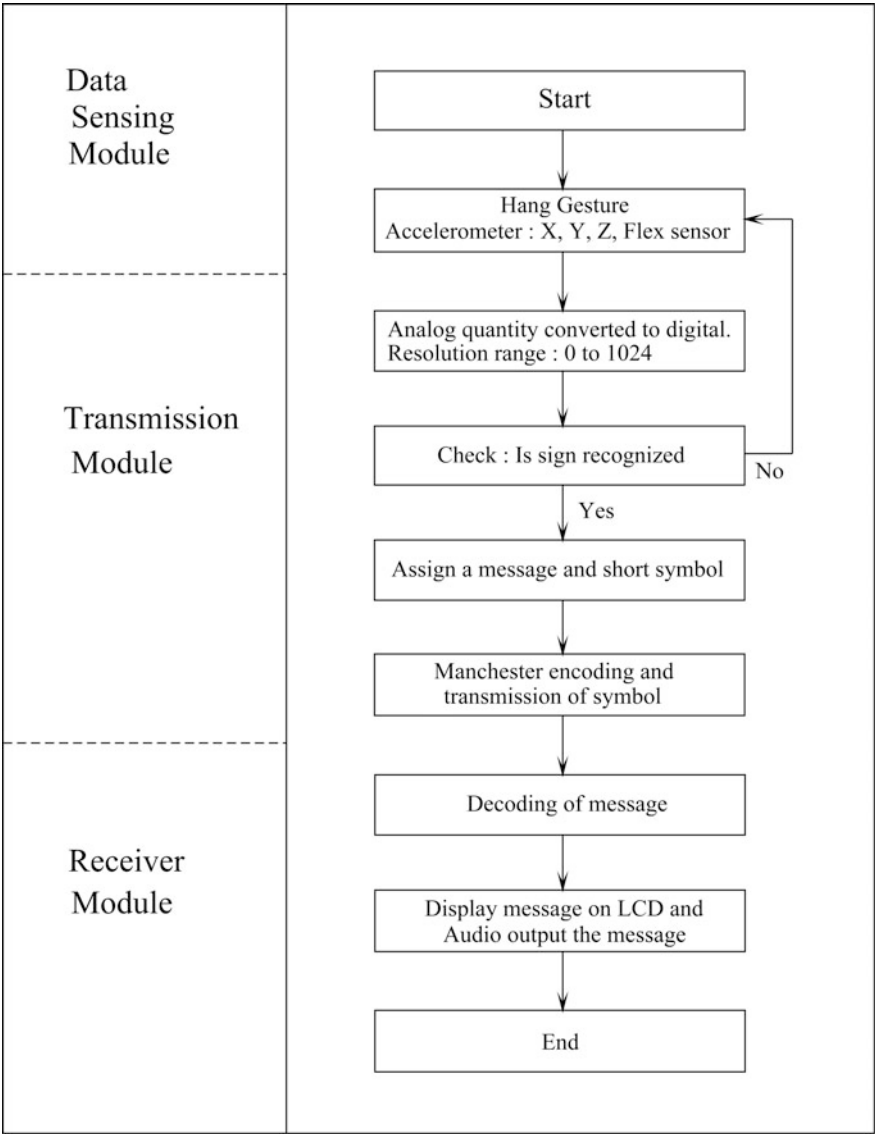

Fig. 3 Data flow of system from gesture sensing to its voice conversion

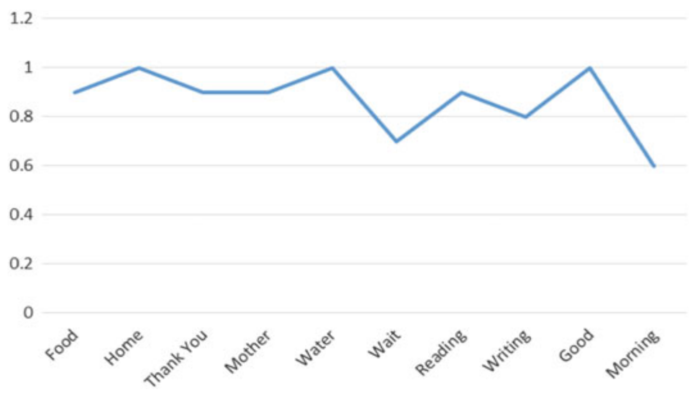

Fig. 4 *X*-axis represents different messages transmitted where each message is transmitted ten times. *Y*-axis represents probability of each message received

Table 4 Values of accelerometer sensor: *X*, *Y*, *Z* and two flex sensors for corresponding gesture

Message Conveyed	*e*	*X*-axis (V)	*Y*-axis (V)	*Z*-axis (V)	Flex 1 (V) (Index finger)	Flex 2 (V) (Middle finger)
Food		1.427	1.501	1.352	2.197	2.250
Home		1.354	1.432	1.698	2.548	2.549
Thank you		1.335	1.473	1.468	2.548	2.540
Mother		1.393	1.578	1.357	1.598	1.893
Water		1.400	1.378	1.513	1.598	1.893
Wait		1.294	1.520	1.597	2.548	2.549
Reading		1.489	1.473	1.326	2.558	2.550
Writing		1.486	1.367	1.775	1.910	1.893
Good		1.626	1.572	1.279	1.598	2.540
Morning		1.626	1.572	1.279	2.500	2.544

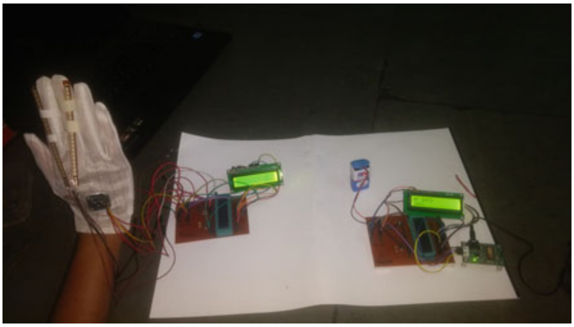

Fig. 5 Data Glove gesture co-ordinates for message 'wait' which is displayed on LCD at transmitter. The message is received at receiver module that is displayed on LCD

4 Conclusion and Future Scope

This paper has described the development of a portable and modular wireless communication system for speech disabled to enable them not only for one-to-one talk with normal people but also in a community talk. Basis words used by speech impaired are studied and voice generation is tested successfully. Practically for 30 m, messages are received without errors by receiver module. The system can become better user customizable by interfacing a memory chip port in which user can insert SD card programmed with various messages in a language compatible for them.

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Effect of Varying Pause Time on Performance of QoS Parameters in MANET

Shashikant Gupta, Sumitra Ranjan Sinha and Pallavi Khatri

Abstract Ad hoc network is spontaneous on the fly, self-adaptive network without requirements of a centralized access point or an existing infrastructure. These aspects lead the infeasibility and inconsistency for providing Quality of Services (QoS) in mobile–ad hoc network (MANET). Real-time multimedia traffic demands high degree of QoS improvements on MAC layer. This work proposes the QoS performance in a new variant of AODV routing protocol using compression and named as compressed AOMDV (AOMDVc). Proposed routing protocol uses MPEG-4 compression in order to improve routing performance on data transmission as well with different network scenarios. Evaluation of AOMDVc is done with respect to frequent changing pause-time and data packet size. Performance of the QoS parameters and network reliabilities are verified by simulation using Network simulator (NS-2). The experimental result shows how the proposed protocol improves the QoS of a network over already existing protocols.

Keywords MANET · QoS · Compression · Pause-time · AOMDVc

1 Introduction

A mobile ad hoc network [1] is a self-directed system consisting of multiple nodes acting as self-configured routers. The router nodes are free to correspond with different nodes arbitrarily due to their unpredictable network topology. Mobile nodes within the scalable network are communicating with each other in a self-doubting error-prone network channel. The ever-increasing use of mobile

S. Gupta (✉) · S. R. Sinha · P. Khatri
Department of CSE, ITM University, Gwalior, India
e-mail: shashikantgupta@itmuniversity.ac.in.com

S. R. Sinha
e-mail: jitsumitra@gmail.com

P. Khatri
e-mail: pallavi.khatri.cse@itmuniversity.ac.in.com

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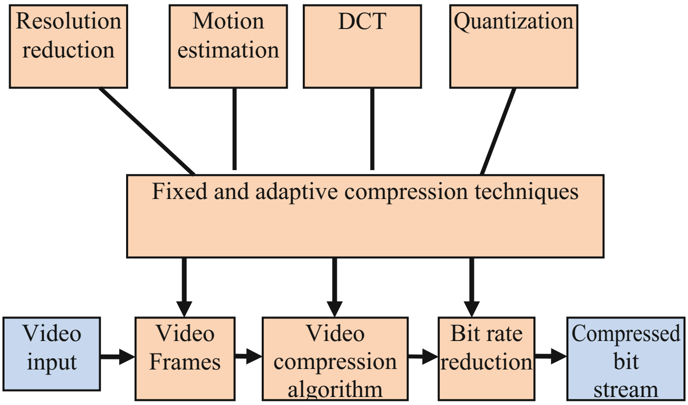

Fig. 1 Flow diagram of video compression

devices and the stipulation of multimedia data applications are facing a major challenge in streaming due to this nature of MANET and unable to provide the QoS in terms of scalability. The real-time multimedia data transmission needs to be fast and error-free and should meet Quality of Service (QoS) [3] parameters and assurance for successful data delivery. Concurrent use of multimedia video data maintains some strict QoS such as bandwidth, delay, throughput, and packet delivery ratio (PDR). Numerous improvements related to multimedia video transmission were made in very recent year for effecting on efficient QoS parameters in MANET. Standard techniques like H.263, H.264, IEEE 802.11b offer an enhanced multimedia video transmission technology which provides better QoS performance on efficient and reliable multimedia MANET over different network behavior and network proceedings. This work uses the MPEG-4 compression techniques for data compression and video data transmission. An overall compression technique that is followed for reduction in number of bits using compression and smooth transmission of video data on MANET is demonstrated in Fig. 1. The remainder of this paper is followed by Sect. 2 with literature review of the existing system and proposed methodology in Sect. 3. Simulation setup used for study is discussed in Sect. 4 followed by results analysis and conclusion in Sects. 5 and 6, respectively.

2 Literature Review

Previous researchers contributed immensely on the basis of supporting and provision QoS over video data as well as multimedia streaming transmission. Different compression techniques, routing algorithms, and other aspects come in consideration for improvement of QoS. This proposed research mainly focuses on combined study of QoS constraints and lossless compression in multipath routing to enhance the performance of routing protocol to improve the QoS parameters. In this section, the research papers are reviewed and the methods that already exist to handle the QoS and compression techniques of the network are identified. For enhancement of QoS, different QoS increasing techniques and video compression techniques are used.

2.1 Compression Techniques

Different effective and efficient routing protocol has been designed for providing the QoS improvement in different aspects with respect to network pause-time and mobility phenomena. Problem regarding video transmission over IEEE 802.11b-based protocol is discussed by Calafate [1], and they discuss the implication H.264 real-time video compression technique over MANET. Mpeg-4 compression technique over large-scale MANET is discussed by Malgi and Gaikward [2] for improving the compression scenario as well as network criteria. An optimal Coding strategy that is used for dropping the data rate for scalable and optimistic video streaming is discussed on [3]. A QoS-driven algorithm [4] based on the forecast model of layer-architecture multiple rate is designed, and its better performance is verified with simulations over frequent and very effective real-world experiments over scalable wireless networks. Some recent video compression techniques are applicable [5] for Mpeg format. H.264 technique is applied to videos within which bit rate is a smaller amount than the prevailing protocol like mpeg. Existing work on MPEG-4 [6] is a large standard compression tool containing and addressing a new class of applications requiring access to coded audio-visual object. It compresses the data by reducing them according to respective bit-rates. Many profile levels such as the Simple and the Advanced have been widely implemented for MPEG-4. Chiariglione [7] has presented an overview of the MPEG standards including requirements, technology, and applications for different versions of Mpeg like MPEG-1 video, MPEG-2 video, and MPEG-4 video standards. Mpeg-4 is a technique which is easily compatible with any type of network and multimedia data. MPEG-4 provides some better realistic results. Different standards of compression and mpeg versions (1, 2, 3, 4, 7, and 21) that are applied on IP-based large-scale network for resulting best effort QoS network are discussed by Md. Hossain [8]. Joint picture expert group (JPEG) compression is also a very recent technique that is implacable for image as well as video data.

2.2 Pause Time Effect on Routing Protocols

In MANET, pause time effects on the performance of the overall network as well as the quantitative parameters that are used for the network evaluation. Scalability issue of the entire network for AODV and other protocol with respect to different pause times is discussed by Ambhaikar in [9]. The paper elaborates the performance of QoS parameters like delay, PDR, throughput. Comparative performance over different routing protocol on scalable network for multiple number of nodes is demonstrated in [10] by Suresh. Routing protocols like AODV, DSR, OLSR are effecting differently in accordance with their respective pause time. Enhancement of QoS somehow depends on the optimal pathfinding and optimal route maintenance [11] with the efficient simulation time and pause time. An optimal QoS-aware routing protocol by varying the pause time is evaluated on a scalable network for providing the best effort routing protocol. The working of multimedia transmission for forwarding data in multipath network in MANET including RTCP—Real-Time Control Protocol for multimedia data is briefed in [12]. The primary function of RTCP is to enhance the transmission rate at the server level and alleviates the problems related to the QoS parameters like PDR, throughput, delay.

3 Proposed Methodology

Different approaches have been discussed in literature for improving the QoS on multipath video data transmission using existing routing protocols. Proposed work is implemented on video data as well as multimedia Mpeg traffic. Initially, video data are transmitted through a multimedia MANET network by routing protocol such as AODV or AOMDV, and compression is applied on the data for improvement of QoS and improves the performance of previously designed compressed AOMDV [13] AOMDVc over relevant and different pause-times. In the proposed system, packet size for the data is set fixed at 1500 bytes. Video data are sent through the entire network with the rate factor 1 and initial seed of 0.5. Video data are categorized into different frames like I, B, and P.

3.1 Rate Factor

Rate factor defines as the amount of data that are needed to scale up or scale down during the video transmission having different frame rate and pause-time. Rate factor is set in application layer of the protocol for controlling the network traffic by setting the packet size being same. In proposed protocol, rate factor is set to be 1 according to the different pause-times and packet size is to be 1500 kb.

3.2 Initial Seed

Initial seed is set at 0.5 for generating the first frame of the video within the entire network.

4 Simulation Setup

Network simulator (NS2) is a simulation tool which is used to study performance of different aspects of any communication networks. This paper evaluates the performance matrices of compressed video streaming simulations using NS2. Simulation parameters used for this study are tabulated in Table 1.

5 Result and Analysis

This section analyzes the effect of varying pause time during data transmission on network parameters. The results of AOMDVc are compared with existing protocols AODV. The results clearly show that performance of AOMDVc is better than AODV routing protocol.

5.1 Average End-to-End Delay

It is defined as the time taken or total time duration for any data packet that transmitted across a network from source to destination.

$$\text{Avg. delay} = \frac{\sum \text{Arrival time} - \text{Start time}}{\sum \text{Node}} \tag{1}$$

Table 1 Simulation parameters

Simulation parameters	Value
Topology	1000 * 1000
No. of nodes	200
MAC protocol	MAC/802_11
Propagation model	Random waypoint
Routing protocol	AODV, AOMDVc
Antenna type	Omni antenna
Data traffic	CBR
Packet size	1500 Bytes
Simulation time	50 s
Mobility	2.5, 5, 10, 25, 40
Compression technique	Mpeg-4
Rate factor	1.0
Initial seed	0.5
Number of connections	20

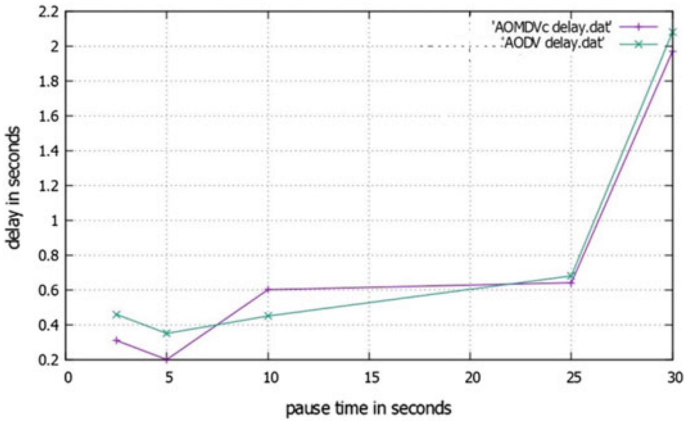

Fig. 2 Average delay

Figure 2 Graph shows that the average network delay of proposed AOMDVc is less than the existing AODV.

5.2 *Throughput*

$$\text{Throughput} = \frac{\sum \text{Data transmit}}{\text{Time}} \tag{2}$$

Figure 3 shows the network throughput for the AOMDVc protocol with respect to different pause-times. For enhancing the overall network performance, throughput plays a vital role among the other QoS parameters.

5.3 *Packet Delivery Ratio (PDR)*

Packet delivery ratio (PDR) is said to be the ratio of packet delivered to the network to the total number of packet received by that same network.

$$\text{PDR} = (\text{pd}|\text{ps}) * 100 \tag{3}$$

where pd = total packet delivered, ps = the total packet sent.

Figure 4 exhibits the network PDR with respect to different pause-times. PDR must be higher as much possible for the enhancement of network performance as well as QoS improvements. Higher value of PDR of AOMDVc over existing AODV shows the betterment of scalable network performance as well as QoS improvements.

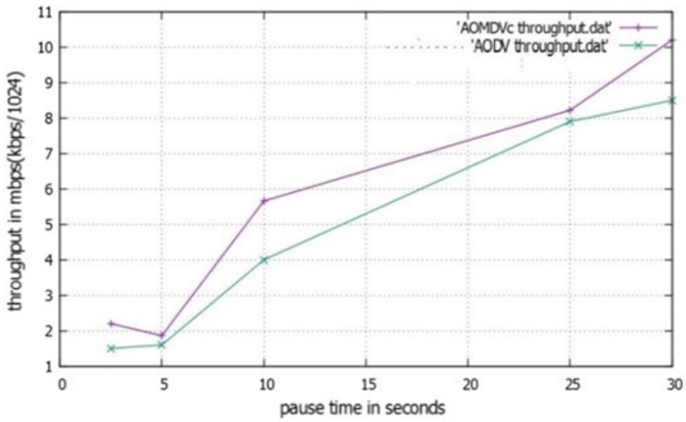

Fig. 3 Throughput

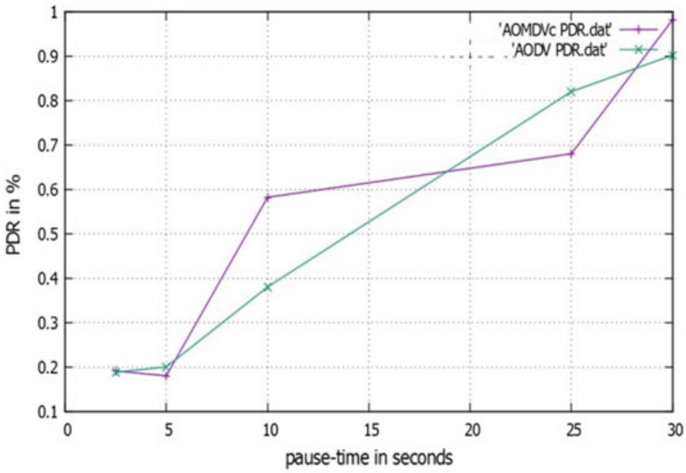

Fig. 4 PDR graph

Table 2 exhibits all the results of QoS parameters like end-to-end delay, throughput, PDR according to various pause times that change simultaneously during simulation.

Table 2 Analysis and comparative table

Protocol	AOMDVc			AODV		
Pause-time	Delay	Th. put	PDR	Delay	Th. put	PDR
2.5	0.31	2.2	0.19	0.46	1.8	0.178
5	0.2	1.98	0.17	0.35	1.6	0.2
10	0.60	5.8	0.58	0.45	4.3	0.38
25	0.65	8.2	0.69	0.68	7.08	0.82
30	1.97	9.8	0.991	2.05	8.5	0.87

6 Conclusion

This work analyzed the performance of a QoS-aware compressive routing protocol (AOMDVc) varying with different pause-times. Multiple QoS-related performance metrics like average end-to-end delay, throughput, and PDR are analyzed according to the predefined pause-time like 2.5, 5, 10, 25, 30. Generated results are plotted through graph and compare with the existing AODV routing protocol. The parametric graphs show that our proposed AOMDVc protocol performs better in many cases with respect to pause-time. This is because after applying compression in the network the network becomes very congestion less due to the absence of redundant data. Also, bit rate of the video data as well as multimedia data is reduced by the invocation of compression. Due to various pause-times, the data which are transmitted through the network are getting as much time for successful and congestion less transmission. Proposed protocol gives much better results in case of QoS parameters like throughput, PDR, and average delay over existing counterparts.

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Deadlock Prevention in Single-Server Multi-CS Distributed Systems Using Voting- and Priority-Based Strategies

Kamta Nath Mishra

Abstract In order to solve the concurrency and starvation control problems of distributed systems, the voting- and priority-based optimal and feasible solution is presented in this research work. In voting-based approach, a process getting the majority of votes will be only allowed to enter into the critical section (CS). But, this method has a disadvantage as if no process remains in the situation of achieving majority of votes then the system will remain in idle state although a considerable amount of minority processes will remain in waiting queue. In the prioritized distributed mutual exclusion-based algorithm, the process having highest priority amongst all the processes of distributed system is allowed to enter into the critical section (CS). Hence, leaving the other lower priority processes into the waiting queue which results an increase in the length of waiting queue. The proposed technique allows the creation of multiple critical sections in a distributed system and prevents the processors from entering into idle state which leads towards increase in throughput.

Keywords Critical section · Maskable/Non-maskable interrupts
Mutual exclusion · Priority-based distributed systems · Voting-based distributed systems

1 Introduction

The mutual exclusion achievement in distributed systems can basically be categorized into two categories, namely token-based and non-token-based algorithms. Almost all the solutions in this field lie under these two conditions. One of the oldest works in this field was given by a researcher named Lamport [1, 2] of Digital Equipment Corporation in 1987. He worked on the original problem of Dijkstra's

K. N. Mishra (✉)
Department of Computer Science & Engineering,
Birla Institute of Technology, Alld. Campus, Mesra, Ranchi, India
e-mail: mishrakn@yahoo.com

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algorithm where he propounded a new solution of the MUTEX problem which was presented in the absence of contention, requiring only memory access and assuming the atomic read and atomic write to the shared registers. In his work 'A fast mutual exclusion algorithm' [3], a solution was presented for only five writes and two reads of a shared memory having time complexity of O(N) and total number of message required was $3(N - 1)$. This algorithm was a non-token-based algorithm [4–6].

As we have encountered a number of solutions in the literatures for the problem of mutual exclusion (MUTEX), still a practical and suitable approach has been missing in most of these algorithms of distributed systems [2]. As far as distributed systems are concerned, many solutions like token-based, non-token/permission-based [7], priority-based, voting-based and coterie-based [8] has been provided in literatures till date. Researchers like Lamport, Maekawa, Ricart-Agarwala, Raymond, Niami-Trehel and Suzuki-Kasami have come with their various suitable solutions for mutual exclusion problems [1, 9]. But all these proposed solutions have their own pros and cons. Thus, in order to provide a suitable and logical solution for mutual exclusion in distributed systems [10, 11], we have proposed 'An efficient voting- and priority-based technique for deadlock prevention in distributed systems' where we have tried to propose a cumulative solution for MUTEX based upon the two different algorithms, i.e. 'A new voting-based MUTEX exclusion algorithm for distributed systems' [8] and 'A prioritized distributed mutual exclusion algorithm balancing priority inversions and response time' by Mishra [12] and Thiare et al. [13].

Michael Fischer proposed the simplest possible algorithm with worst time complexity of O(N). He has used angle brackets for enclosing 'atomic' operations and 'await b' as an abbreviation. Later on Ricart G. solely in his paper 'An optimal algorithm for mutual exclusion' [4] proposed another non-token-based algorithm with total number of message requirement $2(N - 1)$ with synchronization delay of T. The researcher Chandy [14] proposed a probe-based algorithm in which each site had a controller that maintained a Boolean array named 'Depend' which was known as dependency table 'k' for every constituent process 'P_k' where Depend_k is true only if P_k's controller knows that P_i is dependent on itself and hence is deadlocked [15]. But this algorithm had a drawback as some deadlocks were not detected when the degree of contention remained high for some special cases. The researchers Suzuki I. and Kasami K. in their paper 'A distributed mutual exclusion' [16] proposed a new token-based algorithm in 1985, requiring a total number of messages equivalent to 'N' with a synchronization delay of 'T' [17, 18].

Our main aim behind proposing this algorithm is to develop an efficient algorithm which can provide the optimum opportunity to a job/process for entering into critical section (CS) of a system irrespective of its obtained majority (voting-based algorithm) or the attained high-order priority (priority-based algorithm).

2 Proposed Technique

In this section, an efficient voting- and priority-based deadlock prevention technique is proposed for a distributed system and the proposed technique is capable to provide a solution for the distributed system. Here, we have divided the incoming process requests based upon two constraints: (a) Voting (V_i) and (b) Priority (P_b). Next we have divided the voting and priorities obtained by various processes into four different categories based on their equivalent percentage. These categories are: (i) 75.1–100%, (ii) 50.1–75%, (iii) 25.1–50% and (iv) 0.1–25%. Here, percentage window (W_i) is applicable for both the categories [19, 12]. There are various other useful variables which are decisive in elaborating this algorithm. These variables are *Voting-based (V_i)* and *Priority-based (P_b)*.

2.1 Proposed Algorithm

The steps of proposed voting- and priority-based deadlock prevention algorithm are presented in this section. The proposed algorithms take input in two different forms, namely voting and priority generally denoted as V_i and P_r in individual and V_iP_r as a joint expression.

The proposed algorithm for single server with single CS- and multiple CS-based deadlock prevention mechanism is presented in Fig. 1.

Step 1: Process (P_i)→(Enter_CS);/* All processes wants to enter into critical section*/
Step 2: P_i → (Enter_CS); /*Only one process will be allowed at a time*/
Step 3: (P_i-1)→ Wait_queue (W_q); /*Since only one process is allowed to enter into C.S. at a time, rest of the process will keep waiting as P_Req_v in the wait_queue (W_q)*/
Step 4: if ($P_i(\equiv P_p)$ == NMI)
{ P_i → (Enter_CS);}
else{ $P_i = P_i + 1(\equiv P_p)$ → (Enter_CS)}
Step 5: while (P_i!= NMI)
{Check for test cases from V_1P_1 (α) to V_4P_4 (π)}.
Step 6: if (∀V_1P_1(α) to V_4P_4(π)) ∃ P_i== T)
{ P_i → (Enter_CS)}
else{ P_i=P_i+1($\equiv P_p$)→(Enter_CS);}
Step 7: ∀ ($P_i \in W_q$);
{(P_i = Pi + 1)}
Step 8: while ($P_i(\equiv P_p)$ → Enter_CS == Null > T_{con})
{(∀P_i ∈ (V_iP_i ⇔ $P_rP_{i)}$ == 100%) == $P_i(\equiv P)_p$ → Enter_CS}
Step 9: while (∀(NMI ∪ V_1P_1(α) to V_4P_4(π)) → P_i == F)
{case 3 (SJSF): P_i → (Enter_CS)}
Step 10: End.

Fig. 1 Algorithm for single server with multiple CS-based deadlock prevention in distributed system

In Fig. 1, a single server which is already connected to multiple computer systems in a distributed environment wants to inject its processes (P_i) into multiple critical sections for execution.

2.2 Description of Proposed Technique

The exact phenomenon of single server and single CS is shown in Fig. 2. Here, in Fig. 2, every single process coming from various individual computer systems of the distributed environment will gather at server 1. Therefore, a race condition will occur amongst the processes at server 1 in order to make an entry into the critical section for execution. For selecting the most prominent process (P_p) from the available processes, the selection will be based on voting-based (V_i) and priority-based (P_r) processes. In our proposed approach, either c*ase 1* or c*ase 2* or c*ase 3* will be used by server 1 to select a process. In case of conflict between voting- and priority-based processes, the prominent process will be decided by the value of time stamp (T_s).

In the proposed approach, the race condition processes will be checked for 'non-maskable interrupt (NMI)'. If the selected process is a NMI, then it will directly enter into the critical section of the system. If the process is not of NMI type, then according to case 2 of our proposed technique, the processes will be

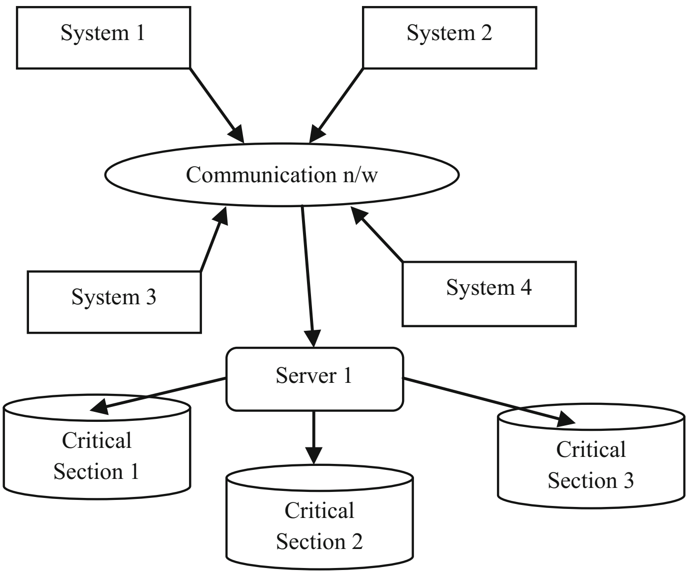


Fig. 2 Diagrammatical representation of process movement in single server and multiple CS-based distributed system [12, 20]

checked out for the different cases, i.e. from V_1P_1 to V_4P_4; depending upon those cases, one particular process will be allowed to enter into the CS.

In case 2 of proposed approach, four percentage windows are defined and used for deciding the process priority. If a process satisfies the criteria of case 2, then the process will enter in critical section and priority of other processes waiting in waiting queue (W_q) will be increased by one in order to maintain the priority level and fairness. Even after the execution of c*ase 2,* the system may not find any prominent process (P_p); then after a certain time constraint (T_{con}), the priority percentage of the waiting requests from the waiting queue will be increased to 100% along with the other requesting processes. If case 2 does not find any prominent process for entering in critical section, then case 3 will be applicable in which the process having shortest job scheduling first (SJSF) will be applied. In this case, the process from voting- or priority-based section having shortest job scheduling will be considered as the prominent process for entry into the critical section.

If two or more processes become a candidate for prominent process, then the decision is made by comparing their normalized time stamps (T_s) and the process having smallest time stamp value will enter into the critical section. In worst case, if the proposed system is unable to find any prominent process after executing case 1 and case 2 then case 3, i.e. SJSF, will be applied to bring a process into CS. In case 3, the job having shortest scheduling will enter into the critical section as a prominent process (P_p). If case 3 also fails to bring a process into CS, then the value of requesting process waiting into the waiting queue (W_q) will be incremented to 100% according to their weight. In this way, we would be able to find out the new prominent process for entry into the CS.

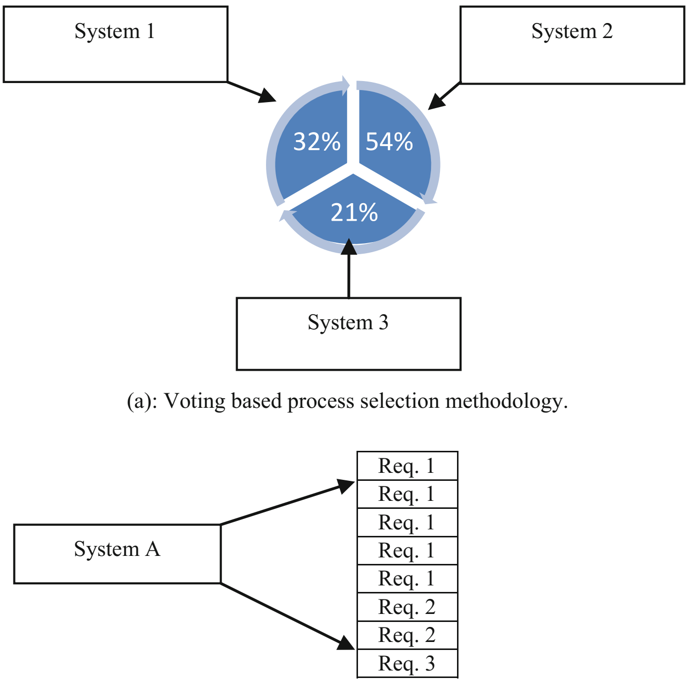
3 Result Analysis and Discussions

In some algorithms, complexity is defined in terms of time and space. The term *Deadlock-Free (D)* here refers to the unavailability of any kind of deadlock from the proposed algorithm. The term *Fairness (F)* here denotes that free and fair chance should be provided to every process waiting in the queue to be selected at least once for making an entry into the critical section. The term *Throughput (T)* is defined as the rate at which processes of distributed system are successfully executing in CS using our proposed algorithm. The *Number of Messages (M)* defines the total number of messages entering or handled by the critical section of the proposed system at a time. Normally, the complexity of any algorithm heavily relies on M. If numbers of messages are higher in a distributed system, then the system will have greater complexity [21].

3.1 Voting-Based Methodology

In this method, a voting technique is implemented for all the participating nodes in order to find out one system with highest percentage of votes. The process selected for the highest percentage of votes is said to attain the majority amongst all processes and it is said to be the most suitable candidate for entering into CS for execution. The components of Fig. 3a and Table 1 describe the exact approach of process selection for a distributed system using voting-based technique.

In Fig. 3a, b, the working of voting- and priority-based process selection methodology is demonstrated. Here, we can see that there are three different systems lying in a distributed system sending its request to enter into the critical section. As we can witness that system 2 is having highest percentage of votes (majority, 54%), process requested by system 2 will only enter into CS while the other two systems will remain in the queue.



(a): Voting based process selection methodology.

(b): Priority based requesting methodology.

Fig. 3 Functionality of voting- and priority-based proposed system

Table 1 Comparison of proposed algorithm with existing MUTEX algorithms [12]

S. No.	Name of algorithm	Complexity (C)	Deadlock-free (D)	Fairness (F)	Throughput (T)	No. of messages (M)
1.	Proposed technique (Single server with multiple CS)	Low	Yes	Yes	Min = 1, Max = N	Min = 1, Max = N
2.	Voting-based algorithm [8]	Low	No	No	Low	Max = $2 \times (N - 1)$
3.	Priority-based algorithm [15]	High	No	No	Low	Min = 0.1 Max = 0.5
4.	Distributed groups mutual exclusion algorithm [23]	High	No	Yes (FIFO)	Medium	Min = 0/1 Max = m

3.2 *Priority-Based Methodology*

The priority-based methodology decides the most prominent candidate on the basis of priority assigned to processes [22]. The priority of a process is decided on the basis of total number of requests made by any node for executing a particular process. The example in Fig. 3b describes that out of seven requests, total number of requests claimed by request_1 is to 5, whereas request claimed by request_2 is three and request_3 is 1. Therefore, in this scenario, request_1 becomes the most prominent candidate in this system to enter into CS.

In Table 1, we have given comparison view of our proposed algorithms amongst each other and with the algorithms of other researchers. Table 1 compares our proposed algorithms with other standard algorithms for five factors, namely Complexity (C), Deadlock-Free (D), Fairness (F), Throughput (T) and Messages (M). Each factor is evaluated on the basis of three scales, namely low (L), medium (M) and high (H). The results of Table 1 show that the proposed algorithm is better than other algorithms in term of factors 'D' and 'F'. In the case of complexity (C), the complexity of single server with single critical section along with the voting-based algorithm is on the lower side. The complexity level of single server with multiple critical sections remains on the medium level.

4 Conclusions

The proposed technique (algorithms) of this work provides a better chance of deadlock prevention by allowing at most one process into every CS, and it provides a very fair chance to all the participating processes for entering into CS. The proposed algorithm of this research work reduces the CS-related problems like deadlock, starvation and unfairness. The implementation of proposed technique with the help of CW BNC mobility work benchmark tool reveals that the proposed technique increases the throughput and efficiency of existing distributed systems. The main motive behind proposing the new technique is that the CS should never remain empty even under worst situation and this motive is achieved with the help of proposed technique.

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Remapping Attack Detection and Prevention for Reliable Data Service in MANET

Aradhana Saxena and Manish Khule

Abstract Mobile ad hoc Network is a promising technology in recent years. The number of nodes are forming dynamic link in between sender and receiver. The Mobile ad hoc Network (MANET) are operating in absence of centralized administration and because of that attackers are simply changed or acting malicious activities in network. One in all the most important challenge in wireless mobile ad hoc sensor networks nowadays is protection. In this title we tend to plan a completely unique security scheme for Remapping Attack. This type of attacks is amendment the priority of communication and acting misbehavior through flooding of huge quantity of reserve packets in communication network. The attacker node is provides the primary priority itself for information sending and remainder of the nodes priority is come back when attacker. The proposed results of assaulter malicious activities are consumed link bandwidth and additionally actual data delivery in network is affected. The aim of this research is to measure the malicious performance of Remapping attack in MANET and identifies the node/s that are affected the routing performance. The proposed security theme are check the priority order of each sender node in network that require to communicate and solely the offender is one altogether the node that flooded the reserve packets in network and in addition the assaulter node is not the sender or receiver. The proposed security scheme against remapping are block the activity of offender. The performance of network is measured on the basis of performance metrics like as network throughput, PDF and routing overhead, attacker node identification.

Keywords MANET · Security · Remapping attack · Flooding Routing

A. Saxena (✉) · M. Khule
Computer Science and Engineering, Gwalior Institute of Technology and Science, Gwalior, India
e-mail: saxena.aradhna@gmail.com

M. Khule
e-mail: mannykhule@gmail.com

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1 Introduction

Mobile ad-hoc network is a collection of spontaneous devices, where each device communicates through radio zone. In the past decade numerous routing are design to optimize the performance of the mobile ad hoc network i.e. energy based routing, capacity based load distribution, security issue resolver etc. due to node mobility those network are unreliable in various zone. Mobile nodes are capable to generate temporary routing and provide infrastructure less service to end devices. While the routing decision take place by the communicator nodes than data delivery starts, but dynamical node motion generates the distortion in the communication. MANET is more vulnerable as compare to infrastructure based communication, because no one can store the historic information to analyze the network behavior and calculate the trust of the nodes, another issue dynamic device motion that generate the unreliability to the communication. So in this paper study about various security threats, its impact and prevention mechanism, in the next face proposed the remapping attack prevention mechanism and secures the mobile ad hoc communication [4].

The offenders in network endlessly deliver the massive quantity of packets in network at whole entirely totally different live and besides modification the priority of communication of senders. This kind of behavior of offender unit of measurement referred to as Traffic Remapping Attack (TRA). This attack are consumes the complete link capacity of network by that nodes don't seem to be deliver the any info in network. Throughout this paper the authors are to develop a replacement profile based theme for shielding network from attack [1–3].

2 Related Work

Konorski and Szott [1] "Discouraging Traffic Remapping Attacks in local Ad hoc Networks" this research work is provides the security scheme of discouragement theme supported the threat of TRA detection and human action. The theme doesn't suppose station identities or a real third party, nor will it might like change of state with the MAC protocol. These authors are analyze an arising non-cooperative TRA scheme and see that at a lower place bound realistic assumptions it solely incentivizes TRAs if they harmless to entirely totally different stations otherwise the egotistical stations return to mind to search out those TRAs square measure harmful.

Wu et al. [4] "A Survey on Attacks and Countermeasures in Mobile Ad hoc Networks" in this paper proposed countermeasures are choices or functions that produce or eliminate security vulnerabilities and attacks. First, they offer an outline of attacks reliable with the protocols stacks, and to security attributes and mechanisms. Then they proposed security approaches following the order of the superimposed protocol stacks. They are in addition suggests an outline of MANET

Intrusion Detection Systems (IDS), that are reactive approaches to frustrate attacks and used as a second line of defense.

Rai et al. has been planned a title [5] "Different varieties of Attacks on Integrated MANET-Internet Communication" during this work they focus on varied varieties of attacks on integrated MANET-Internet communication. They take into consideration commonest varieties of attacks on mobile unintentional networks and on access purpose through that MANET is connected to the online. Specifically, they study but varied attacks influence the performance of the network and choose the safety issues that haven't solved until currently.

Manikandan et al. has planned a paper on title [6] "Survey on Attacks and Defense Metrics of Routing Mechanism in Mobile ad hoc Networks" during this title we tend to tend identified the existent security threats an ad hoc network faces, the safety services needed to be achieved and together the countermeasures for attacks in routing protocols. To accomplish our goal, they have done literature survey in gathering info associated with varied varieties of attacks and solutions. Finally, they have well-known the challenges and projected solutions to beat them. In our survey, we tend to tend to specialize at intervals the findings and connected works from that to supply secure protocols for MANET. However, in short, we tend to are ready to say that the complete security resolution desires the hindrance, detection and reaction mechanisms applied in MANET.

Saha et al. [7] "Study of various Attacks In MANET With Its Detection and Mitigation Schemes" This title additionally classifies many common attacks against the unintentional networks routing protocols primarily based upon the techniques that might be employed by attackers to take advantage of routing messages.

Jain faith [8] "Security Threats in MANETs: A Review" during this title they discuss MANET are the special networks shaped for specific applications. Operative throughout MANET permits all wireless devices at intervals vary of every entirely totally different to search out and communicate throughout a peer-to-peer fashion whereas not involving central access points. Several routing protocols like AODV, DSR etc. are proposed for these networks to hunt out an end to end path between the nodes. These routing protocols are in danger of attacks by the malicious nodes. There's a demand to look at and stop these attacks throughout a timely manner before destruction of network services.

Tayal and Gupta [9] "A Survey of Attacks on MANET Routing Protocols" in this title they have got tried to represent an outline of AODV, the attainable attacks on MANET and a few security mechanism to those attacks.

Sulthana et al. [10] "An Efficient Mechanism of Handling MANET Routing Attacks victimization Risk Aware Mitigation with Distributed Node Control" in this work these authors are proposed debate a risk—aware response mechanism to consistently modify the famous routing attacks. This risk aware approach relies on an extended Dempster-Shafer mathematical theory of proof introducing a notion of importance factors. Additionally, their experiments demonstrate the effectiveness of our approach with the thought of the various performance metrics.

Sen and Clark [11] “Evolutionary Computation Techniques for Intrusion Detection in Mobile Ad hoc Networks” in this paper authors are proposed to explore the use of evolutionary computation techniques, considerably genetic programming and grammatical evolution, to evolve intrusion detection programs for such tough environments. Aware of the particular importance of power potency we tend to analyze the power consumption of evolved programs and use a multi-objective evolutionary algorithmic rule to induce best trade-offs between intrusion detection ability and power consumption.

Gagandeep and Kumar [12] “Analysis of various Security Attacks in MANETs on Protocol Stack A-Review.” Focus is on routing and security issues associated with MANET that are required therefore on offer secure communication. On the basis of the character of attack interaction, the attacks against MANET also are classified into active and passive attacks. Attackers against a network are typically classified into 2 groups like insider and outsider. Whereas are outsider offender isn’t a legitimate user of the network, an executive director offender is a licensed node and a district of the routing mechanism on MANET.

Narang, Sonal [13] “A Study of various Attacks in MANET and Discussion concerning Solutions of Blackhole Attack on AODV Protocol” this title represent, a review of varied types of attacks and existing solutions of blackhole attack and their demerits. Therefore MANET is accessible to every legitimate network users and malicious attackers. There are many routing attacks caused due to lack of security. The one in every of best suited protocol is AODV for MANET and it’s liable to part attack by malicious nodes. It’s virtually just like the part at intervals the universe at intervals that things disappear. The part attack is that where a malicious node advertises itself as a result of it’s the optimum route to the destination by causing RREP message with highest sequence selection and minimum hop count.

3 Proposed Work

The Traffic remapping attack is similar as Denial of service attack. Denial of Service (or DoS) attacks are a kind of attacks against computers connected to the Internet and spread of flood the unwanted junk message in the network. The traffic remapping attack similarly generate the unwanted message in huge amount and sense the ideal terminal and sends junk of message in continues manner, that attack consume the network security as well as change the data priority. So here we design algorithm for detection and protection of traffic remapping attack mobile ad hoc network communication, very first we initialize all variable and check the behavior of remapping attacker, if any node send undefined type packet in very higher rate means lunching the remapping attack that change the priority of communication in network and damage the protocols of network. The traffic remapping attack detected by analyzing the traffic behavior and its data sending rate based methodology. After that detection of attack we apply protection scheme so we create protector node p that node watch neighbor node activity as well as their vulnerabilities and retrieve the information about attack and rate of data exchanging between attacker and captured by attacker node that behavior for useful for protector *p* node for protection. But initially *p* node send the rate control message to the attacker node and if attacker node will not control there rate so *p* node block the particular traffic remapping attacker node and protect the whole mobile ad hoc network.

3.1 Proposed Algorithm

In our mobile sensor communication all node play a important role because all are work collaborative form or dependent base route, that provide one measure issue is security so here we design algorithm for detection and protection of traffic remapping attack under sensor communication, very first we initialize all variable and check the behavior of traffic remapping attack, if any node send undefined type packet in very higher rate means lunching the remapping attack that change the priority of communication in network, but that type of attack measured through historic data analysis base technique and detect the attacker node, after that we apply protection scheme so we create protector node *p* that node watch whole neighbor node activity as well as vulnerable node and retrieve the information about attack and rate of data exchanging between attacker and vulnerable node, and send the rate control message to the attacker node.

That historic analysis base detection and future time real time protection provide strength to the communication network in the form of security issue.

Input parameter

```
Step 1: SensorNodes: N;
MAC layer: 802.11
Routing Protocol: AODV
Attack Type: Remapping
Security Mechanism: PPS (Profile based Protection Scheme)
Inter Arrival Time = IAT (priority based)
//Attacker launches remapping attack
Attacker-node (capture vulnerable node information && send = abnormal packet
&& rate = 2^20*0.1s)
If (vulnerable receiver data)
    {
    Infected;
    Call Remapping attack Module;
    }
Step generate trace file for further analysis
Step analysis trace for detection
If (data type == Remapping a&& rate >= normal)
    {
    Packet is unwanted remapping attack type;
    Find infection ratio;
    Priority of attacker is high
    }
Step: Call protector PPS
    While (PPS-Check susceptible node && total data receives && rate &&
    sender)
{
If (rate >= normal && packet =Remapping)
{
Send rate control message at different Inter Arrival Time If
(control rate = true)
{
Cannot block;
Proper provides priority to senders;
}
Else {block the sender node ;}
}         }
```

4 Outcome of Our Proposed Work

In this section describe our result outcomes in thirty mobile node cases and conclude our results.

A. **Overall Analysis**

The overall performance of network is mentioned in Table 1. In this analysis the priority based scenarios of normal routing performance are represents by S1, S2 and S3. Also include the scenario of remapping attack and security against attack. The scenario represent the individual performance of both transport layer protocol like TCP and UDP and identified that the security scheme is provides secure communication in dynamic network.

B. **Attacker Node Analysis**

The attacker is always performing misbehavior in network and the routing performance of network is completely degrades due to less packets receiving and heavy packet loss. Table 2 is represents the attacker nodes packet capturing analysis. In this table the six nodes are identified in network that performing malicious activities in network. The node 1 is captures highest number of packets and node 9 is lowest.

C. **PDR Analysis**

In following graph (Fig. 1), we measure the Packet Delivery Ratio performance at the time of Routing, Attack and after the proposed security mechanism. The proposed mechanism improves the performance and provides efficient packet delivery in the network. The graph showing simulation time (in Sec.) and

Table 1 Summarized performance analysis

Parameter	Overall summery S1	Overall summery S2	Overall summery S3	Overall summery secure	Overall summery attack
TCP SEND	3326	4350	4828	2733	1260
UDP SEND	4979	4979	4979	4979	4979
TCP RECV	3309	4310	4809	2678	1221
UDP RECV	3155	4797	3844	4978	724
ROUTINGPKTS	1789	860	1053	561	210,268
TCP-PDF	99.49	99.08	99.61	97.99	96.9
UDP-PDF	63.37	96.34	77.2	99.98	14.54
Average e-e delay (ms)	1017.3	396.06	426.18	533.58	1470.25
NRL	0.28	0.09	0.12	0.07	108.11
Attack	0	0	0	0	360,104
Total drop	1841	222	1154	56	4294

Table 2 Attacker analysis

Attacker node	Packet capture	Percentage of infection
1	151,084	57.18
5	55,378	20.96
7	58,726	22.23
9	58	0.02
15	52,420	19.84
22	42,438	16.06

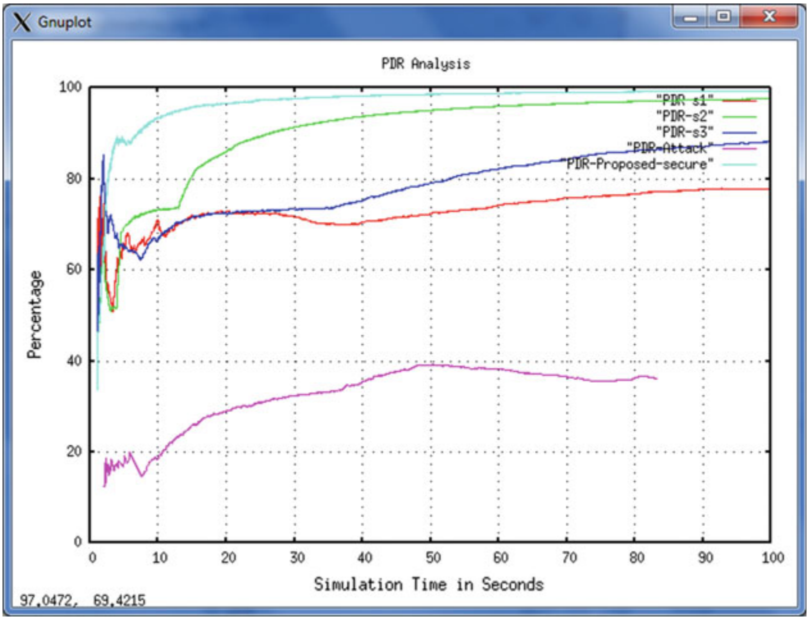

Fig. 1 PDR performance analysis

Percentage of data receiving, during difference scenarios. The Result concludes that proposed security mechanism defends the attacker node from data transmission or participation in communication, meanwhile our data transmission ratio is improved.

D. **Throughput Analysis**

The throughput performance is evaluated through number of packets is received at destination in unit time (Fig. 2). The throughput performance of remapping attacker is about 1300 pks/s up to time 83 s but in security scheme the throughput is

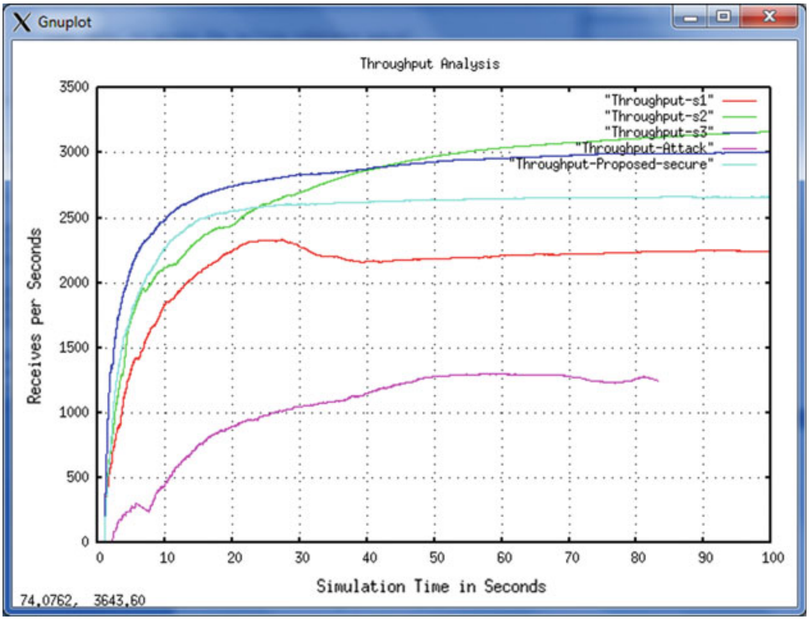

Fig. 2 Throughput performance analysis

enhanced about 2200 pks/s. The performance of rest of the normal scenario is equivalent to secure routing performance and also the S2 reaches to 3000 pks/s.

5 Conclusion and Future Work

In MANET (Mobile Ad hoc Network) mobile nodes are continuously interchanging the information in the foam of packets or bits in network. The MANET is completely dynamic network because of random motion of mobile nodes. The sender in floods request and reply packets in network for identifying destination. The attacker in network is not interacting at the time of route establishment but it directly enhances the flooding capability by that network bandwidth is unnecessary consume. The remapping attacker behavior is same as that, flooding huge amount of packets unnecessarily to set their priority higher. The proposed security scheme is prevents the network from attacker. In this research three normal module S1, S2 and S3, one attacker module and one security module are simulated. The three normal modules are designed on the basis of different priority. The security module observe that the attacker and block their malicious activities. In proposed scheme decentralized network is looking and work like a centralized network and it easily defend and prevent from attack behaviors during mobility environment. The results show that the presence of a Remapping Attack increases the packet loss and routing load in the network considerably. The proposed security mechanism against Remapping Attack protects the network through identified the nodes priority based communication and heavy flooding of malicious node/s.

The nodes of MANET depend on one factor also i.e. node battery power or node energy. The nodes working capability is decided through remaining battery power of node/s. The energy efficient routing will surely improves the network life time in network. In future we will propose the energy efficient routing algorithm to improve network life time and also simulate remapping attack effect on energy consumption.

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Web Log Analysis Tools: At a Glance

Vinod Kumar and Ramjeevan Singh Thakur

Abstract Current cyber space is now flooding with huge number of Web sites, and the analysis of the Web sites is extremely needed to extract the gainful information. For the analysis task on Web sites' log file, there exist various log analysis tools. However, the impeccable trouble emerges in determination of suitable tools. This work provides an examination of open source and commercial toolsets available for the analysis and its basic internal analysis process; the study will provide many choices to pick from when deciding a toolset to manage and analyze log data. The paper will help to review the set of tools currently available and positively hook the right tool to get started on analyzing logs files.

Keywords Web log analyzer · Web usage mining · Web log analysis
Web log

1 Introduction

Web has changed into the environment where people of all ages, dialects, and cultures spend their daily digital lives. Working or entertaining, learning or hang out, home or on the way, discretely or as an assembly, people are ubiquitously encircled by a setup of devices, networks, and applications. This infrastructure combined with the continuously rising amount of information supports the user's intellectual or physical activity. Whether searching, using, or creating and disseminating the information, users leave behind a great deal of data disclosing their information requirements, attitudes, private, and environmental facts. Web designers assemble these artifacts in a variety of Web logs for subsequent analysis.

V. Kumar (✉) · R. S. Thakur
Department of Computer Applications, Maulana Azad National Institute of Technology, Bhopal, Madhya Pradesh, India
e-mail: vinodkumarfbkp@gmail.com

R. S. Thakur
e-mail: ramthakur2000@yahoo.com

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Hence, it is interesting and required to study the user actions and its result on analysis task one of the key tasks. Web log mining is to discover the hidden facts, such as user's browsing habit, and deliver it to the Web site managers or service providers for improving content organization. Today, Web log mining [1] is being performed at its peak over World Wide Web. Web mining is categorized into three basic classes—Web content mining, Web structure mining, and Web usage mining (WUM) [2]. Here, Web usage mining [3] focuses on determining the user's behavior [4, 5] from Web log data. A variety of tools are available that can perform Web usage mining, taking Web access logs as an input and generating the reports as an output. Thus, a log analysis tool is defined as a piece of software that allows analytical processing of log files according to user-specified instructions.

2 Comparison of Various Web Log Analyzers

The large set of Web log analyzer software tools is available in the market for performing the analysis from Web log [6] to get the fruitful information in simple and effective way. Among the large set of tools available today, it is a tedious and time-consuming task to find the suitable tool to perform the analysis economically, efficiently, and effectively. The summarized and comparative [7–10] representation of study in Table 1 clearly discovers the right tool for the work to help the reader commence on analyzing log files. Although, there are a great number of features available in each Web analyzer tools, some of the significant and steering features are included to perform comparison.

3 Methodology for Web Log Analysis

This section focuses and describes entire methodology for Web log analysis how the Web log analysis function is performed. The Web log analysis in the lack of analyzer is quite complex and time consuming and difficult task. Now, the analysis work is simplified by using the automated software tools with the simplified basic steps which are adopted in Web log analysis [11] process. The steps are detailed below.

3.1 Log Data Collection

The first step in the Web log analysis process is the collection of the log data from the sources. There exist many sources of Web log data from which the log data can be obtained. These sources may be your computer system, proxy server, Web server, etc. The log data exists in various sources such as Web server log, application software log, system log.

Table 1 Summarized and comparative presentation of various Web log analysis tools

Serial No.	Name of Web analysis tool	Vendor	Current version	Log file formats	Web site linkage	License	Language	User interface
1	Google Analytics	Google Inc.	Single	CLF, XLF, ELF	Yes	Free	Java Script	GUI
2	Deep Log analyzer	Deep Software Inc.	7.0	Apache, IIS, CLF, XLF, ELF	Imported	Proprietary	In-built	GUI
3	Web Log Expert	Alentum Software	9.3	Apache, IIS	Imported	Proprietary	In-built	GUI
4	Visitors	Salvatore Sanfilippo	0.7	CLF, Apache, IIS, W3C	Imported	GNU-GPL	C	CLI
5	Webalizer	Webalizer	2.23–08	CLF, XLF, ELF, FTP	Imported	GNU-GPL	C	CLI
6	Analog	Community Development	6.0.	CLF, IIS W3C	Imported	GNU-GPL	C	CLI
7	Piwik	Piwik Inc.	2.16.5	Apache, IIS, Ngnix	Imported	GNU-GPL	Python/Ruby	GUI
8	Open Web Analytics	Open web analytics	1.5.7	CLF, XLF, ELF	Imported	GNU-GPL	PHP	GUI
9	AW Stats	AW Stats Inc.	7.5	CLF, XLF, ELF, W3C, etc.	Imported	GNU-GPL	Perl	GUI
10	Web log Storming	Dataland Software	3.2	IIS W3C Extended log file format Apache	Yes	Proprietary	C	GUI
11	Webtrax	John Callender	23	NCSA combined format	Imported	GNU-GPL	Perl	CLI
12	Dailystats	Perlfect Solutions	3.0	CLF, XLF, ELF, W3C, etc.	Imported	GNU-GPL	Perl	CLI
13	Relax	Free Software Foundation, Inc.	2.80	Apache combined, NCSA extended/CTL, WebSTAR	Imported	GNU-GPL	Perl	CLI
14	StatCounter	StatCounter	3	Embedded in Web page	In-Built	Proprietary	–	GUI
15	SAWMILL	Flowerfire Inc.	8.7.8	IISW3C, ELF format, Apache	In-Built	Proprietary	C	GUI
16	GoAccess	MIT Licensed	1.0	Apache, ginx, CLF CloudFront, ELF	In-Built	Open Source	C	GUI-CLI
17	Nihuo Log Analyzer	Nihuo Software Inc.	4.19	Apache, Zeus, Lighttpd/NCSA, IIS 4/5/6/7 logs	Imported	Proprietary	JavaScript, HTML	GUI-CLI
18	HTTP-ANALYZE [10]	RENT-A-GURU, Inc.	2.4	NCSA CLF, W3C ELF	In-Built	Proprietary	C	GUI-CLI
19	Log Analytics Sense	Statspire Software	2.3	More than 40 formats	Imported	Proprietary	-	GUI-CLI
20	AlterWind Log Analyzer	Alterwind Software	4.0	ApacheCommon, Combined, and IIS log file formats	Imported	Proprietary	–	GUI-CLI

(continued)

Table 1 (continued)

Platform	Report format	Availability of dynamic reports	E-mail facility	Report scheduler	Ability to handle compressed files	Real-time analysis	Mobile tracking	Source URL
Platform	Report format	Availability of dynamic reports	E-mail facility	Report scheduler	Ability to handle compressed files	Real-time analysis	Mobile tracking	Source URL
Windows, Mac, Linux, Solaris	HTML, PDF, CSV	Yes	Yes	Exterior	No	Yes	Yes	http://www.google.com/analytics
Windows	HTML/Ms-Excel	Yes	No	In-Built	YES	Yes	No	http://www.deep-oftware.com/
Windows	HTML, PDF, CSV	Yes	Yes	In-Built	YES	No	No	http://www.weblogexpert.com/
Unix/Linux/Mac	HTML	No	No	Exterior	No	Yes	No	http://www.hping.org/visitors/
Unix/Linux/Mac	HTML	No	No	Exterior	Yes	No	No	http://www.webalizer.org/
Windows/ Unix/Linux/Mac	HTML	No	No	Exterior	Yes	No	No	http://analog.gsp.com/
Windows/ Mac/Linux/Solaris	HTML/PDF	Yes	Yes	Exterior	No	Yes	Yes	http://www.piwik.org/
Windows	HTML	No	No	Exterior	No	No	No	http://www.openwebanalytics.com
Windows	HTML/PDF	Yes	Yes	Exterior	No	Yes	No	http://www.awstats.org/
Windows	HTML/PDF	Yes	Yes	Exterior	Yes	Yes	No	http://www.weblogstorming.com
Windows/Unix/Linux/Mac	HTML	No	No	Exterior	No	No	No	http://multicians.org/thvv/webtrax-help.html

(continued)

Table 1 (continued)

Platform	Report format	Availability of dynamic reports	E-mail facility	Report scheduler	Ability to handle compressed files	Real-time analysis	Mobile tracking	Source URL
Windows/Unix/Linux/Mac/	HTML	No	No	Exterior	No	No	No	http://www.perlfect.com/freescripts/dailystats/
Linux	HTML/CSV/Text	No	No	Exterior	No	No	No	http://ktmatu.com/software/relax/
Windows	CSV	YES	No	In-Built	No	Yes	Yes	https://statcounter.com/
Windows/Unix/Linux/Mac	HTML	YES	Yes	In-Built	No	Yes	Yes	http://sawmill.net/
Unix/Linux/Mac	HTML, CSV, JSON	YES	No	Exterior	No	Yes	No	https://goaccess.io/
Windows/Linux/ Mac OS/FreeBSD	HTML	YES	No	In-Built	Yes	Yes	No	http://www.loganalyzer.net
Windows/Linux/ Unix Mac OS/	HTML	YES	No	Exterior	No	Yes	No	http://analyze.org/index.php
Windows	HTML	YES	No	Exterior	Yes	No	No	http://www.statspire.com/
Windows	HTML	YES	–	No	Yes	No	No	http://www.alterwind.com/

3.2 Preprocessing Phase

This is the preliminary task in the Web log analysis work. The preprocessing of Web log [1, 12] data encompasses the following subtasks.

3.2.1 Data Cleaning

During data cleaning, irrelevant and extraneous data are eliminated. It deals with detecting and removing errors and inconsistencies from data in order to improve the quality of data. Now, cleaned data is used by the Web log analyzer mentioned in Table 1 for further processing.

3.2.2 User Identification

The task user identification [13] is to find the different user who has visited the Web site. This is done by all the available Web log analyzer as an important analysis task in Web log data analysis.

3.2.3 Session Identification

According to Habin et al. [13] a session can be described as a sequence of activities carried out by a user between the entry and exit from the Web site. This result helps in finding out the potential visitors over the Web site. This is also the significant feature in the analysis task performed by the above log analyzers.

3.2.4 Path Completion

The local caching and proxy servers pose the problems for path completion [1, 13, 14] because users may reach the pages in the local caching or the proxy server caching devoid of leaving any trace in server's access log. The purpose of the path completion is to accomplish task by appending the discovered user's travel pattern and the missing pages in the user access path.

3.2.5 Pattern Discovery

Pattern discovery [15, 16] is the crucial course of action in Web usage mining which comprises grouping of users centered on similarities in their profile and search behavior. This available feature is significantly helpful in finding out the

Web page navigation pattern used by the users to design the Web site. Deep log analyzer, Web log expert, Webalizer depicts it well. The software tool "Visitor" lacks this feature.

3.3 Pattern Analysis

Pattern analysis [11, 17] is the final phase in Web usage mining which is aimed at mining interesting rules, pattern [18–21], or statistics from the result of pattern discovery step, by discarding unrelated rules or statistics. Finally, the result obtained from pattern analysis is the main crux of the Web log analysis task. Thus, report generated from the Web log analyzer may be saved as HTML, CSV, and PDF, etc.

4 Conclusion

There is range of tools available online for this type of analysis and producing the reports, some of which are open source and proprietary. A comparative investigation on the widely used analyzing tools had discovered a variety of several features which are superior to the other. If somebody wishes to use commercial software, the deep Web log analyzer and Web log expert analyzer are very powerful and useful giving the almost similar result. In case of open source, Piwik is very helpful for Web log analysis. For online and real-time Web log analysis, Google analytics and StatCounter are very useful and powerful Web log analyzer. These tools help in taking decisions to incorporate and improve the Web site as per user requirement. Using the reports and results generated by the tool of the visitors visiting a Web site, one can get a rational and true idea about the behavior of the visitors and their navigational paths and patterns which support in determining the influence and popularity of the Web site.

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A Benign and Malignant Mass Classification Based on Second-Order Statistical Parameters at Different Offset

Pravin Palkar and Pankaj Agrawal

Abstract The objective of this paper is to investigate the classification of masses on digitized screening mammograms as benign or malignant with second-order statistical parameters. Many CAD tools were developed over the past two decades to help radiologists in detecting and diagnosing breast cancer. The proposed method removes and deletes unwanted signs present in the digitized mammogram sample's background and applies enhancement process to eliminate noise and find the breast region. After that, segmentation phase is performed for automatic mass detection. From detected mass, second-order texture features from gray level co-occurrence matrix (GLCM) are extracted. These extracted parameters for different offset are plotted and based on the relation of direction's plots; the mass is classified as benign or malignant.

Keywords Breast cancer · Mammogram · Statistical parameters
Segmentation · GLCM · Mass classification

1 Introduction

Cancer is a disease that causes cells in the body to change and grow out of control. It is uncontrolled multiplication of a group of cells in a particular location of the body [1]. Mostly, the cancer cells are a tumor and the cancer is named after the part of the body where the tumor originates [2]. Breast cancer begins in breast tissue. In recent years, occurrence of breast cancer has increased significantly and deaths occurred due to it is a recognized world health problem. It is one of the leading causes of fatality, with approximately 1 out of 12 women affected by the disease

P. Palkar (✉)
RTMNU, Nagpur, India
e-mail: p_palkar@yahoo.com

P. Agrawal
G. H. Raisoni Academy of Engineering and Technology, Nagpur, India
e-mail: pankaj.agrawal@raisoni.net

B. Tiwari et al. (eds.), *Proceedings of International Conference on Recent Advancement on Computer and Communication*, Lecture Notes in Networks and Systems 34, https://doi.org/10.1007/978-981-10-8198-9_15

during their lifetime. In India, breast cancer is the second most common cancer in female after lung cancers and the death rate is reported as one in eight women [3]. The most effective way to reduce deaths caused by breast cancer is to detect and treat it early as there are chances of successful treatment. Currently, many imaging techniques for breast cancer detection are available [4] and the mammogram is the most efficient system to detect abnormal masses [5], recommended for breast cancer screening. Detecting suspicious abnormalities to radiologist is a repetitive and fatiguing task. Due to this, abnormality may be overlooked. Hence, a number of computer-aided detection (CAD) systems has been developed in past few decades to aid radiologists in detecting mammographic suspicious mass, which may indicate the presence of breast cancer. These systems can only assist to improve accuracy of detection, but the final decision has to be made by the radiologist only [6]. The input to computer-aided detection (CAD) systems can be obtained either from a conventional or a digital mammogram. The computer software then searches abnormal masses in mammogram, which may indicate the presence of breast cancer. The CAD system enhances these masses by preprocessing. In CAD system, first stage covers the mammogram preprocessing and detection of the breast region. The second stage detects suspicious masses in the breast region. It then finds ROI and its statistical features. These obtained statistical features indicate some quantifiable information of detected mass of mammogram which is input to the classification stage. Based on this, the suspicious mass is classified further as benign or malignant [7].

2 Preprocessing and Mass Detection

In our proposed method, we are using MIAS's database images [8]. This database includes both right and left-sided mammograms. For simplifying the preprocessing, we swap right-sided mammograms to left side. Then we deleted the unwanted signs, labels, and noises of the image. For deleting these, we act as follow: first, we performed median filtering. It is mainly used to reduce or eliminate noise presents in the image. Nonlinear median filter not only reduces the noise but also preserves useful information in the image [9]. This filter efficiently removes the salt and pepper noise and retains the sharpness of image edges [10]. Then compared median filtered image with threshold intensity value to get processed digital mammogram image by doing following process [11]. From the binary objects in the mammogram image, the regions with fewer than 50 pixels are removed by using the *bewareaopen* function. Then a morphological operation is performed to reduce distortion and remove isolated pixels (individual 1's surrounded by 0's) of the binary images using the function *bwmorph* with parameter 'clean.' After this, we removed the left, right, and background parts of the mammogram which is redundant as it does not cover breast region. Now it is also important to detect the pectoral muscle and defines the region of interest (ROI) for further analysis. The pectoral muscle, slightly brighter compared to the rest of the breast tissue as shown in Fig. 1, can appear in the mammogram.

For removing redundant parts and for detecting and removing the pectoral muscle of the breast, the following method is applied. As shown in Fig. 1, initially trace the mammogram from left side and find first nonzero column to get the cutline AB then determine the middle point C at the top margin and straight-line CD plotted from the point C to lower left corner point D of the mammogram. This line CD crosses the line AB at point E. The resulted inverted right-angle triangle ACE is cropped from the breast region. In this way, the pectoral muscle is detected and removed efficiently in most of the cases [12]. Next, to get straight-line FG, trace the mammogram from right side and find first nonzero column.

In this way, we successfully removed unwanted pectoral muscle and left-hand, right-hand black stripe from the mammogram. The above method is tested on MIAS database and as per expectation, it detects and removes the pectoral muscles with good success ratio [13]. The mammogram carries the information in the form of different intensities and textural variations. Our approach is to isolate the spatially interconnected structures in the image to form regions concentrated around prominent intensities. Hence after getting interested breast contour as shown in Fig. 2, we found brightest pixel to get threshold value for getting spicules. Once getting intended spicules, we identified seed point and grown that dynamically to get mass region as shown in Fig. 3.

In the figure, we observe that abnormal areas of density, mass, or calcification are easily detected and with respect to the size of mass, size of ROI is defined dynamically [14]. This defined dynamic ROI of digital mammogram is used to extract the statistical features to detect the breast cancer.

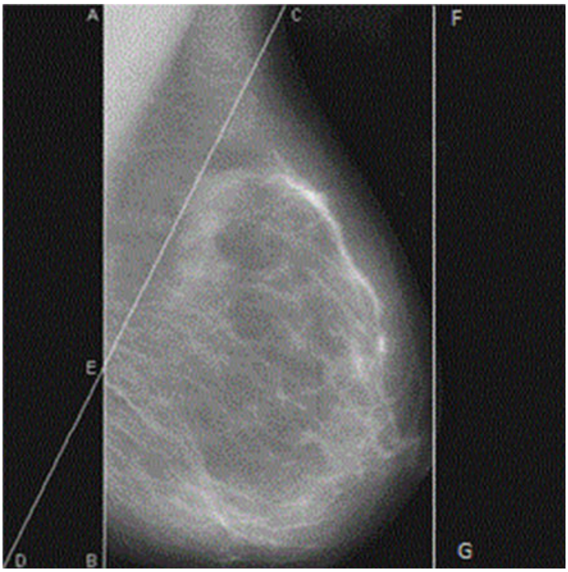

Fig. 1 Mammogram with pectoral muscle and background

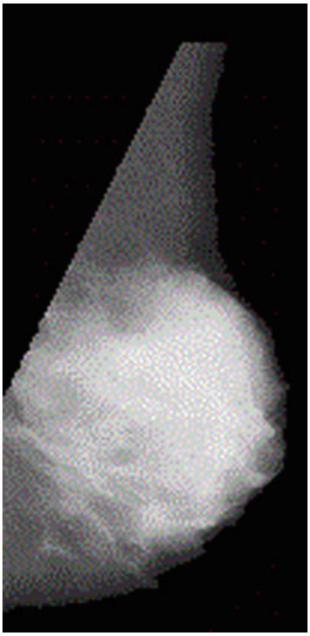

Fig. 2 Mammogram without pectoral muscle and background

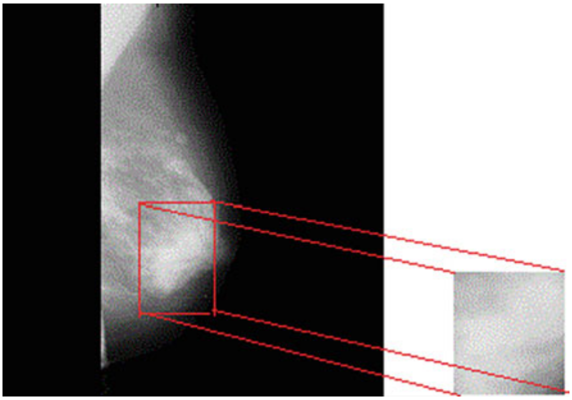

Fig. 3 Automatic detection of mass region in digital mammograms

3 Feature Extraction

The mammogram tissues are characterized by random and no homogeneous structures. For this reason, the analysis by the statistical methods will be preferentially used [15]. Statistics that describe a texture can be computed from the gray tones (or colors) themselves. This approach is less intuitive but is computationally efficient and can work well for classification of textures [16]. Texture features have been proven to be useful in differentiating masses of breast tissues as benign and malignant [17]. In our proposed method, we have extracted second-order statistical features of GLCM. These features provide information about the texture of the mammogram. The GLCM matrices are constructed with distance varying from $d = 1–10$ in step of 1 in orientation of 0°, 45°, 90,° and 135°. At any single orientation and distance, it will provide insufficient texture information, so we have considered four different orientations with different offsets for benign and malignant mammograms. We have considered following gray levels values of GLCM matrices:

- Contrast: It is a measure of local level variations and takes high graylevel values for the mass of mammogram of high contrast.
- Energy: It is referred as uniformity and takes high graylevel values for the mass of mammogram which has very similar pixels.
- Homogeneity: It is measures of closeness of the distribution of elements in GLCM to the diagonal of GLCM and is high for uniform gray levels.
- Correlation: It measures the joint probability occurrence of the specified pixel pairs.

4 Experiment Results

After extraction of features, the graphical representation of second-order statistical features with respect to different offset is very interesting. The observation of variation of each features with different directions given as 0°, 45°, 90°, and 135° at different offsets are very useful to classify the mass. The detected mass is used to calculate graylevel values of GLCM second-order statistical features such as contrast, homogeneity, energy, and correlation with respect to different orientation for $d = 1$ in benign and malignant cases and is shown in Tables 1 and 2, respectively.

The graphical representation of the energy contrast, homogeneity, and correlation values for benign and malignant masses is also cited in Figs. 4 and 5, respectively.

Table 1 Statistical parameters of benign mass

Direction (°)	Statistical parameters at $d = 1$			
	Energy	Contrast	Homogeneity	Correlation
0	0.4689	0.0323	0.9839	0.938
45	0.4526	0.0525	0.9738	0.8989
90	0.4633	0.0382	0.9809	0.9269
135	0.459	0.0443	0.9779	0.9148

Table 2 Statistical parameters of malignant mass

Direction (°)	Statistical parameters at $d = 1$			
	Energy	Contrast	Homogeneity	Correlation
0	0.3482	0.065	0.9675	0.9294
45	0.3263	0.0964	0.9518	0.8955
90	0.3516	0.0591	0.9705	0.9362
135	0.3428	0.0716	0.9642	0.9223

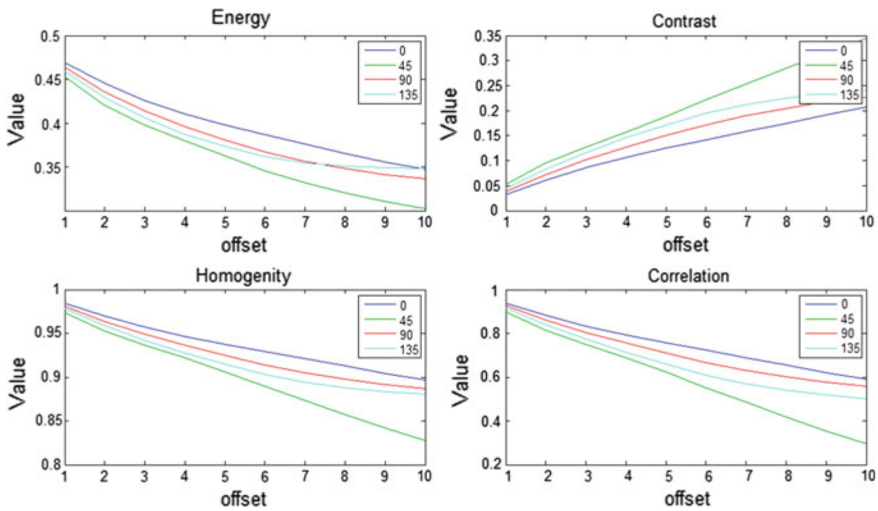

Fig. 4 Relation of second-order statistical parameters at different direction for benign mass

The graphical representation shows that the variation in values of energy contrast, homogeneity, and correlation for mass of sample mammogram is highly different as per our expectation for benign and malignant masses, and the variation for both the cases is different and easily recognizable. It shows effectiveness of the proposed method in discrimination of the masses as benign and malignant.

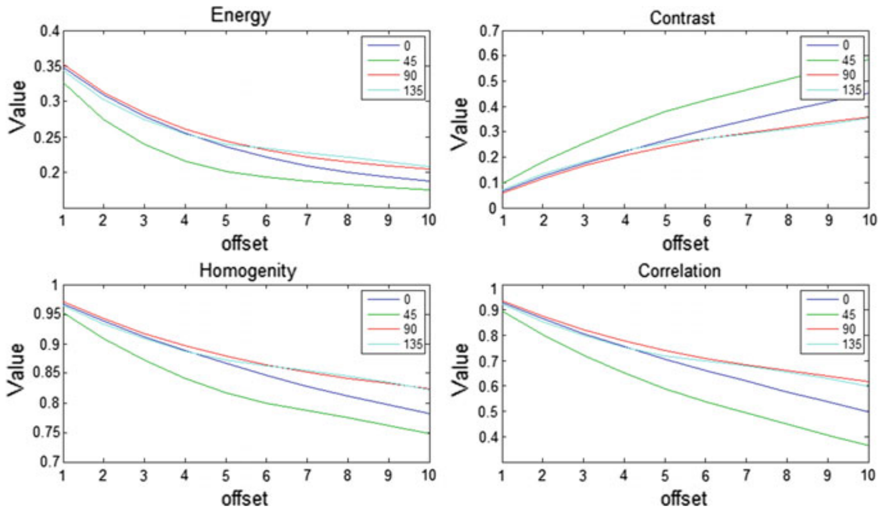

Fig. 5 Relation of second-order statistical parameters at different direction for malignant mass

5 Conclusion

In this paper, we have presented a method to detect the suspicious mass of a digital mammogram and characterize this mass region based on statistical parameters with different directions at different offsets. Investigation of the preliminary results obtained from graphical representation reveals that the variation in mentioned statistical parameters w.r.t offset clearly distinguishes the mass between benign and malignant. Thereafter, the variation in parameters with different direction at different offset could be used to define criteria of decision that will permit to distinguish a mammogram as benign or malignant.

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Support Vector Machine (Linear Kernel) and Interactive Genetic Algorithm-Based Content Image Retrieval Technique

Ankita Dayma, Amit Shrivastava, Aumreesh Kumar Saxena and Manish Manoria

Abstract Images are used to understand better and efficient services in many fields like crime prevention, government, hospitals, fashion and graphics, journalism. The popularity of the entire digital image tends to the huge amount of digital data in image database. It is difficult for the system to retrieve and search the query image from the large amount of data in database. This process takes a lot of time, and to overcome this problem Content-based image retrieval was introduced (CBIR). In CBIR, the image is searched or retrieved by sending the query image by the user and the visual feature extraction is done of the CBIR to retrieve the query image. The main ingredient of the proposed work is support vector machine along with the genetic algorithm. Here the chromosome is made differently. This work is implemented in MATLAB and calculates its performance.

Keywords Support vector machine · Genetic algorithm · Content-based image retrieval · Precision · WANG image dataset

1 Introduction

The technique to search and list the images in a huge collection of data based on the visual contents like textures, shapes, colors, and spatial layouts is known as content-based image retrieval (CBIR) [1, 2]. In CBIR, metadata description keywords or tags are not used which are associated with the image in that database.

A. Dayma (✉) · A. Shrivastava · A. K. Saxena · M. Manoria
CSE, SIRTS, Bhopal, India
e-mail: ankitadayma19@gmail.com

A. Shrivastava
e-mail: sagar.amitshri@gmail.com

A. K. Saxena
e-mail: aumreesh@gmail.com

M. Manoria
e-mail: manishmanoria@sirtsbhopal.ac.in

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The extracting of data from the database in CBIR is typically done by one or many multidimensional vectors from every image [3]. This process is done in the very beginning phase of extracting data. Similar query image is extracted at the query time so the similarity function is used which will get the difference between the same query images and the actual query image vector [4, 5]. There are various applications of using CBIR such as in GIS, medical diagnostics, military applications, computer vision, pattern recognition, and many others. In some of the application, only the feature extract is done by CBIR which has certain properties of the query image vector locally for its region or globally for that image. There are some features which are widely used in content-based image retrieval like color feature because it is independent of image orientation and size. They are extracted by calculating the color moments, color histogram, or dominant color for different color spaces like HSV, YCbCr, and RGB [3, 6].

1.1 CBIR Techniques

Color-Based Method—The most vital feature of any image is color. In color model or space, the color feature is the subject to be described for the particular image. In the 3D space, every single pixel of the color image can be pointed and embodied. There are various color spaces that are used in CBIR like LUV, HSV, and RGB for image retrieval. Uniformity is the main characteristic of any color space feature used for appropriate picture retrieval. For the picture display, RGB space is the most utilized color space [3]. The color constitutes in this space are red, green, and blue. For the computer graphic display, HSV space is most commonly used in color space and is also very intuitive and delineating color. The color constitutes for this space is hue, worth (brightness), and saturation (Lightness). There are three main methods used in color-based method for image retrieval in CBIR. They are as follows [7, 8]:

1. Color Moment (CM)—It is utilized in the arrangement which is countless and encompasses after the object. In this technique, the mean early order, the variance (subsequent), and the skewness which is the third-order color moments are computed. The main advantage of using this technique is that it is very compact, effective, and competent as difference to the supplementary feature extraction. The limitation of this technique is that it does not describe every color and also does not provide spatial information.
2. Color Histogram (CH)—If the picture is contrasted along the side of the rest of data set than the color histogram is used which acts as an competent representation of the colored part of that particular image. The benefit of using this technique is that computation is easy and it provides rotation about the view axis and robust to translate.
3. Color Coherence Vector (CCV)—It is a dissimilar method to assimilate spatial data into the color coherence and color histogram method proposed. The

histogram bit is divided into two bits that is incoherent if the bit does not belong to the colossal uniformly colored span, or consistent if it belongs to it. In this technique, picture is described as the vector. The advantage of using CCV over color histogram is that it shows the spatial information which retrieves better image but it is not cost efficient and also needed high dimension.

2 Support Vector Machine (SVM) Model

Classification SVM is a support vector machine classifier for one- or two-class learning. To trained a data then classification done by SVM classifier. Trained classification SVM classifiers store the training data, parameter values, prior probabilities, support vectors. Support vectors are observations corresponding to strictly positive estimates of $a_1 \ldots a_n$. SVM classifiers that yield fewer support vectors for a given training set are more desirable. The SVM binary classification algorithm searches for an optimal hyper lane that separates the data into two classes. For separable classes, the optimal hyper lane maximizes a margin (space that does not contain any observations) surrounding itself, which creates boundaries for the positive and negative classes. For inseparable classes, the objective is the same, but the algorithm imposes a penalty of the length of margin for every observation that is on the wrong side of its class boundary. The linear SVM score function is $f(x) = x'\beta + b$ (Fig. 1).

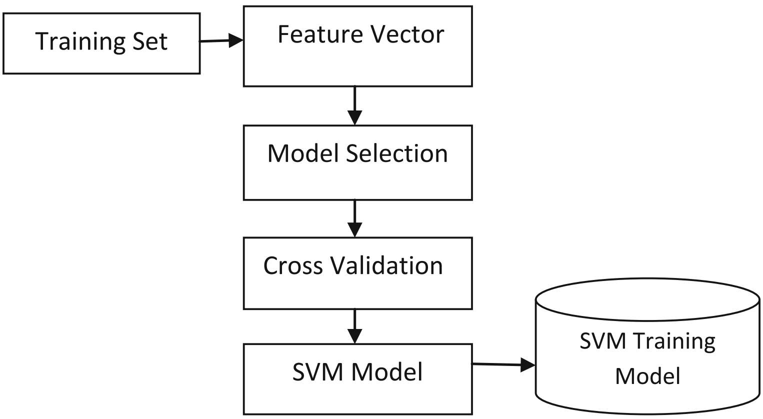

Fig. 1 SVM generation model

3 Proposed Methodology

3.1 Genetic Algorithm in CBIR

Genetic algorithms are the problem-solving methods which use genetics as a model shown in Fig. 2. It is a technique in which the approximate solution to the search and optimized problem is solved. There are some phases in genetic algorithm to solve the problem. There is first the selection than crossover and then the mutation. The very basic genetic algorithm is as follows [9]:

Step 1 START (*n* number of chromosomes, appropriate solutions for the problem).
Step 2 FITNESS (Assess the worth of each chromosome in population).
Step 3 NEW POPULATION (Apply the following steps for creating new population).
Step 4 SELECTION (Selection of better fit chromosome from the population).
Step 5 CROSSOVER (crossover of the new parents to make a new children, copy of parent).
Step 6 MUTATION (Due to probability, mutation at each position in chromosome is done).
Step 7 ACCEPTANCE (Placing the newly born chromosome to population).
Step 8 REPLACE (The new population is summed up for new algorithm).
Step 9 TESTING (Return of the optimal solution in current population).
Step 10 LOOPING (Return to the step 2 for evaluating fitness).

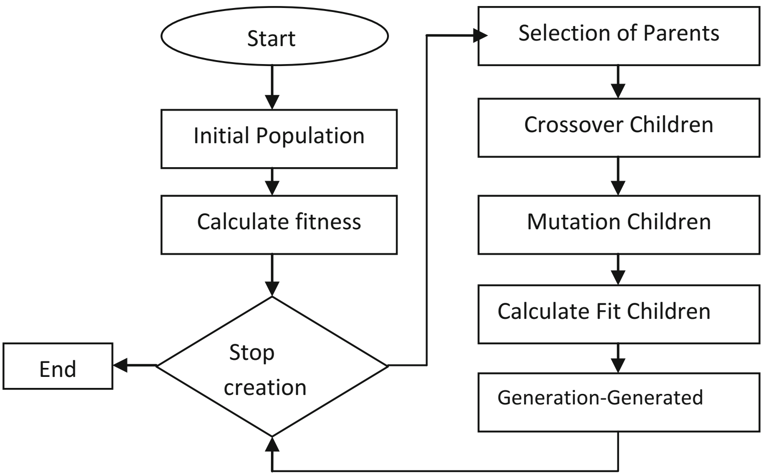

Fig. 2 Genetic algorithm flowchart

3.2 FlowChart

Content-based image retrieval is a process which needs to implement the following features:

1. Improve the precision of the target query images.
2. Decrease the false positive rate of the image retrieval (Fig. 3).

3.3 Formulas

Precision: It is a static quantity which measures the efficiency of the algorithm to find the relevant images out on retrieved images in search domain.

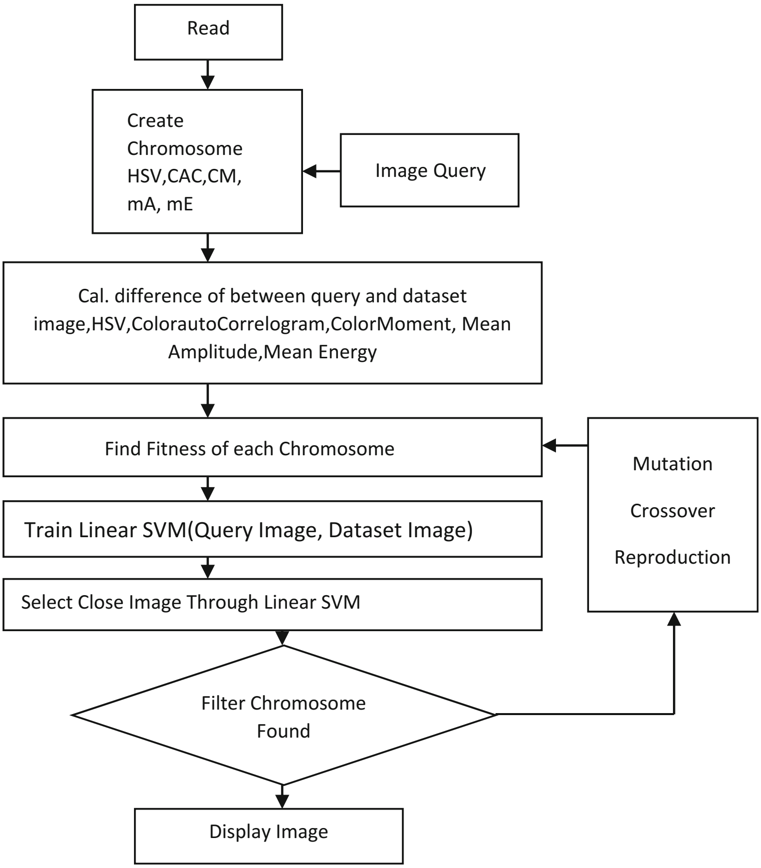

Fig. 3 Flowchart of proposed work

$$\text{Precision} = \frac{\text{No. of Relevant Images} * 100}{\text{No. of Retrieved images}}$$

Here hybrid approach based on SVM and genetic algorithm is used to achieve better precision and decreased false positive rate. In this proposed work, SVM is used to enhance the efficiency of the interactive genetic algorithm. The SVM used in this proposed work is implemented through linear kernel.

Proposed Work()
{
Input: query image and database
Output: some selected image from database

1. Read database and calculate chromosome value for each image.
2. Read query image and calculate its chromosome.
3. Calculate difference between query image and other dataset images.
   (1) distance_CAC(Dataset Image) = pdist2(q_chrom.colorAutoCorrelogram (Query Image),image_db(Dataset Image).colorAutoCorrelogram);
   (2) distance_CM(Dataset Image) = pdist2(q_chrom.colorMoments(Query Image),image_db(Dataset Image).colorMoments);
   (3) distance_h(Dataset Image) = pdist2(q_chrom(Query Image)HSV,image_db(Dataset Image).HSV);
   (4) distance_MA(i) = pdist2(q_chrom.meanAmplitude(Query Image),image_db(Dataset Image).meanAmplitude);
   (5) distance_msEnergy(Dataset Image) = pdist2(q_chrom.msEnergy(Query Image),image_db(Dataset Image).msEnergy);
   (6) fit_value(i) = distance_CAC(i) + distance_CM(i) + distance_h (i) + distance_MA(i) + distance_msEnergy(i);
   (7) fit_value(i) = fit_value(i)/5;
4. Consider image dataset as input for SVM.
5. Train SVM from imagesdataset along with Linear kernel.
   (1) databaseValue = [distance_CAC′,distance_CM′,distance_h′];
   (2) [sortedDistindx] = sortrows(fit_value′);
   (3) svm(databaseValue, Image_name);
6. Select Close Image = SVM (each member image with respect to query image).
7. Calculate fitness of solution by selecting the two fittest parent came from step 3 through SVM.
8. Crossover the parent to form new offspring. If no new offspring is formed then offspring will be same as parent
9. If fitter offspring is produced then keep them in population
   else
   keep parent

10. Repeat step 5 to 7 step till stopping condition is reached

    }

4 Result Analysis

Image dataset WANG [10] is used while performing experiments. There is various kind and features of images such as flowers, horses, buses, butterfly. These images are 100 in each of the categories. These dataset images are shown in figure mentioned below:

Some flower images are shown in row-4, mountain in row-5, butterfly in row-6, and tree in row-7.

Table 1 shows the results when we pick a flower image 600.jpg as a query image and search the dataset images. The target is to find all similar images through our proposed work. Table 1 shows that how many similar images are found in the

Table 1 Flower images

Image file	Precision (in %)
600.jpg	100
609.jpg	100
608.jpg	100
610.jpg	95
601.jpg	95

Table 2 Mountain images

Image file	Precision (in %)
800.jpg	85
811.jpg	90
807.jpg	95
876.jpg	85
804.jpg	95

Table 3 Butterfly images

Image file	Precision (in %)
1.jpg	95
2.jpg	90
3.jpg	90
4.jpg	90
6.jpg	95

Table 4 Tree images

Image file	Precision (in %)
899.jpg	85
901.jpg	95
976.jpg	95
910.jpg	95
914.jpg	90

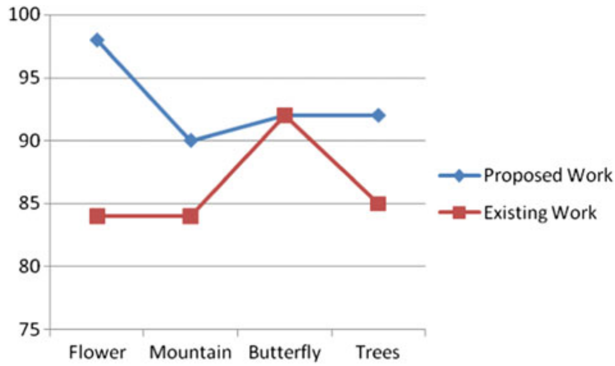

Fig. 4 Comparison of precision values with existing work

Table 5 Comparison of precision values with existing work

Images	Flower	Mountain	Butterfly	Tree
Proposed work	98	90	92	92
Existing work [10]	84	84	92	85

process. This number of similar images, out of all retrieve images, is numerically shown through precision values in the percentage. Similarly, Tables 2, 3, and 4 show the results (Fig. 4).

5 Conclusion

There is tremendous growth in the social network and multimedia technology in the recent years which leads to the large amount of images or digital data. Due to this reason, content-based image retrieval is the active topic of research for many researchers. The main problem is to retrieve the image fast and accurate, for this reason many algorithms are proposed to provide efficient and good performance [11]. The content-based image retrieval (CBIR) technology is used in various applications like crime prevention, medical, historical research, fingerprint identification, biodiversity information system, digital libraries, and many others. It is very much transparent from Table 5 along with the graph 1 that the performance of the proposed work is far better than the existing work. This efficiency got increase due to the fact of combination of SVM with genetic algorithm in association with chromosome structure. Percentage Increase Precision Value is as follows: flower: 16.66, mountain: 7.14, butterfly: 0, tree: 8.23. Overall Improve Precision Propose Methodology is 8%.

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A Research Paper on: Online Summarization and Real-Time Timeline Generation Using Stream of Tweets

Geeta G. Dayalani, Balkrishna K. Patil and Rajesh A. Auti

Abstract Twitter is the most popular microblogging service where millions of tweets are being posted daily on a wide range of topics. Short text messages are called tweets. The length of the tweet is limited to 140 characters. They are initiated at a very high rate. Tweets contain large amount of data which is noisy and redundant in nature. In this paper, a unique framework called Summblr for the summarization of continuous tweet data to deal with the issue is introduced. Traditional summarization procedures pact with smaller sets of data those are also static while Summblr, is introduced to deal with large data stream of tweets which arrives dynamically at an actual quicker rate. The framework comprises of three components. As a primary step, an algorithm to cluster the data stream of short text messages called tweets is developed that is networked which binds the tweets together and also maintains it in a novel data structure called TCV that is tweet cluster vector. Secondly, a new technique called TCV Rank summarization for producing both online and historical summaries of random time durations is projected. Thirdly, an approach for effectively recognizing the topic evolution is developed. This method analyzes progressively the alterations that are based on summary or else the quantity-based deviations to generate the timelines from large data of tweet streams automatically.

Keywords Summarization · Timeline · Tweet stream · Cluster Specification · Extractive summary · Tweet rank summarization Pyramidal time frame

1 Introduction

The huge amount of short text messages are being shared among the multiple users today. These short messages are called tweets on social networking and microblogging sites. Twitter, the microblogging site, which was started in the year

G. G. Dayalani (✉) · B. K. Patil · R. A. Auti
Computer Science Engineering, Everest College of Engineering, Aurangabad, India
e-mail: geetadayalani@gmail.com

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2006, has grown into a social significant happening. Millions of tweets are collected by Twitter on a daily basis. In the unprocessed form, tweets, while being expressive, can also be overpowering. If seeking for any latest Twitter topic, it may produce heap of tweets, ranging from weeks. Even if some filtering criteria are applied, seeking though ample amount of tweets for the relevant data would be an illusion, by taking into account the huge volume of repetition or redundancy and noise that one may come across it. Moreover, new tweets that satisfy the criterion of filtering the tweets may appear at an incalculable speed continuously. There are *n* numbers of ways to the overload problem of tweet data. One solution that is possible to overload problem of data is summarization. Summarization symbolizes a collection of few documents with a synopsis which comprises of very few numbers of sentences. A summary which is good should possibly cover all the significant topics including the subtopics and have diversification between various sentences to lessen the redundancy to a larger extent [1]. There are *n* numbers of uses of summarization like content or data presentation which is one of them. This case is especially when users surf on the net with the help of notebook or PDA devices like mobile phones which usually have very shorter screens when it is compared to PCs called personal computers. Existing methods to summarize the documents are of less valuable for tweets by considering both the plenty of tweets count and the quick essentials of the incoming tweets which are endless. Therefore, tweet summarization is in need of the features that differ from the traditional summarization functionalities to a greater extent. In extension, the tweet summarization has to consider the temporal nature of the plenty number of approaching tweets. The summarization system of tweets that is Summblr framework must encourage the two queries as follows: summaries of random durations of time and also the real-time timelines. Such kind of applications would be very supportive to simply move in the most important topics of tweets and will also support different examining tasks like immediate reports or the historical survey. In this paper, a novel method is proposed that summarizes the tweets together by taking into consideration the continuous nature of arriving tweets.

To execute continuous summarization of tweet data stream is a very complicated job, considering ample of tweets that are not relevant and contain lot of tweet data which is noisy. Hence, such tweet data is valueless in nature. In addition, all the tweets relate very strongly with the posted time and recent tweets continuously appear at a very quicker rate. Eventually, an enhanced solution for continuous or endless summarization of tweet data is needed which has to consider the following three points:

(1) Effectual, (2) adaptability, (3) topic advancement or evolution.

Traditional techniques of summarization do not complete the above three necessities because:

(1) They target small data sets that are also static in nature, and hence, these techniques are not helpful for too large data sets and streams.
(2) Iterative summarization is needed to perform for each and every time duration, which is not at all feasible.

(3) Results that are obtained from the summary do not take into consideration the timing factor. Thus, it not simple to find out the change in any tweet topic.

In this paper, it is intended to propose a novel framework to summarize the tweets called Summblr. Summblr implies continuous summarization by clustering of tweet data stream.

The main goal of this framework is as follows:

– A novel framework Summblr is proposed. Summblr indicates summarization by clustering. This is used to produce the short tweet summaries and timelines of the data streams.
– TCV, a novel data structure, is build up for the functioning of the tweet data.
– TCV Rank summarization algorithm is proposed for summarizing the online as well as historical tweet data.
– A new topic progression recognition algorithm that produces the timelines by supervising three different forms of deviations is also proposed.

2 Literature Survey

Here, related existing research work is illustrated here, and we also explain how our work is different from it. Summarizing the tweets altogether is a process that involves two steps. In the very first step, clustering together of tweet data is done, and in the next step, precise summarization of tweets is carried out.

A vast number of algorithms have been created for the summarization of documents during the most recent years. Out of this, well-known algorithms are Sum Basic [2] and also the centroid algorithm [3]. Sum Basics indicate that the words that take place across the documents very frequently have a higher chance of choosing for human-constructed multiple document summaries rather than the words that take place very less frequently in multiple documents. The 'centroid algorithm' considers a centrality calculation of a sentence formulated on the overall topic of the complete cluster of documents or to a document if it is the summarization of a single document. The LexRank algorithm [4] computes the significance of textual data units or the sentences in a single document or in the multiple documents. The TextRank algorithm [5] is basically an approach that is graph-based which tries to filter out the most high-priority sentences or specifically the keywords from the document using the algorithm called PageRank [6].

A. **Data Stream Clustering**: Data stream clustering is used for different varieties of applications that generally involve huge amounts of stream data. BIRCH [7] aggregates the information by utilizing the main memory structure which is called CF-tree structure in place of the unusual bulky data set. Bradley [8] advanced another important framework used for clustering which saves only the significant chunks of the data specifically and eliminates the remaining parts of the data which is of no use to the user. CluStream [9] is another stream clustering method. It comprises of two phases: One is online microclusters, and the other is offline microclusters. The authors also developed PTF that is pyramidal time frame [9] to recover the historical data clusters of random time durations specified. The clustering algorithm of tweet stream data is an online technique which does not require any clustering that is offline.

B. **Microblogging and Twitter**: The recent interest has been emerged in determining and also tracking the progress of different dealings on Twitter and also other social medium Websites, e.g., talks related to a volcanic eruption or earthquakes on Twitter [10], to detect novel procedures that are also called initial stories in the tweet stream data [11], visualizing the development of tags [12]. The difficulty has also been experienced from the point of vision of effectiveness: [13] suggests indexing and squeezing or compression methods to hurry up event discovery exclusive of sacrificing detection exactness. We suppose that the event detection has already been carried out, and our objective is to combine all the data in the tweets and bring out a timeline of the event in a summarized form.
C. **Document/Microblog Summarization**: Summarization of more than one document or multiple documents can be done by using two ways: One is summarization by extractive, and the second one is abstractive. Extractive summarization is a simple process. In this process, the data or the sentences are preferred from many of the documents itself, and on the other hand, abstractive summarization generates the group of words called phrase which may not be at hand in the definite active document.

In this paper, we ponder on the summarization that is extractive. Relevant scores are given to the statement of the documents and that sentences are particulated based on their ranking. Top ranked sentences are firstly selected [14, 15]. Some of the authors try to regain the summaries by neglecting the salient scores. Abstractive summarization is too difficult on the tweet data since it is very simply influenced by the noise and also the redundancy or by the huge changes in tweet data.

D. **Timeline Detection**: The requirement for examining extensive contents in social media rises to the development in different techniques related to visualization. Timeline is one of the famous methods which can make our investigating task very easy and also fast. Timeline is a better way to display a record of summaries of tweets in a proper sequential order.

3 The SUMMBLR Framework

As revealed in Fig. 1, our Summblr structure composes of three important components, namely clustering of tweet stream module, the high-level specification module, and the timeline creation module. In the section below, each of the modules in detail will be considered.

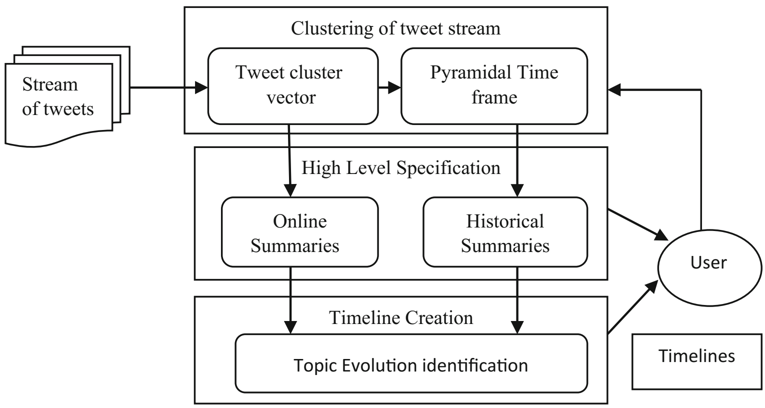


Fig. 1 The framework of Summblr

In the clustering of tweet stream module, the clustering algorithm that is highly effective is developed. An algorithm is online which allows clustering together the tweets with only a single pass over the entire tweet data. This algorithm makes use of two new data structures. The first one is called the tweet cluster vector (TCV). During the stream processing of tweets, TCVs are preserved dynamically in the main memory. The second data structure is the pyramidal time frame (PTF). To cache and systematize the snapshots of tweet cluster at various altered points, PTF is used. PTF permits the historical information of all the tweets to be fetched by any random period of time.

The high-level specification or summarization module helps to generate two kinds of summaries, namely online summary and historical summary.

(i) For producing the online summaries, the input is given by TCV which consists of the active or the current clusters that are maintained dynamically in memory. An algorithm called TCV Rank summarization is proposed for the same. The algorithm computes the centrality score of all the tweets that are maintained in the memory and selects that tweets which are highly ranked in terms of maximum content coverage and new topics.
(ii) Similarly, to generate the historical summary, the input is given by pyramidal time frame (PTF). PTF stores the tweet cluster snapshots. Here, we initially obtain two historical snapshots of cluster which indicates the beginning as well as the ending points and the time duration is specified by the user. Then, based on the change in the specified snapshots of the cluster, the TCV Rank summarization algorithm is finally used to create the summaries of tweets.

The third module that is timeline creation module is an identification algorithm of topic evolution, which consumes online summaries in addition to historical summaries and is given as an input to finally produce real-time timelines. This module detects the subtopic evolution by supervising the large quantifying variations when the tweet data stream is being processed.

4 Methodology

By using three different modules for tweet data, the proposed work can be successfully implemented. The modules are (A) tweet stream clustering, (B) summarization of tweet data, and (C) timeline generation of tweets.

A. Tweet Stream Clustering

In this module, initially, a tiny amount of tweets are heaped. A tweet cluster vector that is TCV is formed which consists of the tweets along with their respective time stamps. Thereafter, *K*-means algorithm is used, and preliminary clusters are formed. Then, the clustering process of tweet stream starts to update the vectors of tweet clusters incrementally. In incremental clustering, any of the tweets that comes at a certain timing factor *t* is headed to the minimum bounding similarity (MBS) and is determined whether that tweet should be added to existing clusters or created as a novel cluster. It resolves whether to perceive '*t*' in one of the present clusters or enhance *t* as completely a novel cluster. It finds that cluster whose centroid is nearest to time *t*. The updating process is carried out as soon as the new tweet arrives.

B. Summarization of Tweet Data

This module gives us the summary of tweets of any arbitrary or random durations of time. Historical summarization provides the effective data to the end user. Online summary particularizes what is at present argued socially or among the public. While historical summary supports us to be aware of the main actions during the specified period of time. This module removes the entire tweets that consist of unwanted data, outside of that mentioned period. These clusters are eliminated as the outdated clusters. The TCV Rank summarization method is being used to create the summaries of the clusters of tweets.

C. Timeline Generation of Tweets

This module deals with the topic evolution detection to generate real-time timelines. During the stream processing, the algorithm detects the subtopic changes by supervising the quantified variations. A hefty difference signifies a subtopic alteration which eventually creates a novel node on the timeline. This method initially collects all the tweets based on the time factors and then processes the tweet stream progressively. Whenever the large variation occurs, it creates a new node on the existing timeline.

5 Results and Analysis

The Summblr framework which comprises of three modules, namely tweet stream clustering, tweet summarization, and timeline generation of tweets, was successfully executed. Clusters of continuous tweet stream were created, and also, the summarizations of tweets between the defined timelines are also generated.

Input:

(1) We choose a data set of Twitter containing large number of tweets. The reference timelines are then generated.
(2) We perform searching operation of any particular query which is usually entered by a user in tweet data set.

Output:

(1) Gives the summarization of the related query that is given as an input.

System Boundaries:

The older data which is very not often visited by users or preceded by the users of Twitter is deleted and that the average time stamp of the most recent 10% tweets is above three days old and is considered obsolete and hence eliminated (Fig. 2).

To evaluate the performance of our system, we take into consideration the time essential to generate the summarization of large number of tweets and also the size of data. For existing system, to produce the summarization of tweet data of size 50,000 requires 60 s. For recommendation system, to produce the summarization of tweet data of size 5000 is expected to require 25 s. Clustering is executed with some tweets that are given as an input to cluster them altogether into their respective clusters depending on the togetherness or proximity of each and every tweet with the single topic of the cluster. Summarization is achieved with the help of rank formation on every tweet based on the reaction given by the users. Eventually, the tweets in addition to the time slots are also grabbed at which they are formed because of which the seeking method becomes easier. The graph shown below presents a complete visual illustration of the large deviations in the amount of tweets falling in at dissimilar bins of time in a month.

Figure 3 shows the results produced by the tweet data stream. The graph shows how the Summblr performs with respect to the tweet data continuously generating

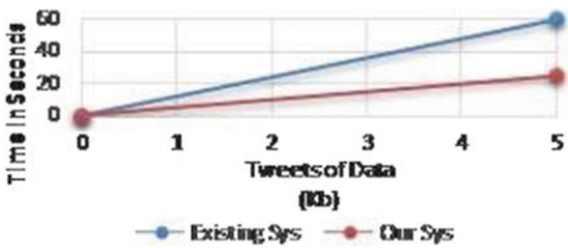


Fig. 2 Performance evaluation

Fig. 3 Scalability on data size

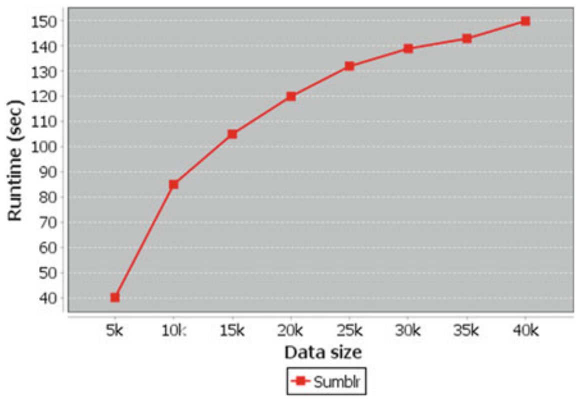
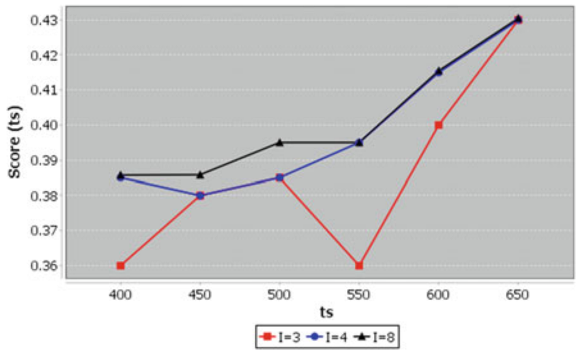


Fig. 4 Quality on time duration



within the seconds. Summblr is faster even if the data size is increased. So, our framework performs better as it is very flexible with respect to the tweet data.

Figure 4 shows the quality of the summary produced by our framework. Higher quality of summary is produced by more recent durations of time.

Figure 5 gives us the results produced for different step sizes. Summblr supports largely the continuous summarization. As the step size increases, Summblr performs very well in terms of the quality of summary and also the computational cost. Summblr balances between the efficiency and the quality of the summary produced.

6 Research Work

The framework Summblr effectively overcomes the drawbacks of traditional approaches. Traditional approaches are not effective since the volume of tweets is very large and the nature of tweet arrival is fast and continuous. Also, they mainly pay attention to very small size of data sets that are also static in nature. In addition,

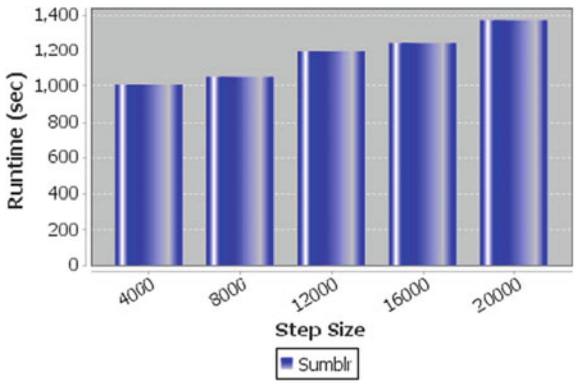


Fig. 5 Efficiency on step size

their summary results do not focus on the timing factor. Summblr takes into regard the temporal characteristic of the large arriving tweets. Summblr effectively implements continuous tweet stream summarization addressing the three issues, namely efficiency, flexibility, and topic evolution. Summblr produces very precise summary and generates it on timeline. Summblr is even not influenced by step size as it supports continuous tweet stream summarization. It strikes a superior stability between summary excellence and efficiency. Similarly, in addition to single topic, we have also implemented the framework for multiple topics.

7 Conclusion

In this paper, the system focusses on the collection and summarization of tweet streams with reference to the up-to-the-minute topics along the timelines to create the overview of evolution in topics that is characterized by subtopics. A framework called Summblr is projected which chains the summarization of tweets continuously. To reduce the large stream of tweets, Summblr uses clustering algorithm to cluster together the tweets into TCV structure and preserves them dynamically in an online manner. Consequently, a TCV Rank summarization algorithm is used for producing two kinds of summaries, namely online as well as historical summaries with the random time period. Eventually, the topic evolution can also be automatically discovered, which permits the Summblr framework to generate the timelines dynamically for ample of tweet data streams. In future, we try to improve our system to generate more meaningful summary and implement this framework on distributed system to evaluate large data sets.

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Performance Analysis of Multidimensional Indexing in Keyword Search

K. S. Sampada, Lalit Adithya and N. P. Kavya

Abstract Information retrieval from large collections of Web pages might require support of multidimensional index structures to speed up retrieval. Given a query with multiple keywords and range position that a user is concerned in, a range-based search in Web should reclaim and score the most pertinent Web pages. These queries are to be searched using both the spatial and indexed textual information. Range index and textual index are applied discretely or in efficient hybrid index structures are used in many of the proposed approaches which results in poor performance. Since merging of range and text is not straightforward to combine into current search engines, these approaches might not rank Web pages accurately. In this paper, a hybrid index technique, called range inverted index [RI2], is proposed to handle range-based Web searches. To flawlessly search and rank relevant documents, we have used *R** tree and KD tree for spatial search and *t*erm-*f*requency-*i*nverted *d*ocument *f*requency (TF-IDF) for ranking the keywords in that range. Performance of these two trees are analyzed for their scalability and accuracy.

Keywords Multidimensional index · Keyword search · Information retrieval *R** tree · KD tree · Spatial index

K. S. Sampada (✉) · L. Adithya · N. P. Kavya
Department of Computer Science & Engineering,
RNS Institute of Technology, VTU, Bengaluru, India
e-mail: k.s.sampada@gmail.com

L. Adithya
e-mail: lalitadithya5071@gmail.com

N. P. Kavya
e-mail: npkavya@gmail.com

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1 Introduction

Users may search for different type of information from anywhere. The expected results are based on the query consisting keywords and the range submitted by the user. The results are to be optimized as the users are increasing exponentially. Let us consider that we have a group of records, and every record expresses objects, where objects can be reviews, Web pages, photographs, videos tagged with geo-locations [1, 2]. It is required that we want to construct a system to allow users to search on these records. Consider an example where a user, Michel, who relocates to the central part of Phoenix. He desires to go for breakfast to celebrate birthday. He puts forward a query to the system with two keywords “birthday breakfast” and indicates “Downtown Phoenix” as the range. The result should comprise the list of restaurants in downtown.

Phoenix is popular for breakfast. Our aim is to find the best records that are of concern to Michel. Consider there are six reviews for the restaurants in the depository with locations nearby Downtown Phoenix. Figure 1 shows these locations represented as points, and the shaded region demonstrates the interested area of user query. In addition, each review’s keywords have been extracted as shown in Fig. 1.

Every record has text keywords in its content. Frequencies of query keywords “birthday and breakfast” in the records are shown in Fig. 2. We want to discover the top-k results to the query. The query keywords “birthday and breakfast” may not fetch the results of user interest, since no record may have the keyword specified as a range “Downtown Phoenix” or even “Phoenix” in them. To find the response to the query is to discover the reviews with a location contained in the query region and with the multiple query keywords, as projected in some studies in the literature [3, 4]. With this mechanism, we can only discover review R1 as an answer, since it satisfies both conditions. Even though record R4 contains both the keywords, it is not an answer as its region is not completely enclosed in the query region. The key

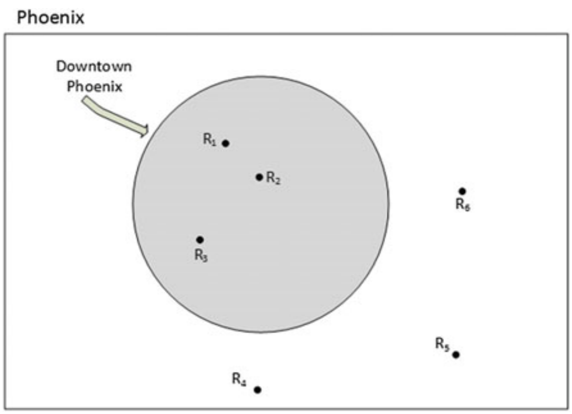


Fig. 1 Locations of restaurants

limitation of this technique is that it may not consider the records with partial spatial and/or textual matching, even though they comprise data that could be of user's interest.

In this paper, we demonstrate the search of multiple keywords in spatial datasets. We unveil the ranking mechanism of documents by relating range and textual features, to discover top-*k* results to user queries. It is also necessary to apprehend the relevance of the document with respect to the query. Effectively, a record could be of concern to the user if it at least matches the partial query keywords, and its position is nearby region as stated in the query. Record R4 is not very applicable to the query, since its region is far from the query region. Hence, the records which overlap in a specified region are to be ordered since the user may be interested in the top-*k* results of the documents. The mechanism which efficiently indexes and searches the position-specific records has to address some of the challenges. Primarily, the range and text are two unlike data types entailing diverse data structures. Secondly, the ordering and exploration techniques are not being alienated. Thirdly, the hybrid technique of combining spatial relevance and textual relevance should fetch user the top-*k* results.

In this paper, we present a new grading mechanism which integrates both spatial and textual significance to retrieve the query results. We put forward an innovative mixed index structure called range inverted index, which can handle the range and textual topographies of data concurrently.

To recapitulate, we recommend subsequent contributions:

- We describe the issues of scoring queries on records with range and textual topographies.
- We run through TF-IDF to compute the indexing and ordering of the records which comprises of textual significance.
- We drill R* tree and KD tree which are efficient multidimensional indexing trees in spatial datasets.
- We have combined the spatial R* tree and KD tree with TF-IDF a textual relevance.
- We have performed an investigational assessment on real datasets for the accuracy and scalability of these two approaches.

Fig. 2 Reviews containing keywords

Location	Review	Keywords	
		Birthday	Breakfast
Monroe Street	R1	1	1
Washington Street	R2	1	0
W Madison Street	R3	0	1
E Villa Street	R4	1	1
E Van Buren Street	R5	0	0
E Jefferson Street	R6	0	1

2 Related Work

Constructing spatial information retrieval system has created lot of interest. Range-keyword search has been explored for years as the search engines are commercialized. *R* tree and its alternatives are applied as range index and inverted file for text index in the majority of the index structures [5–9]. Yufei et al. developed method spatial inverted index that extending the inverted index to cope up with multidimensional data and proposed algorithm which can answer the spatial queries supported with keywords in real time which can be easily incorporated with any search engine to achieve the parallelism [10]. The popular index structures integrate range and textual indices depending on the merger schemes [11]. Among them, Felipe et al. [8] proposed scheme that blends signature file instead of inverted file into each node of the *R* tree. Inverted file-*R** tree (IF-*R**) and *R**-tree-inverted file (*R**-IF) [9] are spatio-textual indices that mix the *R**-tree and inverted file freely. Hariharan et al. [3] recommend *KR** tree, a framework for GIR systems focusing indexing strategies, but does not address the distributed databases. Cary et al. [6] projected SKI that assimilates *R* tree with an inverted index by the inclusion of location indication. The IR tree is recommended in [5] to generate the summary of the textual information of the objects to each node of the *R* tree, and the position term is expressed as bitmaps rather than records. An IR tree as suggested by Li and Chen stores one inverted file for all the nodes, and in [12], S2I index structure based on *R* tree and inverted file is recommended. The objects as suggested in [13] are laid diversely based on document frequency and infrequency of the term. [ND6] proposed Integrated Inverted Index (I3), where data space is partitioned into cells known as keyword cells based on the Quad tree structures. In [11], X. Cao and G. Cong suggest a Web Object Retrieval System (SWORS) by using IR tree and inverted file for index, which considers the range queries to obtain spatial Web objects as response. Two types of queries are supported such as location-aware top-*k* text retrieval (LKT) and spatial keyword group (SKG). The system proposed in reference [14] discusses the capability of amalgamation of range and text indexes and also describes the way to search the resulting index to find response. This paper suggests the usage of IR tree index and tries to bridge the gap between queries and data; it is important to support approximate keyword search on spatial database. Reference which proposed the MHR tree supports a wide range of query including range and NN queries. This paper used the *R* tree, the min-wise signature and the linear hashing technique for efficiently answering approximate string match queries in large spatial databases.

3 Preliminaries

3.1 Problem Definition

We presume a compilation $R = (r0, r1, \ldots, rn)$ of n records, where every record R contains of a set of keywords Kr and a location Lr. Every location is characterized by a minimum bounding rectangle (MBR) even though any other random shape can be exercised. A range-keyword query is labeled as $Q = (Kr; Lr)$, where Lr of query specifies the location characterized as one or more minimum bounding rectangles, and Kr is a cluster of keywords in the query.

3.2 Multidimensional Index

A multidimensional index, clusters the entries so as to exploit "nearness" in multidimensional space. The basic motivation for multidimensional indexing is that for efficient information retrieval. Existing multidimensional indexes can be categorized into two: *low-dimensional indexes* and *high-dimensional indexes*. The basic data structures used for indexing multidimensional datasets are KD tree, Quad tree, Grid, R^* tree. The data structures for the text used are inverted files. When user submits a geo-tagged keyword query, index structures are applied in isolation for textual part and spatial part of the query. Hence, the results are also retrieved separately, which might not be the expected results.

3.2.1 KD Tree

KD tree [15] is a data structure for storage of information to be retrieved by associative searches, where k defines the dimensionality of the search range. Figure 3 shows the point of locations and construction of KD tree. Figure 4 shows the split of KD tree.

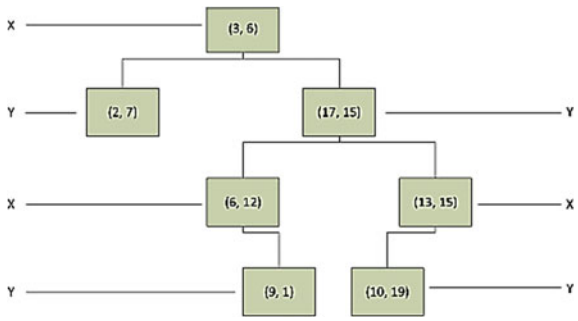


Fig. 3 KD tree with seven nodes

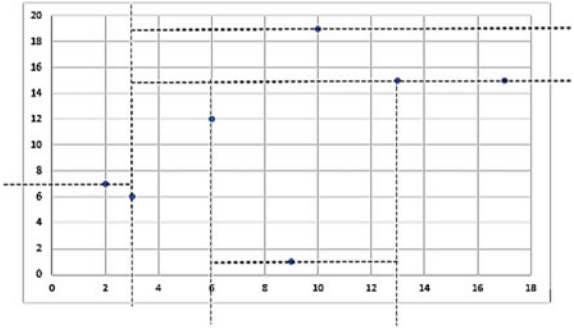


Fig. 4 Splits made by KD tree

3.2.2 *R** Tree

The *R* tree (Guttmann 1984) is a balanced tree structure used for multidimensional index. *R* trees are deliberated for indexing based on minimum bounding rectangles which results as sets of rectangles and other polygons. Each key stored in a leaf entry is intuitively a box, or collection of intervals, with one interval per dimension. Figure 5 shows the construction of *R** tree, and Fig. 6 demonstrates the * split of the tree.

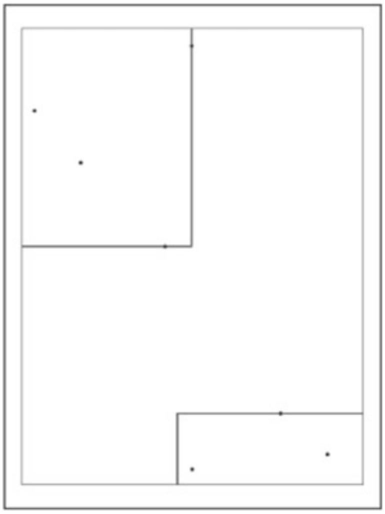
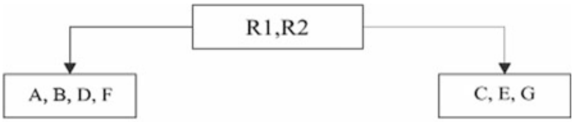


Fig. 5 Splits made by *R** tree

Fig. 6 *R** tree



NAMES	X	Y
A	3	6
B	2	7
C	17	15
D	6	12
E	13	15
F	9	1
G	30	19

3.2.3 Textual Index

Keyword generation: The words in the documents may appear in any inflected form, such as nature, natural, naturally. There are some words which are derived from the same family such as far, jar, car. In many circumstances, it seems as if it would be useful to search for one of these words to return record that contain another word in the set. Different algorithms have been proposed to generate keywords; popular ones are *Stemming* and *Lemmatization*.

Example: The word "Conduct" can have base form of a noun or of a verb depending on the context, e.g., "his Conduct is good" or "he conducts workshop". Lemmatization in contrast to Stemming attempts to select the correct lemma depending on the context. In this paper, we have used Lemmatization for generating keywords. Figure 7 shows the keywords generated.

4 Range Inverted Index

Various types of range-keyword queries are being used. The Boolean range query [8] $q = (Lq, Kq)$ where Lq is a specified range and Kq is a cluster of keywords provides all places that are specified in the range Lq and that contain all the keywords in Kq as response. Diverse of this query may also score the qualifying places. The Boolean KNN query $q = (Pq, Lq, k)$ considers three arguments; Pq is a specific point in a range, Lq is as above, and k is the number of places to return. The response includes k places, each of which contains all the keywords in Lq, ranked in increasing range distance from Pq. The top-k range query $q = (Lq, Kq, k)$, where Lq, Kq, and k are as above, reclaims up to k places that are located in the query region Lq, now ordered according to the significance of text relevance to Kq.

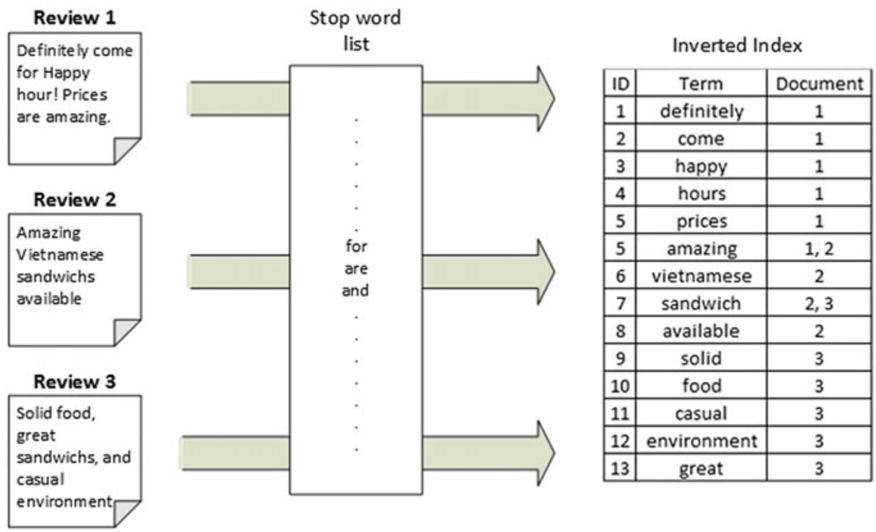


Fig. 7 Calculation of inverted index

4.1 Combining Spatial and Textual Relevance

The proposed system creates hybrid range-textual index structure that integrates location index and text index to process range-keyword queries efficiently. In this system, KD tree and *R** tree are freely amalgamated with inverted file. KD tree and *R** tree are used for range queries, and inverted file is used for keywords index which is considered the most effective index for information retrieval. For every location referred in the query identified as a node by of KD tree/*R** tree, an inverted file is created for indexing the text components of objects contained in the node. It retrieves *k* objects ranked according to a score that takes into consideration spatial proximity and text relevance.

Figure 8 shows the construction of hybrid tree. First range tree will be constructed based on the spatial locations. Given multiple keywords, the textual index is being created for that location.

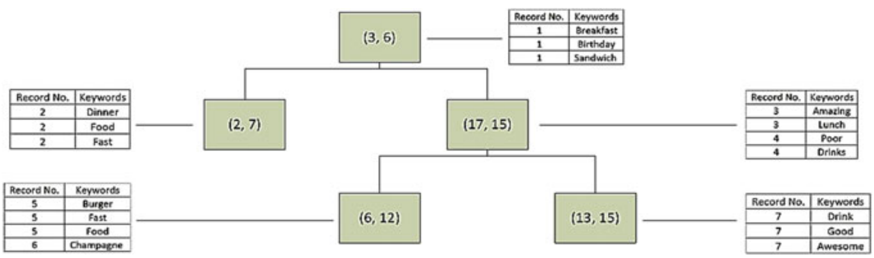


Fig. 8 Hybrid tree

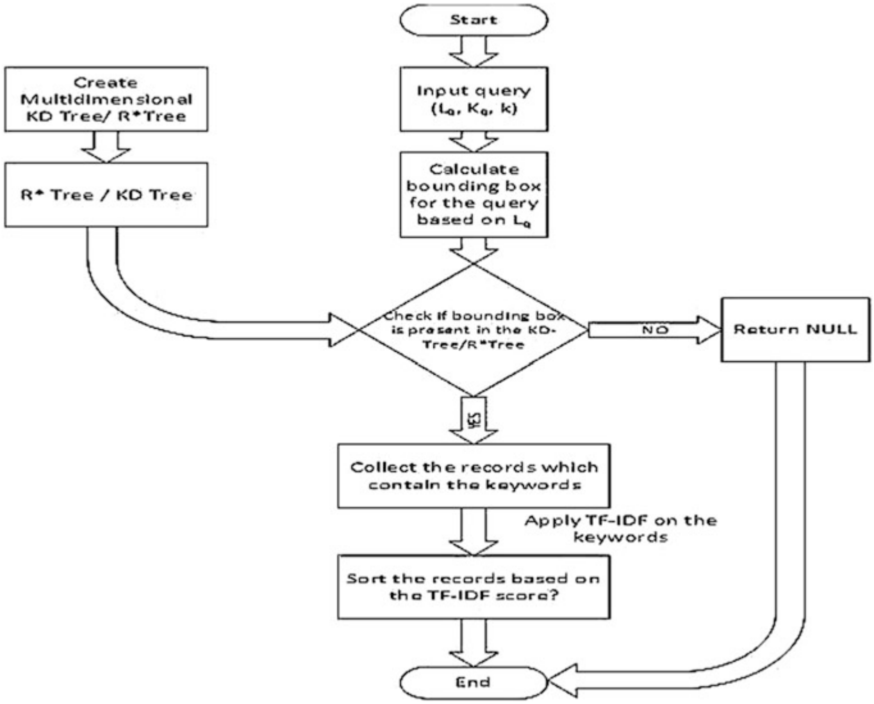


Fig. 9 Flowchart for query processing

4.2 *Query Processing*

The range-keyword query can be partitioned into query keywords *Kq* and the query location *Lq*. To execute range-keyword queries, *Lq* is to be converted into to a set of cells *Cq*. *Cq* is the cluster of cells overlap with the record at location *Lq*. After calculating *Cq*, *Tq* is the set of terms defined as follows: *Tq* = *Kq* U *Cq* for every query. The algorithm proposed for range query in a hybrid approach is as given in Fig. 9.

5 Experimental Results

In this section, we experimentally evaluate the performance and accuracy of the hybrid approach of range inverted query. KD tree and *R** tree are combined with IDF and are compared for their accuracy and scalability.

We have used Yelp datasets for our experimental study. The description of the dataset is as follows:

- 4.1 M reviews and 947 k tips by 1 M users for 144 k businesses
- 1.1 M business attributes, e.g., hours, parking availability, ambience
- Aggregated check-ins over time for each of the 125 k businesses

The 229,907 reviews of various restaurants were chosen as the dataset for all the experiments. Each review consisted of two parts, text information and location information. The text portion of the review is the text of the review in natural language. The location information contains the latitude and longitude of the objects for which the review was written. The location information in the review is never modified. Using this dataset, the accuracy and scalability of the proposed system are analyzed. The accuracy of the system is analyzed by increasing the number of keywords and, time taken to retrieve results is measured. In order to measure scalability, the dataset size is increased keeping the number of keywords constant and time taken to retrieve results is measured.

In order to perform the tests, a machine with Intel core i3-6100 CPU with four cores and each core clocked at 3.7 GHz, and 8192 MB of RAM running Microsoft Windows 10 Pro was used. No other processes were running on the target machine throughout the period of testing.

The first step is the process of keyword generation. The text part of each review is taken, and keywords are extracted from it by using Lemmatization. Now, each review will contain three parts, the raw review text, the location information, and a list containing all the keywords that have been generated for that particular review. The information is inserted into a multidimensional index tree: $R*$ tree and KD tree individually. The tree will not be serialized and placed on a disk but instead will be kept in the main memory itself. Once the tree has been constructed, the system will run *auto-generated range queries* on the tree and results are considered in terms of time taken to complete the query.

For each review, we generate a query, where the query string is the review text and we set the query range as a circle with its center being the location of the object, and the radius of query range is randomly assigned between 10 and 100 km. Once all the queries are generated, the system will run the query on the tree individually and the time taken to retrieve the top-k results is compared.

For every query, the query keywords are extracted using Lemmatization. In view of the location, the minimum bounding box is calculated and this bounding box is specified as a range query to the tree and records pertaining to that range are retrieved. The keywords of these results and the query keywords are used to rank the reviews based on TF-IDF. Once the keywords are assigned with scores, the records are ordered and top-k results are presented to the user, with the most relevant record first and the least relevant record at the last.

6 Performance Analysis

Keywords are varied from 10 to 200 with the datasets varying from 1000 to 10000. Time taken for searching query keywords on KD tree and R^* tree is compared.

Figure 10 above shows the comparison of KD tree and R^* tree for varying keywords ranging from 10 to 200 and with constant dataset size of 10,000. Performance of both the trees has similar characteristics as shown in the graph (Fig. 10). We can observe that R^* tree takes lesser time than KD tree for varying number of keywords. In Fig. 10, the difference in the performance of both the trees is similar, and the performance of both the trees becomes constant after 100 keywords.

Figure 11 shows the comparison of KD tree and R^* tree for varying keywords ranging from 10 to 200 and with constant dataset size of 1,000. After 100 keywords, the time taken by KD tree increases exponentially, whereas it increases

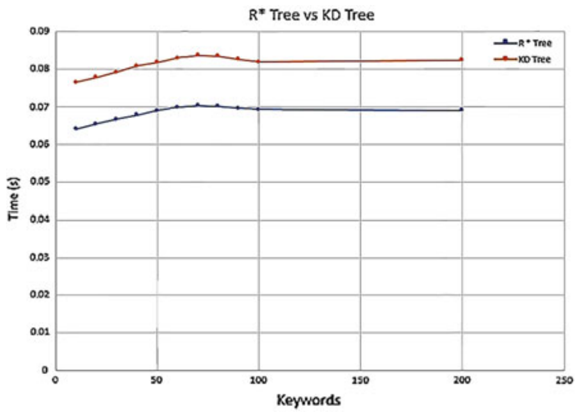


Fig. 10 Varying keywords with data set size of 10000

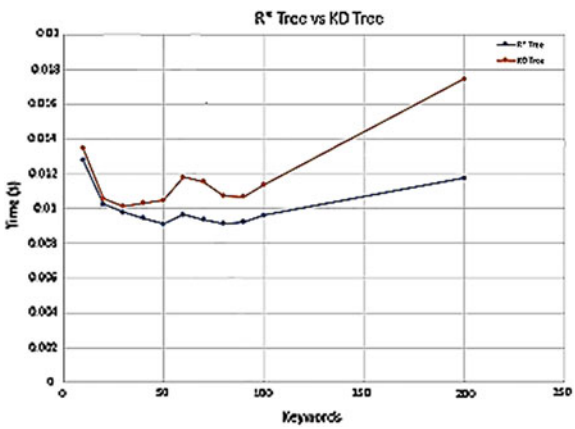


Fig. 11 Varying keywords with data set size of 1000

linearly in case of *R** tree as shown in Fig. 11. Hence, we can conclude that performance of *R** tree increases with the increase in dataset size.

The trees are also compared for the varying number of dataset size from 1000 to 30,000. Figure 12 shows the performance of trees with 10 keywords with varying dataset size. Here also we can see that the performance of *R** tree is 1.15% better than the KD tree. Figure 13 shows the performance of 100 keywords with varying dataset size. Performance of *R** tree is 1.14% better than the KD tree. This also shows the overall performance of keyword query with TF-IDF.

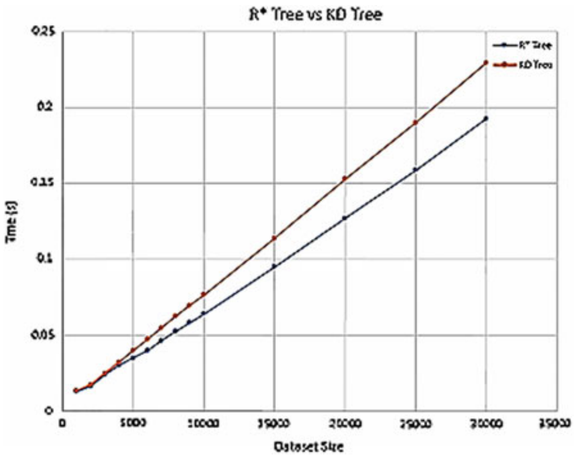


Fig. 12 Varying dataset size with 10 keywords

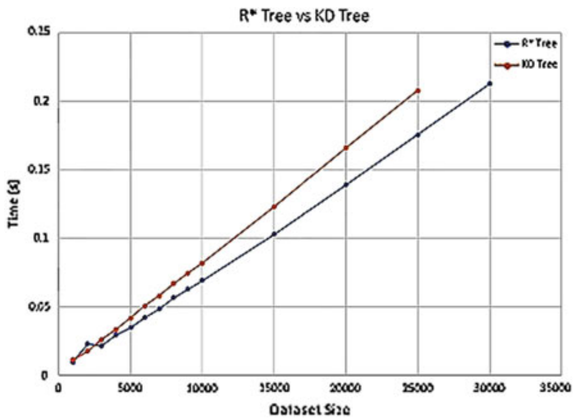


Fig. 13 Varying dataset size with 100 keywords

7 Conclusion

In this paper, a new fusion technique of integrated range and textual query significance is suggested. R^*-tree and KD tree are considered for range queries, and inverted index for keyword index is used. Both the range trees for multidimensional indexing are combined with the inverted index tree for keywords. These trees are compared for their accuracy and scalability. Performance of R^* tree both in terms of varying data size and varying datasets is considerable. In this experiment, the trees are constructed for the range mentioned in the datasets before execution of the query. The construction time of R^* tree takes considerable amount of time when compared to KD tree.

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Performance Forecasting of National Stock Exchange of India Using Symbolic Versus Numerical Methodology

Sachin Kamley, Shailesh Jaloree and Ramjeevan Singh Thakur

Abstract Though stock market holds instability in nature and due to instability, its knowledge representation and forecast procedure is exceptionally complicated. For the previous couple of decades, various tools and techniques are developed to forecast symbolic and numerical stock prices. However, these tools and techniques have been totally failed to make inferences from stock market knowledge base. During this direction, backward reasoning and back-propagation methods are adopted for symbolic and numerical forecasting, respectively. This study mainly highlights the performance comparison of both the approaches. The common LISP 3.0 and MATLAB R2011a tool are used to make inferences from stock market knowledge base. Finally, experimental results had shown that back-propagation method performs significantly well as compared to backward reasoning method.

Keywords Stock market · Artificial intelligence · Backward reasoning
Back-propagation · Common LISP 3.0 · MATLABR2011a

1 Introduction

From the beginning, stock price forecasting has become one of the popular subject areas in financial time series forecasting. This is due to the fact that various business analysts, investors, and researchers have paid attention to the longer-term estimation of stock values [1, 2, 18].

S. Kamley (✉)
S.A.T.I, Vidisha, MP, India
e-mail: skamley@gmail.com

S. Jaloree
Department of Appl. Math's and C.Sc, S.A.T.I, Vidisha, MP, India
e-mail: shailesh_jaloree@rediffmail.com

R. S. Thakur
Department of Computer Applications, Maulana Azad National Institute of Technology, Bhopal, Madhya Pradesh, India
e-mail: ramthakur2000@yahoo.com

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In artificial intelligence (AI), especially artificial neural network (ANN) is populated as most powerful prediction technique which has mystery to solve stock market problems . The most important characteristics of ANN have an ability to determine nonlinear relationship in the input data set without a prior assumption of the knowledge of relation between the input and the output [3]. An expert system (ES) is one of the oldest and powerful areas of AI that has shown its importance and utility in designing successful business applications [4]. Throughout the previous few years, the stock market has shown its worthiness in the fastest growing economy, but accurate share price prediction is still challenging and difficult process. Previously, various algorithms have been proposed for symbolic and numerical forecast, but no authors have attempted the comparison of both approaches. Some important concerns for this research study are :

(1) This study employs a comparative study between backward reasoning and back-propagation methods.
(2) Various fundamental, technical, and macroeconomic parameters are considered to model stock market knowledge base.
(3) To aware stock analysts, investors and researchers by providing a clear picture of (AI) tools and techniques.
(4) Improving the forecasting performance of stock market by the selection of an appropriate strategy.

2 Literature Review

This section briefly describes the some significant researchers' works over the years.

Dutta et al. [5] have presented ANN approach for nonlinear time series forecasting. However, they have considered the weekly close prices of BSE SENSEX as input data and future day price as output data. Finally, their experimental results showed the very low RMSE and MAE, i.e., 4.82 and 3.93%, respectively.

Hammady and Rizka [6] have proposed NN model to predict stock prices of Egypt's Stock Exchange (ESE) index as Commercial International Bank (CIB). The proposed system is trained using recurrent neural network based on ARIMA analysis as differentiating the CIB data. However, the nonlinear version of ARIMA (1, 1, 2) is identified and examined using ACF and PACF plots. Finally, experimental results stated that NN had excellent forecasting accuracy over ARIMA model.

Zarandi et al. [7] have presented fuzzy rule-based approach to predict the worth of the stock market. They have used fuzzy linguistic variables for determining the quantitative judgment. Therefore, knowledge base is mapped based on various fundamental stock variables such as capital structure, employee's knowledge, customer capital. At last, system has great extensive power to predict stock prices in terms of linguistic variables.

Patel et al. [8] have presented the fusion of machine learning techniques for predicting the movement of an Indian stock market. However, the techniques used such as ANN, support vector machine (SVM), random forest (RF) and Naïve Bayes. Finally, experimental results had stated that performance accuracy for all models is improved when technical indicators are considered as input variables.

Mohamed et al. [9] have used forward and backward reasoning inference methods to predict multiple-input linear and nonlinear time series data. In their study, they have considered various fundamental and technical parameters to map the stock knowledge base. Therefore, the proposed approaches show outstanding performance over other methods.

Olivera et al. [10] have presented the short-term forecasting model to predict the movement of Petrobras, Brazil market based on NN approach. They have considered the close prices as input parameters, and the network is trained based on three different window sizes. Moreover, the best prediction accuracy is achieved using window size 3, i.e., 93.62%.

Tsai and Wang [11] have proposed MLP model to predict the future worth of the stock index. In their study, they have considered various macroeconomic indicators such as inflation rate, interest rate to model the stock database. Finally, the proposed model had shown 78% prediction accuracy over other approaches.

Bola et al. [12] have used ANN and Bayesian network (BN) approaches to forecast the Nigerian Stock Exchange (NSE). In their study, they have considered various technical parameters to model stock sample database. Finally, experimental results stated that BN approach had shown 78.13% prediction accuracy over ANN approach.

Kamley et al. [13] have presented comparative study between forward and backward chaining techniques over global stock exchanges. In their study, they have considered various macroeconomic indicators such as gross domestic product (GDP), inflation rate, unemployment rate, and interest rate and stock knowledge base is mapped with 50 expert rules. At last, experimental results stated that backward chaining has excellent performance over forward chaining approach.

3 Proposed Methodologies

3.1 Backward Reasoning

Backward reasoning procedure firstly begins by searching the top-level goal or required goal. However, the procedure continues to find the required goal, i.e., whatever the facts and evidences are needed to prove the required goal. Algorithm 1 describes the backward reasoning procedure in detail [4, 14].

Algorithm 1 Backward Reasoning Procedure

(1) Start
(2) Check to see all the given facts against the knowledge base and compare with the required goal.
(3) Pop out all corresponding precedents (Comes from the Rules that is "Fired" in Previous Steps and Called "Sub-Goals").
(4) If no precedents and rules are exhausted:
    (4.1) Declare preposition can't be proved (based on existing information in the rule base).
    (4.2) If all precedents are true:
        (4.2.1) Proved and declare Success.
        (4.2.2) Finally compile a list of sub-goals must be resolved by the procedure.
(5) Stop

3.2 Back-Propagation Learning Algorithm

Back-propagation is one of the well-known and popular learning algorithms that adjust the weights in the network by propagating weight changes in the backward direction (i.e., output nodes to the input nodes). The most important capability of back-propagation learning is that it is easy to understand and is generally applicable in classification and prediction problems. Algorithm 2 describes back-propagation learning process [4, 14].

Algorithm 2 Back-Propagation Learning Process

(1) Start
(2) Variable selection and apply data normalization step.
(3) Accept the input for training purpose as well as decide desired output.
(4) Perform some weighted summation and apply it to input layer neurons to hidden layer neurons using by transfer functions (Sigmoid).
(5) Calculate the output at output layer.
(6) Calculate error (i.e. Actual Value- Predicted Value).
(7) If there are errors then changing the weights and biases again by applying the same procedures i.e. go to step 4.
(8) Finally check that errors are acceptable.
(9) Stop

4 Experimental Results

For the last seven decades, List Processing (LISP) has been widely used for designing the commercial expert system applications. In this study, common LISP 3.0 editor is selected for the implementation of backward reasoning algorithm. However, the knowledge base is encoded in the form of all applicable rules [4, 15]. The inference engine (IE) is in charge of looking all the applicable rules within the knowledge base and updated the actual fact base once execution of rules. Rule invocation environment for backward reasoning is shown by Fig. 1.

Figure 2 shows the relationship graph among iterations, facts, and rules.

Figure 2 depicts that as increasing no. of rules, no. of iterations also increasing. Forecasting performance of backward reasoning method is given in Table 1.

The results given in Table 1 depicts that forecasting performance of the stock market as well as provided an opportunity to stock users to invest money in the market and earn profit regarding decision. Figure 3 shows performance graph of back-propagation training algorithm.

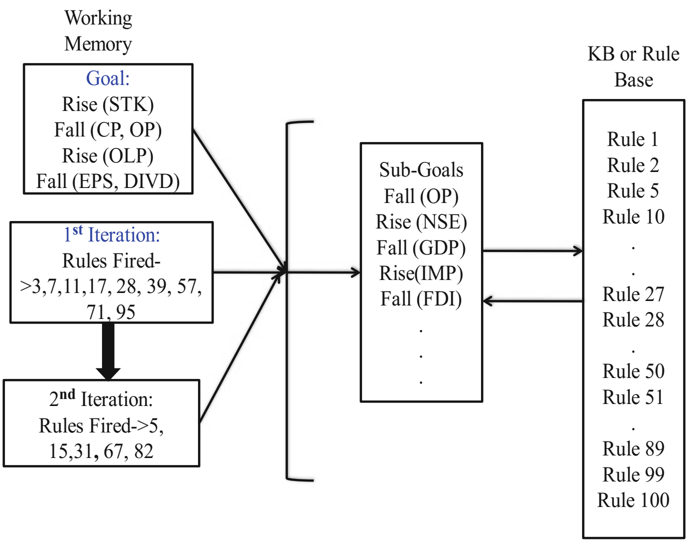

Fig. 1 Rule invocation environment for backward reasoning

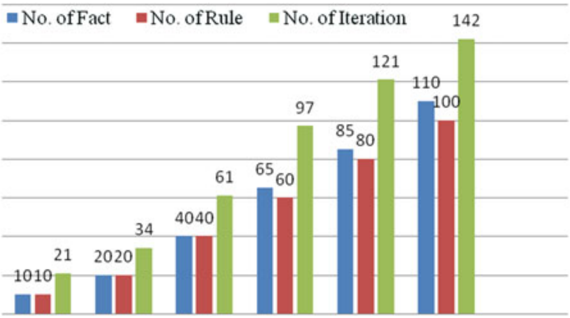

Fig. 2 A relationship graph among iterations, facts, and rules

Table 1 Forecasting performance of backward reasoning method [16, 18]

S. No.	Fact	Inference result	Investment decision
1	Falling gross domestic product and inflation rate	Falling NSE	Buying
2	Falling oil prices and gross domestic product	Falling NSE share prices	Buying
3	Falling inflation rate	Rising open price	Selling
4	Rising gross domestic product	Falling NSE and close price	Buying
5	Falling unemployment rate	Rising NSE share prices	Selling
6	Rising foreign direct investment	Rising NSE and high price	Selling
7	Rising open price and close price	Rising high price	Selling
8	Falling unemployment rate and volume	Falling NSE shares	Buying
9	Rising high prices	Rising NSE share prices and volume	Selling
10	Rising oil prices	Falling NSE	Buying
11	Rising dividend and EPS	Falling NSE	Buying
12	Falling open price and high price	Falling close price	Holding
13	Falling foreign direct investment and PE ratio	Falling NSE shares and low price	Holding
14	Rising PE ratio and falling open price	Rising NSE	Selling

Figure 3 depicts that in the beginning mean square error (MSE) is very high [17]. Thus, best validation performance got at epoch 9. Table 2 shows forecasting performance of back-propagation training algorithm.

Finally, back-propagation method had an overall 92.5% accuracy, while backward reasoning method had 77% accuracy.

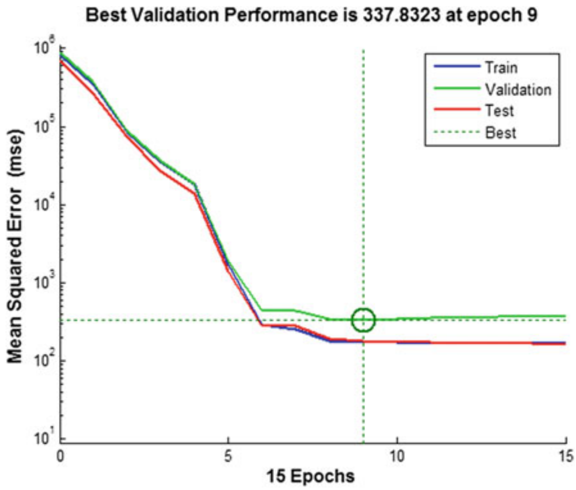

Fig. 3 Performance graph of back-propagation training algorithm

Table 2 Forecasting performance of back-propagation training algorithm [16, 18]

Date	Actual output	Predicted output	Forecasting error (%)	Investment decision
12/01/2016	2377	2365	0.6	Selling
12/02/2016	2384	2379	0.25	Buying
12/05/2016	2391	2397	0.3	Holding
12/06/2016	2447	2432	0.75	Buying
12/07/2016	2457	2440	0.85	Buying
12/08/2016	2453	2462	0.45	Holding
12/09/2016	2461	2449	0.6	Selling
12/12/2016	2499	3006	0.3	Holding
12/13/2016	2506	2498	0.4	Holding
12/14/2016	2545	2550	0.25	Buying
12/01/2016	2559	2564	0.25	Buying
12/02/2016	2526	2517	0.45	Holding
12/05/2016	2510	2499	0.55	Buying
12/15/2016	2502	2512	0.5	Selling
12/16/2016	2584	2571	0.65	Buying
12/19/2016	2592	2598	0.3	Holding
12/20/2016	2598	2587	0.55	Holding
12/21/2016	2464	2462	0.1	Holding
12/22/2016	2577	2582	0.25	Buying
12/23/2016	2580	2571	0.45	Holding

5 Conclusion and Future Scopes

In this study, backward reasoning and back-propagation learning approaches are implemented for symbolic and numerical forecast of stock data. However, various technical and macroeconomic indicators are considered for forecasting the stock performance. Based on the results, it is observed that back-propagation training algorithm has outstanding forecasting performance as compared to backward chaining strategy. The back-propagation training algorithm has vast capability to train the large data size networks and has very good predictive power to forecast the output patterns. On the other side, backward reasoning approach takes long time to infer the goal from the large knowledge base as well as modeling is too much complicated. Therefore, rule enhancement process also degrades the performance of expert systems. In the near future, fuzzy- and frame-based approaches will be considered to numeric and symbolic forecast, respectively.

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Comparative Study of Chronic Kidney Disease Prediction Using Different Classification Techniques

Pritha Tikariha and Prashant Richhariya

Abstract There are many fields where data mining is effectively applicable like marketing retail e-business, which has made it noticeable to the alternate sectors also. One of such sector is healthcare. Healthcare sector has colossal data, but those data are not utilized in a productive way, which make it knowledge poor. Also they lack in a proficient tool which helps to discover the concealed relationship among the available data. This paper presents analysis on some data mining techniques particularly in chronic kidney diseases (CKDs). K-nearest neighbor (KNN), C4.5, support vector machine (SVM), and Naïve Bayes classification algorithm are applied on the same dataset. The experimental result implemented in Weka tool shows that the KNN algorithm gives more accurate result when contrasted with different algorithms.

Keywords Classification · KNN · Naïve Bayes · Chronic kidney diseases SVM · C4.5

1 Introduction

Data is extremely significant for healthcare services; however before utilizing that data, it should be changed into information. Medicinal data mining gives an approach to explore the concealed relationship present in the dataset of the medical realm. This relationship can be utilized for the diagnosis purpose. Be that as it may, these medicinal datasets are distant, heterogeneous, and expansive. They should be organized and integrated to form a medical information system. Data mining technology gives an approach to accomplish these things.

P. Tikariha (✉) · P. Richhariya
Department of Computer Science and Engineering, Chhatrapati Shivaji Institute of Technology, Durg, Chhattisgarh, India
e-mail: prithatikariha1@gmail.com

P. Richhariya
e-mail: prashantrichhariya@csitdurg.in

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Patients normally contrast in various medical, physical, and economic attributes, for instance, by age, seriousness of illness, inconveniences, and speed of recovery [1]. Patients who suffers from a particular disease from quite a while or the patients who are raced into the hospitals for a few crises ought to be categories as the group with comparable needs. These groups of patients have heterogeneous medicinal services needs and therefore require a more detailed classification model. This heterogeneous healthcare need requires more effective and efficient management of the data. Accordingly from this point of view, these heterogeneous groups must be separated into small homogeneous gatherings. Homogeneity brings the advantages of increased certainty in clinical diagnosis, anticipating individual patient needs and resource utilization.

Chronic kidney diseases (CKDs) sometimes also known as chronic kidney failure is a slow but progressive loss of kidney functions over a period of many years. Ultimately, it prompts to permanent kidney failure. Kidney disease is a standout among the most widely recognized disease, and frequently it is left undetected in the early stages. It is basic for individuals to recognize about it exactly when their kidney is 75% damaged than of the normal. As the kidney disease propels, the risk level of waste fluid can quickly grow in the body. On the off chance that it is analyzed at the end stages, it is not possible for the patient to get by without regular dialysis or kidney transplant. So, early diagnosis of CKD is an imperative task.

Many classification techniques have been applied for the prediction of CKD. In this study, CKD is predicted using four classification algorithms, K-nearest neighbor (KNN), support vector machine (SVM), C4.5, and Naïve Bayes. Their performance is evaluated on the premise of accuracy, precision, recall, and F-measure.

The rest of the paper is organized in the accompanying way: Sect. 2 audits the past work done on the endless kidney ailment. Section 3 portrays the methodology and the dataset. Section 4 incorporates the experimental setup comes about; lastly, Sect. 5 has conclusion of the research work and the future extension.

2 Literature Survey

Kourou et al. [2] researched on a study of machine learning applications in cancer disease and its prediction. In the research, they reviewed various recent machine learning approaches for the prediction of cancer disease. They have presented a survey of recent work done as such far in prediction of cancer diseases.

Baby et al. [3] proposed a system for diagnosis and prediction based on predictive mining. They have employed a dataset on kidney disease for analysis using Orange software. They have studied the performance of many machine learning algorithms such as AD Trees, J48, K-star, Naïve Bayes, Random forest. They have presented a statistical analysis for predicting kidney disease using these algorithms.

According to their observation, K-star and random forest algorithms perform best for their dataset, where ROC value is 1.

Lakshmi et al. [4] have put their efforts to evaluate the performance of various data mining techniques for predicting survivability of kidney dialysis. They have applied various data mining techniques such as artificial neural networks (ANN), Decision tree and Logical Regression to mine the relation between many variables and patients survival. They have compared the performance of these data mining techniques for extracting the knowledge about the kidney dialysis survivability. These techniques ids are tested on the data collected from various dialysis centers. The results are analyzed, and ANN is marked as the best algorithm for kidney dialysis survivability with better accuracy and performance.

Shah et al. [5] researched on various data mining techniques for predicting the survival of kidney dialysis patients. Many data mining techniques are used to extract the knowledge about the patients and kidney dialysis. Knowledge is mined in the form of decision rules using two data mining techniques. Data mining algorithms are applied on the individual visits of the patient's dataset rather than the aggregate dataset. Most invariant patients form a signature for making the decision rules. It is observed that the performance of the data mining algorithms is much higher when applied on the individual visit dataset as compared to the aggregate dataset. The accuracy of prediction for individual visit-based rule sets is significantly higher over the aggregate-based rule sets.

Dhayanand et al. [6] have done a comparative research on SVM and ANN to predict kidney diseases. They compared the performance of these two data mining algorithms on the basis of execution time and accuracy. From the analysis, it is found that the ANN algorithm performs better than the SVM algorithm for the dataset he used.

3 Methodology

In this research work, four classification techniques are applied on the dataset to predict the CKD in the patient. The classifier applied is KNN, SVM, C4.5, and Naïve Bayes. These four classifiers are applied on the dataset to predict the disease, i.e., CKD and non-CKD. Performance of the each classifier is assessed on the premise of accuracy, precision, recall, and F-measure.

The working of the architecture is as follows: The dataset is extracted from the UCI repository. Extracted dataset contains many missing values. To expel the missing values, filter is applied on the dataset. Once the missing values are expelled, different classification algorithm is applied on the preprocessed data. Result of the evaluation will determine the best classifier algorithm for this dataset by contrasting the assessment parameters (Fig. 1).

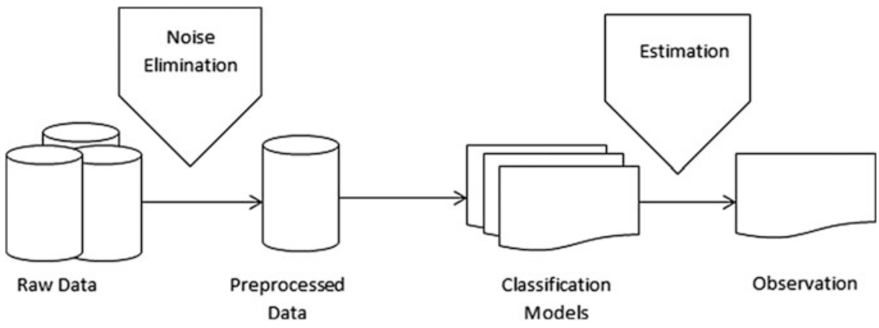

Fig. 1 Architecture of predictive data mining

3.1 Dataset and Preprocessing

The dataset is gathered from the UCI repository and fed as input to the Weka tool for predicting the CKD and non-CKD. The data is gathered from Apollo Hospital in Tamil Nadu in July 2015. Dataset contains 400 instances which are already classified as CKD and non-CKD. There are 250 instances delegated CKD and 150 as non-CKD. It has 25 nominal and numeric attributes, for example, age, circulatory strain, sugar, potassium, hemoglobin. Out of 25 characteristics, last one is the class which can be either CKD or non-CKD [7]. The dataset is found to have lots of missing values. Missing qualities from the dataset are expelled in the Weka tool utilizing unsupervised attribute filter. Replace missing values filter replaces the nominal and numeric missing qualities in a dataset by taking mean and modes from the training data [8]. Once the missing qualities are expelled, each of the four classification algorithms is applied on the preprocessed information.

3.2 Evaluation Parameters

Accuracy: Accuracy is defined as the number of predictions which are correct.

$$\mathrm{Acc} = \frac{(\mathrm{Tp} + \mathrm{Tn})}{(\mathrm{Tp} + \mathrm{Tn} + \mathrm{Fp} + \mathrm{Fn})} \tag{1}$$

Precision: Precision is defined as the probability by which the randomly selected instance is relevant.

$$\mathrm{Pre} = \frac{\mathrm{Tp}}{(\mathrm{Tp} + \mathrm{Fp})} \tag{2}$$

Recall: Recall is defined as the probability that the randomly selected instance is relevant in the search.

$$\mathrm{Re} = \frac{\mathrm{Tp}}{(\mathrm{Tp} + \mathrm{Fn})} \tag{3}$$

F-measure: F-measure is calculated as the harmonic mean of precision and recall.

$$F_{\mathrm{mean}} = \frac{2 * (\mathrm{Pre} * \mathrm{Re})}{(\mathrm{Pre} + \mathrm{Re})} \tag{4}$$

where,

Tp true positive, i.e., CKD is classified as CKD.
Fn false negative, i.e., CKD is classified as non-CKD.
Fp false positive, i.e., non-CKD class will classify as CKD.
Tn true negative, i.e., non-CKD class will classify as non-CKD.

3.3 Classification Algorithms

- **KNN**

KNN stands for K-nearest neighbor. It is a nonparametric lazy learning algorithm; this means that it does not make any presumptions on the basic information dispersion. It is an instance-based learning algorithm. The input to the algorithm is example of K closest training set. Output of the algorithm is a class membership. K in KNN varies from 1, 2, 3… n. When $K = 1$, the class is single nearest neighbor. In a simple weighting plan, singular neighbor is allocated to a weight of $1/d$ if d is the distance to the neighbor. The shortest distance calculated between the two neighbors is always plotted as a straight line, and this shortest distance is called Euclidean distance [9].

- **SVM**

Support vector machine is a supervised machine learning algorithm. It is used for both classification and regression. It is based on nonlinear and linear classification. SVM algorithm builds a model which classifies the new example to one of the training classes. Thus, it is also called non-probabilistic binary linear class [10]. An SVM model is represented as mapped points in space so that the different categories are separated from each other as wide as possible. New examples are then classified into one of the categories depending upon which side they fall.

- **J48**

C4.5 decision for classification is implemented using a simple J48 classifier in Weka tool. It is a statistical classifier. It is the most approachable classifier for any classification problem. It constructs a binary tree from the training data. Each node of the tree splits into sub-node in such a way that the sub-tree formed is enriched in one or the other class. Once the tree is built, all the tuples in the database are classified according to the tree [11].

- **Naïve Bayes**

The Naïve Bayes algorithm is a simple probabilistic classifier which is based on Bayes theorem [12]. It is a type of supervised learning algorithm which uses the method of maximum likelihood. It generates a probability set calculating and counting the frequencies of the values on the dataset. The algorithm assumes that all the attributes are independent given the value of the class variable. It constructs a class model from some finite set. One of the advantages of Naïve Bayes is that it requires very small number of training data to calculate the parameters required for classification.

4 Experimental Results

This work is carried on Weka tool. The Waikato Environment for Knowledge Analysis (Weka) is one of the best tools for machine learning. It has many inbuilt algorithms; however, in the meantime it permits the analysts to implement their own particular algorithms. The preprocessed data is taken as input to the Weka tool, and four classification algorithms are applied on it. The performance of the classifiers is assessed on the premise of different evaluation parameters. The performance of the classifiers is evaluated on the basis of various evaluation parameters (Table 1).

Table 1 shows the accuracy of KNN is highest, i.e., 98.5% when contrasted with the rest of the classifiers. Below there are the graphs which demonstrate the results of various evaluation parameters when the preprocessed dataset is applied on the Weka tool (Figs. 2, 3, 4, and 5).

Table 1 Experimental analysis of various classifiers on dataset

Classifier	Evaluation parameter			
	Accuracy (%)	Precision	Recall	F-measure
KNN	98.5	0.985	0.985	0.985
SVM	97.75	0.979	0.978	0.978
Naïve Bayes	94.5	0.951	0.945	0.946
C4.5	96.75	0.967	0.968	0.967

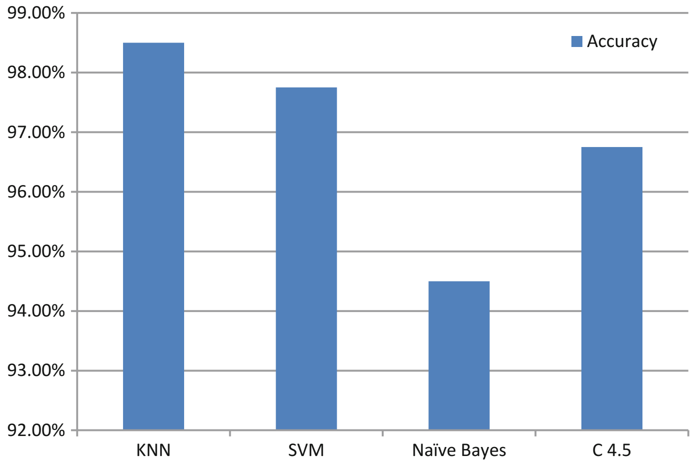

Fig. 2 Accuracy graph

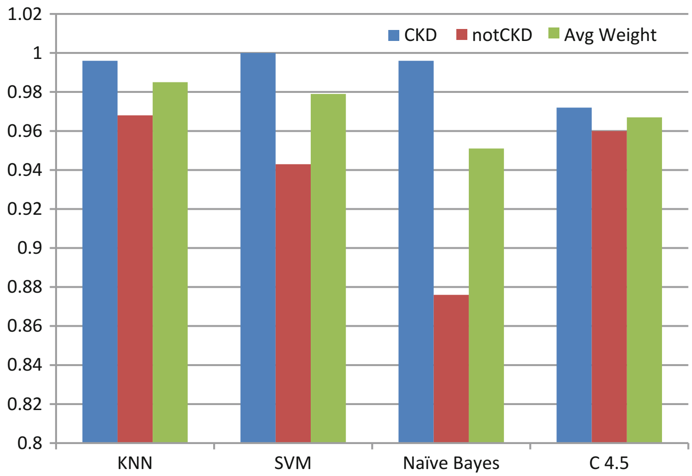

Fig. 3 Precision graph

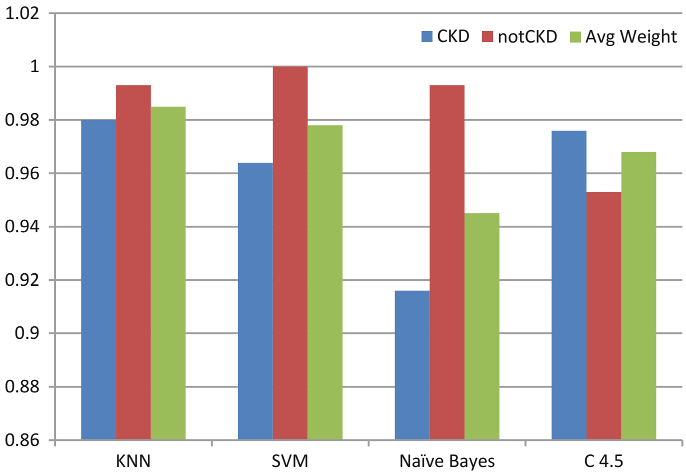

Fig. 4 Recall graph

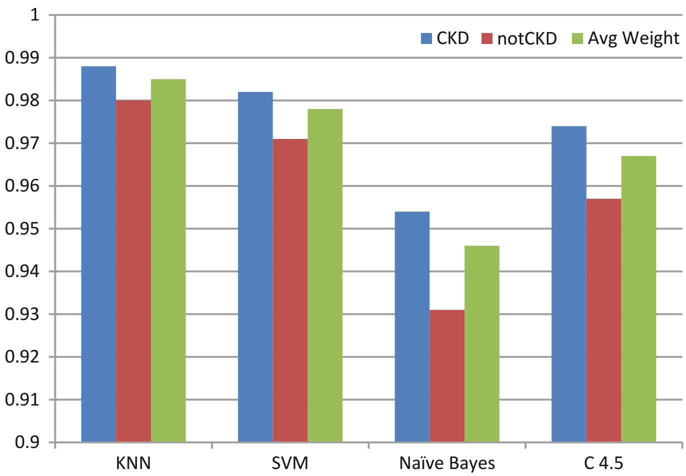

Fig. 5 F-measure graph

5 Conclusion and Future Work

This paper aims at the comparative study of various classification algorithms using Weka tool. Classifiers utilized for this review are KNN, Naïve Bayes, SVM, and C4.5. Dataset of CKD is taken as an input for the Weka tool to assess the performance of all the classifier. KNN gives best results for accuracy, precision, and F-measure, whereas SVM shows good result while calculating recall value. From the analysis, it is presumed that KNN performs superior to different classifiers for predicting CKDs.

KNN gives an accuracy of 98.5%; there is an extent of other evolutionary techniques which can enhance the execution of the classifiers. For early prediction of the CKD, a decision support system is required as very little work is done in a similar territory.

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Compressed Medical Image Transmission in Telemedicine Architecture

Vibha Tiwari, Prashant P. Bansod and Abhay Kumar

Abstract To implement widespread use of Telemedicine services, high data rate supporting networks are required. In this work, Telemedicine network architecture has been implemented using existing widely available networks such as WPAN, WLAN, and LAN. To transfer huge size medical images on such networks, it is imperative to use suitable compression techniques. Compressive Sensing technique has been used in this work which reduces the image scanning duration so as to comfort the patient and reduces the storage and transmission time as well. The transmission times for various considered network scenarios have been obtained. Real-time WPAN transmission of images has been done using Bluetooth L2CAP protocol. A client and server are established to implement transmission on LAN and WLAN networks. It is observed that suitable quality of US and MRI images has been obtained after compression at reduced transmission times.

Keywords Telemedicine network architecture · Medical image compression
Compressed sensing

V. Tiwari (✉)
Medi-Caps University, Indore, Madhya Pradesh, India
e-mail: getvibha@gmail.com

P. P. Bansod
Biomedical Engineering Department, Shri G. S. Institute
of Technology and Science, Indore, Madhya Pradesh, India
e-mail: ppbansod43@gmail.com

A. Kumar
School of Electronics, Devi Ahilya Vishwavidyalaya, Indore, Madhya Pradesh, India
e-mail: dr.abhaykumar@gmail.com

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1 Introduction

Moving toward fifth generation of wireless systems, ubiquitous high-speed data network with 1 Gbps data rate and less than 1 ms latency will enable provision of faster global health care services. Body implantable medical devices (IMDs) and physiological parameter measuring sensors can be used to transmit vital information for earlier diagnosis and planned treatment of critical disease [1]. Regular monitoring of patient's health record and better consultation may be obtained from specialized practitioners residing at any distant place, if high-speed data network is available.

Millimeter wave with massive MIMO consisting of hundreds of antenna array elements promises to provide more than 1 Gbps of data rate with reliable backhaul links [2]. Existing 2.5G and 3G packet data services supports data rate of 20–40 kbps and >100 kbps, respectively. 4G LTE supports data rate of about 100 Mbps in uplink and 50 Mbps in downlink with 20 MHz bandwidth. To implement Telemedicine network architecture, apart from licensed, unlicensed services are becoming more popular as it is cheaper and provides considerable data rate. Next-generation high-speed providing Wireless Local Area Network (WLAN) standard based on multi-user MIMO and OFDMA technique promises to support 1 Gbps rate [3].

Body Area Network (BAN) covering a range of 2 m allows collecting physiological information like glucose level, cardiac activity, blood pressure and pulse rate of human body using low-power IMDs or sensors [4] and then this information can be transmitted to far places using Wireless Personal Area Network (WPAN) gateways connecting Internet. By the end of the year 2020, with efficient machine-to-machine (M2M) communication using heterogeneous BAN, WLAN, LAN, or cellular 3G/4G/5G networks, Internet of Things (IoT) will revolutionize the growth of health care industry [5].

To transfer huge size medical images on existing networks, it is necessary to use suitable compression technique which reduces size of image without loss of clinical information [6]. In this paper, Compressive Sensing (CS) technique has been used to reduce the imaging duration [7, 8]. Since reduced number of samples is collected, so it reduces the acquired and stored image size. The medical images used in the paper are taken from Ultrasound (US) and Magnetic Resonance Imaging (MRI) modalities. Analysis of network performance in different heterogeneous Telemedicine network scenario is performed by measuring the transmission times taken by original and compressed size medical images.

The quality of compressed medical images has been evaluated by measuring Peak Signal to Noise Ratio (PSNR), Mean Square Error (MSE), Structural Similarity Index (SSIM), Normalized Error (NE), and Normalized Cross-Correlation (NKR). The existing network architecture which has been used for transmission of medical images includes WPAN, WLAN, and LAN. Bluetooth protocol has been used to transmit images over WPAN, IEEE 802.11n standard for WLAN and 1 Gbps Ethernet standard for LAN. The rest of the paper is organized as follows. CS technique adopted to reduce the size of medical images is illustrated in Sect. 2. In Sect. 3, simulation and results analysis is done.

2 CS Technique for Medical Images

CS technique allows samples to be collected at rate lesser than Nyquist rate and reconstructs faithful signal/image using sparse approximation algorithms, under the constraint that the signal is sparse and incoherence property is satisfied. In simplified manner, CS technique can be understood by considering an image of size $N \times N$ and its column vector as $\tilde{s}$ in the transform domain, such that $\tilde{s} = \psi\, s$ where ψ is transform or sparsity matrix $(\psi \in R^{N \times N})$. The reduced number of measurements $(M < N)$ is obtained by using sensing matrix $\phi \in R^{M \times N}$ as,

$$y = A\tilde{s} \tag{1}$$

where $y \in R^{M \times 1}$ and $A = \phi\psi$ are a measurement matrix. In Eq. (1), y and A are known and $\tilde{s}$ needs to be estimated. Equation (1) is an optimization problem which can be solved by L_0-norm minimization,

$$\min \|\tilde{s}\|_0 s \cdot t \cdot y = A\tilde{s} \tag{2}$$

Unfortunately L_0-minimization is non-convex and the problem becomes NP-hard [8]. Solution can be obtained using L_1-norm or smooth L_0-norm minimization. The signal is reconstructed by taking inverse transform of the estimated signal $\tilde{s}$ $\left(s = \psi^T \tilde{s}\right)$.

a. **CS technique adopted on US images**

US image pixel values are measured in wavelet transform domain. Reduced numbers of measurements are taken by using sampling/sensing matrix of size $M \times N$, where $M < N$. Image is sparsified by eliminating insignificant coefficients using hard thresholding. Fast smooth L_0-norm (SL0) minimization algorithm has been used as a sparse recovery algorithm [9].

Using sparse recovery algorithm, it is possible to reconstruct the image from fewer number of measurements, if image is sparse and sensing and sparsity matrices are incoherent [10]. The sensing matrix is constructed based on sparse block circulant matrix approach [11], and the sparsity matrix is constructed using Daubechies wavelet transform (10 db) [12]. To fulfill incoherence criteria, mutual coherence (μ) between sensing and sparsity matrix must be within Welch bound obtained as [13],

$$\sqrt{\frac{(N-M)}{(N-1)M}} \leq \mu \leq 1 \tag{3}$$

As per image size, value of M is selected between 100 to 768 and value of N as 128, 256, 512, or 1024. The Welch lower bound obtained is 0.031, and the value of μ lies in range 0.7219–0.8126. As μ lies within the limits, so it is possible to reconstruct the images faithfully by adopting the optimization technique.

b. **CS technique adopted on MRI images**

Few samples of MRI images are obtained in partial Fourier domain called as under-sampled k-space data. As MRI image of internal organs is sparse in wavelet domain and has small total variation so the optimization problem of Eq. (1) for MRI can be solved efficiently by including the total variation and wavelet transform of an image in the objective function as [14],

$$\tilde{s} = arg \min_{s} \left\{ \frac{1}{2} \|As - y\|^2 + \alpha \|s\|_{TV} + \beta \|\psi s\|_1 \right\} \tag{4}$$

where A represents the partial Fourier transform, ψ is wavelet transform, and α & β are the two positive parameters set to 0.001 and 0.035, respectively. Variable and operator splitting composite algorithm has been used with fast iterative shrinkage thresholding algorithm (FISTA) [15] to minimize total variation and L_1-norm regularization of Eq. (4) so as to reconstruct accurate MRI images in lesser time. As the number of measured samples is reduced, so the image scanning duration gets reduced.

3 Simulation and Results Analysis

US and MRI images in DICOM format have been taken from online database to perform simulation [16]. Images considered are of size 50, 100, 150, 200, 250, 300, 400, 500, 600, and 1024 KB. US and MRI images are compressed as elaborated in Sect. 2, thereby choosing 25, 50, and 75% of coefficients. Real-time transmission of medical images using Bluetooth protocol is done by using Bluez protocol stack [17] in Ubuntu 14.04 operating system. To implement WLAN, LAN or WLAN to LAN connection, TCP/IP client and server transmission is established between the two nodes. Programs are written in C language for real-time image transmission.

WLAN to LAN setup is shown in Fig. 1a. LAN-to-LAN scenario is shown in Fig. 1b. In Fig. 1c, the heterogeneous network setup is shown, where data/image captured from patient is transmitted using Bluetooth Logical Link Control and Adaptation Protocol (L2CAP), to nearby personal computer (PC) or personal digital assistant (PDA). The collected data/image is then transmitted using WLAN network present in Hospital to remote server using wired network. Transmission times for transmitting original and compressed medical images over these three scenarios have been obtained.

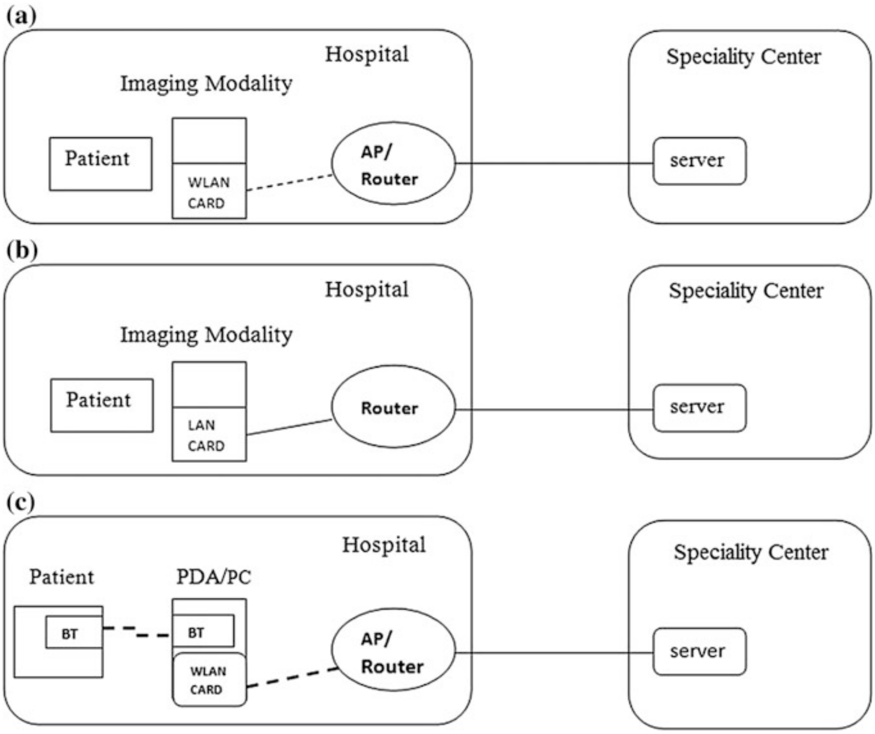

Fig. 1 Various network scenarios

It has been observed that Bluetooth L2CAP protocol with MTU size 32,768 takes minimum time to transmit as compared to other MTU sizes because of lesser overhead. Thus for WPAN transmission L2CAP protocol with MTU size 32,768 has been used and transmission time obtained is shown in Fig. 2a. Transmitting an original image of size 1024 KB using Bluetooth protocol takes approximately 4.04 s to transmit and after compressing the same image to contain 25, 50, and 75% of pixel coefficients, it takes approximately 1.75, 2.12, and 3.94 s to transmit.

Transmission time obtained after transmitting images over LAN is shown in Fig. 2b. To transmit an image of size 1024 KB over LAN takes approximately 0.094 s and after it is compressed to contain 25, 50, and 75% of pixel coefficients, approximately 0.02, 0.04, and 0.07 s, respectively, are required. Using WLAN, the obtained transmission time is shown in Fig. 2c.

In second setup, an image captured from imaging modality connected wirelessly with access point is transmitted to remote server connected with wired network using seamless connection. The time taken to transmit over WLAN and wired network is shown in Fig. 2d. An image of size 1024 Kb is transmitted in approximately 4.46 s in this setup. The compressed images containing 25, 50, and 75% of coefficients take approximately 0.42, 0.79, and 1.73 s, respectively.

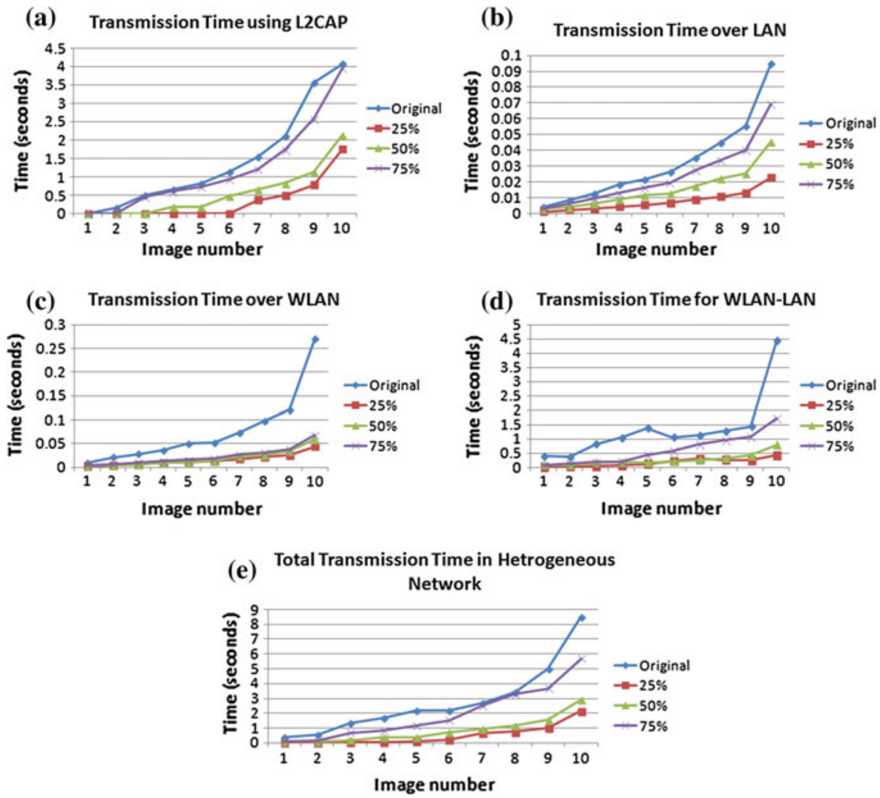

Fig. 2 Transmission times

In Bluetooth, WLAN and LAN heterogeneous network setup, the time taken to transmit different size of images is shown in Fig. 2e. In this setup, an image of size 1024 KB is transmitted in approximately 8.51 s and its compressed size containing 25, 50, and 75% of coefficients takes approximately 2.18, 2.92, and 5.68 s to transmit.

Analysis of reconstructed image quality is then discussed taking example of MRI image. MRI reconstructed image quality parameters are given in Tables 1 and 2 for 25 and 50% chosen pixel coefficients, respectively, which shows that with 25% chosen pixels, average PSNR $\sim$ 32 dB, MSE $\sim$ 0.09, SSIM $\sim$ 0.86, NE $\sim$ 0.082, and NKR $\sim$ 0.9944. Choosing 50% pixel coefficients, average PSNR $\sim$ 44 dB, MSE $\sim$ 0.003, SSIM $\sim$ 0.95, NE $\sim$ 0.04, and NKR $\sim$ 0.9966. Similar results have been obtained for US images as well. Thus, with 25% pixel coefficients, storage cost and transmission time over WPAN–WLAN–LAN network is reduced by a factor four approximately and considerable quality of image quality is recovered. Choosing 50% of pixel coefficients, storage cost is halved and transmission time over the similar

Table 1 Image quality parameters in MRI (25% of coefficients)

Image no.	PSNR	MSE	SSIM	NE	NKR
Image 1	35.97	0.00363	0.8682	0.0820	0.9944
Image 2	26.10	0.30161	0.6277	0.7245	0.6772
Image 3	28.85	0.17183	0.7660	0.4768	0.8159
Image 4	26.86	0.02663	0.7887	0.1500	0.9727
Image 5	29.77	0.24734	0.7396	0.5896	0.7429
Image 6	25.18	0.03884	0.7746	0.1959	0.9568
Image 7	61.28	0.00012	0.9945	0.0173	0.9993
Image 8	22.55	0.08272	0.6805	0.3741	0.8610
Image 9	38.60	0.00251	0.9282	0.0579	0.9952
Image 10	36.85	0.05556	0.9652	0.3159	0.9143
Average	32.80	0.0930	0.8633	0.2984	0.9124

Table 2 Image quality parameters in MRI (50% of coefficients)

Image no.	PSNR	MSE	SSIM	NE	NKR
Image 1	45.12	0.0004	0.9308	0.0282	0.9994
Image 2	39.85	0.0012	0.9605	0.0390	0.9983
Image 3	29.10	0.0171	0.8847	0.1404	0.9813
Image 4	35.66	0.0036	0.8930	0.0543	0.9963
Image 5	40.69	0.0020	0.9520	0.0488	0.9978
Image 6	36.67	0.0008	0.9377	0.0290	0.9990
Image 7	70.42	1.47E-05	0.9999	0.0055	0.9999
Image 8	49.92	0.0001	0.9998	0.0109	0.9999
Image 9	46.97	0.0003	0.9899	0.0218	0.9994
Image 10	47.00	0.0053	0.9998	0.0869	0.9956
Average	44.14	0.00308	0.9548	0.0464	0.9966

network is reduced by a factor three approximately with comparatively increased recovered image quality having increment in average PSNR by approximately 11 dB.

4 Conclusion

Telemedicine network architecture has been implemented using existing Bluetooth, LAN, and WLAN networks. Performance of different scenarios is analyzed by establishing real-time networks to transfer original and compressed size US and MRI medical images. When the original image size is less than 100 KB, transmission using L2CAP Bluetooth protocol is least of about 1 ms. As the image size increases above 100 KB, the transmission time in LAN is the least. An image of

1024 KB takes approximately 4.07 s to transmit using L2CAP protocol and 4.45 s from client connected in WLAN to server connected on LAN. The total transmission time to transmit 1024 KB size image using L2CAP and WLAN to LAN transmission is 8.51 s approximately. The compressed size image takes approximately 2.18 s using L2CAP and WLAN to LAN transmission. Thus over existing networks, it is possible to transmit medical images at reduced radiation exposure, storage, and transmission cost using CS technique.

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Analyzing and Preprocessing the Twitter Data for Opinion Mining

Neetu Anand, Dhruvi Goyal and Tapas Kumar

Abstract With a rapid growth of the world of Internet, the social media is eventually growing and is playing a very major role in most of our lives. There are various social networking sites such as Twitter, Google+, Facebook which provide a platform for the people to present themselves. Twitter is an efficient micro-blogging tool which has become very popular throughout the world. Nowadays, there is an ongoing trend of posting every thought and emotion of one's life on these social networking sites. Due to this, emotion analysis has gained popularity in analyzing the thoughts, opinions, feelings, sentiments, etc., of various people. The present paper is based on the demonstration of a complete step-by-step process of analyzing emotions from tweets related to Budget 2017.

Keywords Twitter · Data analysis · Sentiments · Social media
Emotion analysis · Budget 2017

1 Introduction

Social media is becoming the most essential part in the life of most of the people worldwide. Day by day, the number of people being a part of social networking sites is rapidly increasing. Social networking sites provide an ease to communicate with any person living in any corner of the world, and it also allows to share one's thoughts, opinions, views, and emotions with others in the real-time environment which takes just a fraction of milliseconds or even less than that. The popular social

N. Anand (✉) · D. Goyal
Maharaja Surajmal Institute, New Delhi, India
e-mail: neetuanand@msi-ggsip.org

D. Goyal
e-mail: dhruvigoyal98@gmail.com

T. Kumar
Lingayas University, Faridabad, India
e-mail: Kumartapas534@gmail.com

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medias of nowadays are Facebook, Twitter, Google+, Pinterest, Blogs, etc. Twitter is the most popular among them. Twitter is a micro-blogging tool which allows its users to share whatever they wish to share with rest of the world in maximum of 140 characters. It has 319 million users, as of fourth quarter of 2016. People often tweet something depending upon the emotion of their minds at that point of time [1]. Mental state or sentiments (emotions) of anyone at the time of posting can be interpreted by analyzing the tweet that a person has made. The type of tweets that a person makes helps us to know about the nature of that person. Also, nowadays, many companies promote their products or the goods and services provided by them on Twitter, so that billions of people worldwide could know about their products being launched and may also give their feedback to it. By analyzing the views of various people, the firm gets to know about the liking and disliking of customers toward their products as well as they would be able to analyze the position of their goods and services in the current market. It is abysmally necessary to analyze different types of data on Twitter. Analysis helps to understand a person in a psychological manner. It gives a better view of positive and negative mindsets of people toward a particular thing, some product, any changes taking place, or a specific rule being implemented [2]. Emotion analysis helps in analyzing various sentiments of a person, like if a person is happy, sad, angry, excited. A comment of a person could be judged as if it was said in a positive or negative manner, or if it was just neutral. Twitter data analysis is therefore becoming a very crucial task nowadays [3]. R is a widespread statistical platform provides roughly 6000 packages and offers different data analytics techniques. It is a strong platform for data analysis and exploration. Data analysts, scientists, engineers, and big data analyst use R language for statistical computing and analysis purpose. R is a most popular open-source platform with different version on Windows, Linux, and Mac OS. Therefore, our aim was to use R language and RStudio for development. The rest of the paper is organized as follows: In Sect. 2, we delineate the term "Sentiment Analysis". Section 3 discusses the literature survey in the field of Sentiment Analysis on Twitter data. Section 4 deals with the need of data analysis. In Sect. 5, we portray the methodology adopted in analyzing emotions. Section 6 presents the detailed experiment. Section 7 draws conclusion and future scope.

2 Sentiment Analysis

Sentiment in a simple language is the emotion or feelings through which one undergoes. A sentiment of a person refers to the state of mind he or she has at that point of time. Sentiment Analysis is measuring the people's opinions, attitudes, views, emotions and classifying them mainly as positive or negative, and sometimes neutral as well. With the advancement of social media and increase in the people connected with it, there is a great need of analyzing the sentiments [4].

Social media posts are short, unstructured, fast-evolving, and domain-specific, though they provide convenience in instant communications for users so it becomes the challenging task to accurately identify the overall sentiment polarity from the text.

Sentiment Analysis of twitter data involves analyzing views, emotions, thoughts, attitudes, opinions, etc., of a person from his or her tweet toward any other individual, product, organization, topic, services, etc. Therefore, Sentiment Analysis is becoming a trend nowadays. Various approaches for automatically classifying sentiments from tweets related to products and movie reviews have been extensively studied for years [5, 6] and can roughly be divided into supervised and unsupervised Sentiment Analysis.

3 Literature Survey

In the past few years, there are many research works done by various researchers in the field of emotion analysis of Twitter data. Some of the works are discussed in this section. In the very first stage, the emotions were classified as bipolar, i.e., either positive or negative. Neutral emotions were not taken into consideration. R. Parikh and M. Movassate [7] considered two models, i.e., a Maximum Entropy Model and a Naive Bayes Bigram Model for classifying tweets. After analyzing the tweets through both the models, the result of Naive Bayes Bigram Model was considered much efficient as compared to Maximum Entropy Model. Go. R. Bhayani and L. Huang [8] used distant supervision for performing emotion analysis on tweets, where they collected the sample data with emoticons for analysis, and emoticons were termed as noisy elements. They built a new model based on the pre-existing models, i.e., Naive Bayes and Support Vector Machine (SVM) models. A. Pak and P. Paroubek [9] proposed a new model for performing both the subjective and the objective classifications of data, which classified the tweets as objective, positive, and negative. To perform the classification on objective data, they collected the tweets which ended with some emoticons. They collected tweets having ":)" or ":-)" depicting positive emotion and ":(" or ":-(" showing negative emotion of a person. For the classification of subjective data, they gathered the tweets from the accounts of the popular newspapers of that period like "Washington Posts" and "New York Times". They built their own emotion analysis model by utilizing the already existing models, i.e., Maximum Entropy, Naive Bayes, and Support Vector Machine (SVM) and found that the result of SVM was more efficient as compared to the other two. Bifet and E. Frank [10] collected the Twitter data (tweets) using Firehouse API that enabled all the public data from all the users, which is available in the real-time environment. They analyzed multinomial Naive Bayes, Hoeffding Tree, and Stochastic Gradient Descent (SGD) on the collected data, and they concluded that with a proper learning rate, SGD model produced much better results as compared to other two.

4 Need of Data Analysis

Data analysis means interpreting various data and categorizing them in different predefined categories. It is usually performed either on the basis of pre-existing algorithms or models, or by creating a new model for the analysis. Data analysis is generally performed on the large sets of data, and therefore, some tools are used to perform this tedious task rather than performing it manually [11]. With the passes of time, analyzing data has become a very crucial task.

Day by day, data analysis is becoming more and more advanced, either by the development of new tools and models, or by increasing the efficiency of already existing models. There are various tools built in different languages, which can be utilized to analyze the sentiments of twitter data effectively. Multiple languages used for analysis purpose are python, R, hadoop, JavaScript, ruby, etc. [12–14]. There are various data analyzing techniques which are used for Sentiment Analysis, such as Naive Bayes, Maximum Entropy, Support Vector Machine, Tree Kernel, Feature-based model [15, 16].

5 Methodology

The complete life cycle adopted to determine the emotions of a particular tweet is broadly comprised of the following four phases:

Twitter Data Extraction: This phase involves creating a Twitter API and downloading the tweets as per the requirements, i.e., downloading tweets of a particular user or tweets having particular keyword. Twitter API supports extracting the linguistic tweets or the locality-based tweets. The data can be retrieved in any format particularly as .txt, .csv, .doc, etc., according to the convenience.

Tweets Preprocessing: Create an R program to ingest data from—Twitter; it requires several packages to install like twitterR, devtools, digest, Rcpp, tables, and many more. The extracted tweet contains various unwanted things in it. Preprocessing involves keeping the relevant data by removing the noisy and inconsistent elements such as URLs, hash (#) tags, @ symbols, stop words, special characters. [17].

Emotion Analysis: The processed data is classified by using R program. The results of the analysis will be in the form of positive, negative, and neutral emotions or sentiments [18].

Experimental Result: The result of Sentiment Analysis is represented in the form of various graphical tools, such as bar graph, pie chart or in the form of tables. It depicts the total number of tweets in each of the positive, negative, and neutral emotions.

The flowchart showing the detailed approach used for classification of sentiments is shown in Fig. 1.

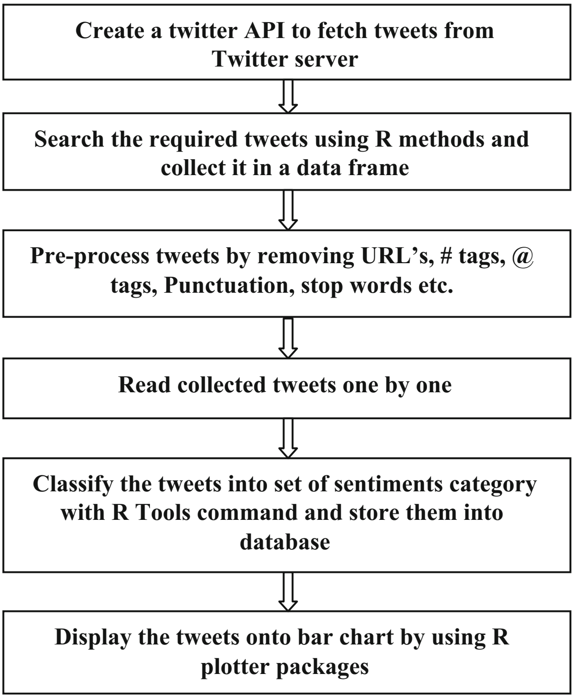

Fig. 1 Flowchart showing the different phases of methodology

6 Experiment

The detailed description of each step performed in the experiment is as follows:

6.1 Data Collection

We made a Twitter API so as to collect the tweets. All the tweets related to Budget 2017 were downloaded by providing the keyword "Budget2017" in RStudio [19–21]. The downloaded file was saved in the .csv format. Screenshot of the raw data which was collected is shown in Fig. 2.

6.2 Data Preprocessing

The collected data has many inconsistent and redundant elements that are to be filtered so as to perform Sentiment Analysis techniques on the collected tweets [22, 23]. A number of tasks performed in data preprocessing are as follows:

```
[[21]]
[1] "gstnashik: RT @bcs_llp: #GST legislation enters the final lap | @bcs_llp @gstnashik
 #gstcouncil #Budget2017 \n\nhttps://t.co/vEAXtVGYPm https://t.co/4ro…"

[[22]]
[1] "gstnashik: RT @bcs_llp: Tax slabs: Should #GST Bills be tabled as Money Bills? @bcs
_llp @gstnashik #gstcouncil #Budget2017 \n\nhttps://t.co/7NA8eYI6Gk h…"

[[23]]
[1] "sanket215: RT @bcs_llp: Tax slabs: Should #GST Bills be tabled as Money Bills? @bcs
_llp @gstnashik #gstcouncil #Budget2017 \n\nhttps://t.co/7NA8eYI6Gk h…"

[[24]]
[1] "bcs_llp: Tax slabs: Should #GST Bills be tabled as Money Bills? @bcs_llp @gstnashik
 #gstcouncil #Budget2017… https://t.co/v4Xlopdvr1"

[[25]]
[1] "sanket215: RT @bcs_llp: #GST legislation enters the final lap | @bcs_llp @gstnashik
 #gstcouncil #Budget2017 \n\nhttps://t.co/vEAXtVGYPm https://t.co/4ro…"

[[26]]
[1] "bcs_llp: #GST legislation enters the final lap | @bcs_llp @gstnashik #gstcouncil #B
udget2017 \n\nhttps://t.co/vEAXtVGYPm https://t.co/4rokxaSY8N"

[[27]]
```

Fig. 2 Data collected (raw) from the Twitter API on "Budget2017"

Converting to lower characters: Text in the tweets will be in the combination of both upper and lower characters. Data is converted into the lower case so that it would become easy to analyze by doing case-insensitive comparison.

Removing URLs: URLs have got nothing to do with emotion analysis. They sometimes mislead the emotional interpretation of the tweet. So, URLs should be removed from the tweets for effective analysis.

Removing hash (#) tags: Hash (#) tags are just used to highlight a particular word(s) in the whole tweet, and it does not share any contribution toward analyzing the emotions of a person. Hence, they should be removed to make analysis process easy.

Removing @ symbol: "@" symbol is used to specify a user's name so as to alert them toward a particular tweet. It does not represent any opinion and is therefore filtered from the collected tweets.

Replace emoticons: Emoticons like ":)" and ":-)" represent a positive sentiment and hence are replaced with the word "happy" so as to count it as a positive emotion. Also, the emoticons like ":(" and ":-(" show the negative sentiments and are therefore replaced with the word "sad" so that it could be counted as a negative emotion during analysis.

Remove all non-English words: In our research, we had taken into consideration all the English tweets for analyzing the sentiments. So, all the linguistic words other than English are removed from the data.

Remove stop words: Stop words are the most commonly used words in the sentences that do not show any sentiments. Therefore, they have to be removed from the data so as to not overcrowd the essential data.

Expand acronyms: There are various acronyms used in the tweets which should be expanded so as to perform emotion analysis task efficiently. Hence, the acronyms are expanded to produce effective results.

```
  [1] "changes in income tax laws from apribudget budget capitalgaintax incometaxtaxes i
nvestmentplan taxes"

  [2] "so narendramodi govt promised in the budget saying transparency and accountabilit
y in political fundings\ncontd"

  [3] "whatever said amp done ground reality economy is in mess many businesses struggli
ng to survive demo budget gstfailin…"

  [4] "whatever said amp done ground reality economy is in mess many businesses struggli
ng to survive demo budget gstfailin…"

  [5] "whatever said amp done ground reality economy is in mess many businesses struggli
ng to survive demo budget gstfailing to revive economy"
```

Fig. 3 Dataset after performing preprocessing

Anger	Anticipation	Disgust	Fear	Joy	Sadness	Surprise	Trust
0	1	0	0	1	2	0	2
0	0	0	0	0	0	0	2
0	0	1	0	0	0	0	3
0	0	1	0	0	0	0	3
0	1	1	0	0	0	0	3
1	1	0	1	1	0	0	3

Fig. 4 Emotions and their values

Remove special characters: Special characters have no significant meaning. They are just used as punctuations in the phrases and sentences. They do not play any vital role in emotion analysis and hence should be removed.

Remove recurring characters: A new trend has been started of using words with concurrent characters on social media to express the intensity of the emotions for a particular word. But machine does not understand those words as it is not present in their dictionaries. So it is mandatory to remove these letters to correctly analyze the emotions of tweets. Hence, we replace all the characters that are recurring more than three times with three consecutive characters.

The screenshot of data after preprocessing, i.e., after performing all the above steps is as shown in Fig. 3.

6.3 *Visualizing the Tweets*

The next step is to create visual plots to envisage the sentiments of the user. The words within a sentence can be associated with eight emotions (anger, fear, anticipation, trust, surprise, sadness, joy, and disgust). Below shown is a data frame in which each row represents a sentence from the original file. The columns include one for each emotion type (Fig. 4).

Finally, the percentage of each emotion in the text can be plotted as a bar graph (Fig. 5).

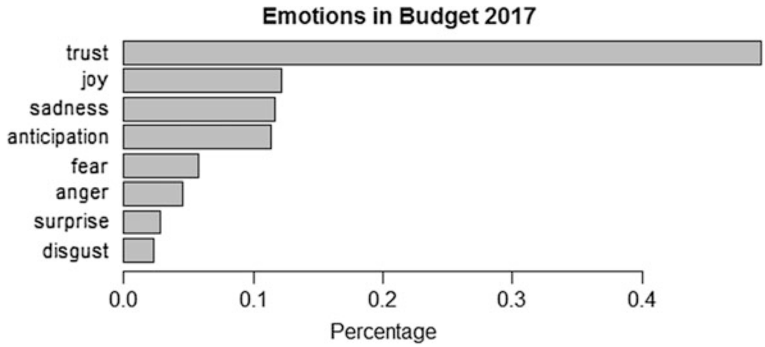

Fig. 5 Bar graph showing percentage of each emotion in a text

7 Conclusion

The data is gathered by using Twitter API, which provides up-to-date information. The collected tweets will be stored in a data frame. RStudio is used to analyze data by using various packages. A sentence-level Sentiment Analysis is performed on the collected tweets of "Budget 2017". This is done in various phases. In the first phase, preprocessing is performed. Secondly, the processed data is analyzed, and score is provided to each tweet based on various emotions. In the final step, the percentage of each emotion is plotted. In future, we will represent the results of emotion analysis in the form of numerous types of graphs. To further alleviate these issues, we will apply machine learning algorithms. Overall with the use of sentiment analyzer, various social and political issues can be analyzed in a better way.

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Intelligent Decision Making Real-Time Automated System for Toll Payments

Aditya Vikram Agarwal, Navneet Verma and Sanjeev Kumar

Abstract Automation is a major concern in the modern age with an increasing number of cases related to traffic jams, caused due to the lack of proper traffic management, contributing to various problems directly and indirectly. Internet of Things can potentially minimize this chaos. We can use sensors, along with some processing devices and algorithms, to minimize human efforts in regulating traffic and to definitively smoothen and fasten vehicle flow on roads. Tollbooths on highways can be automated with the help of Internet of Things and digital payment mode which will reduce, or even remove, the long toll payment queues for vehicles, can be introduced. We, in this paper, present an implementation of Internet of Things, using infrared light sensors, cameras, and image processing algorithms to develop such vehicle detection systems according to their types (heavy vehicles, small vehicles, and the like), in coherence with a database to automate tollbooth processing.

Keywords Internet of Things · Genetic Algorithm · Real-time systems
Databases · Image processing · Automation · Intelligent decision making
Infrared light sensors

1 Introduction

In the modern world, automation of things is very important and, in fact, ponderable. It improves productivity, quality of living, robustness, and security, and also efficiency in day-to-day life [1, 2]. Due to the internetworking and interconnectivity of physical devices, vehicles, sensors, and all such objects capable of some kind of processing made possible by using the implementations of Internet of Things, automation of almost everything is possible and, now, is becoming more and more

A. V. Agarwal (✉) · N. Verma · S. Kumar
Department of Computer Science, School of Engineering and Technology,
Jaipur National University, Jaipur, India
e-mail: adityavagarwal.research@gmail.com

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prevalent [3]. Information handling services forecast that there will be around 75.4 billion electronic devices around us by 2025. Integration of sensors and data can also make, for that matter, automation of traffic system very possible, efficient, reliable, and secure, just like the automation of various other areas of applications including the industrial sector, agricultural sector. There are increasing numbers of cases of where due to lack of automation, frequent traffic jams are caused. Tons of carbon dioxide is produced when vehicles get stuck in such situations. The number of accidents due to defying traffic rules is continuously rising. Using the very concepts of Internet of Things and vehicle connectivity to processing software for making a better, prominent, and automated traffic management system is the optimum solution to address such problems associated with not only traffic management but also any type of processing that requires vehicle identification. Constructing an intelligent vehicle-type identification technique based on Internet of Things [4, 5], which has a number of benefits including the improvement of traffic conditions, the reduction in traffic jams and management costs, the increase in reliability, the increase in traffic safety, the reduction of human labor, and the independence and autonomy of weather conditions, is not only an urgent need and obligation but also can be an adjunct to many more areas of applications. Thus, in this paper, we are using Internet of Things to identify the vehicles, especially vehicles running on highways, and use that data to automate the toll payment system and, for that matter, use that data to automate any type of process that requires the identification of vehicles. All the sensors used in our technique will be connected to the database where further processing of data will be done. The information collected from all vehicles by our sensors can be used not only for automating the toll system on highways but also for any other processing and by anyone for smooth driving. The system also needs to be protected from potential hackers in order to keep it safe from any menace. Hence, having a prototype implementation for keeping the data collected safely will be an added advantage, a boon, to our system [6].

Hence, the goal of this paper is to present an overview of the real-time traffic information acquisition of the vehicle types running on roads, particularly highways, and monitoring architecture based on Internet of Things. This technology can be mingled with existing communication infrastructures for an intelligent traffic management system [7]. The system gathers real-time data, generated by the sensory units, and automation of toll payment system will be monitored. Specific actions will be taken by the devices with a degree of intelligence and autonomy, and interact with their environment in a useful way, thus decreasing the network load, facilitating Internet of Things to provide support for collaboration in Internet of Things, programmable infrared frequency identification devices, and wireless sensor networks to overcome network latency, resulting in an autonomous execution [8, 9].

2 Related Work

A lot of research dealing with the problems of intelligent traffic monitoring and controlling has been done. Bhadra et al. [10] applied an agent-based fuzzy logic technology for traffic controlling situations, which convoluted multiple approaches for different vehicle movements. The author of the paper proposed a system based on a service-oriented architecture for an effective integration of Internet of Things in enterprise services [5, 11].

Recently, researchers [12–15] have shifted their attention to the Internet of Things-based solutions and making a paradigm shift in their approach to developing systems which are very popular in various domains of the society, like health care, business inventories, intelligent house, smart environment, monitoring electrical equipment. Different Internet of Things systems, such as UbiComp [16], are using simple message-passing techniques for communicating with different devices having certain IPv4 or IPv6 addresses [17, 18]. Agent technologies are implemented to help vehicles in traffic congestion and to provide optimal routes for the vehicles. Using architecture integrating objects and cloud computing to develop decentralized smart objects within the Internet of Things was also proposed [19], while other system comprising of mobile agents to handle not just the communications among different devices coming under the Internet of Things but also to conduct searching for needed resources [20–23].

3 The Setup

Many automobile companies are doing a lot to make the vehicles smart. There are a number of sensors which are already fit in vehicles to make them intelligent like hall sensors to detect the position of moving components, the inductive sensor to measure the speed of the vehicle, digital compass for better orientation of vehicles, night vision system to travel safely at night [6]. Instead of making vehicles smart, even roads can be made smart. This is a different yet effective approach of seeing problems and finding solutions to them. These additional features will upgrade the current traffic management scenario.

3.1 Infrared Light Sensors

In order to determine the height of a vehicle traveling on the road, we need an infrared light sensor having high voltage due to large gaps between the poles and the vehicles. The infrared light sensor's functionality as a whole is to emit and receive infrared light when it reflects after striking a surface. This infrared light sensor consists of two component parts: the infrared light emitter and the infrared light receiver. Each of these two component parts has a purpose. These light sensors are situated on the pole above in such a manner that if vehicles pass below them, the infrared light sensors will strike any point on the surface of those vehicles. However, the infrared light emitted by the infrared light sensors strike a vehicle only if the vehicle is directly below the infrared light sensor. So, for this reason, we need to have more than one infrared light sensors situated on the pole above. If we have the number of infrared light sensors greater than or equal to the minimum number of infrared light sensors required for any vehicle to be below at least one infrared light sensor, then this problem of a vehicle going on the road with no infrared light sensor above will be removed. If W is the width of the highway road and w is the minimum possible width of a vehicle, then the minimum number of infrared light sensors we need is W/w and we arrange them in such a manner on the pole such that if the first sensor is at a distance between 0 and w from the left end of the road then each successive light sensor is at a distance just less than w from the previous sensor. This arrangement of sensors on the pole above ensures that a minimum number of sensors are used such that every vehicle passes below at least one sensor.

Infrared light emitter. In order to determine the height of a vehicle traveling on the road, we need an infrared light sensor. The infrared light emitter will be used to

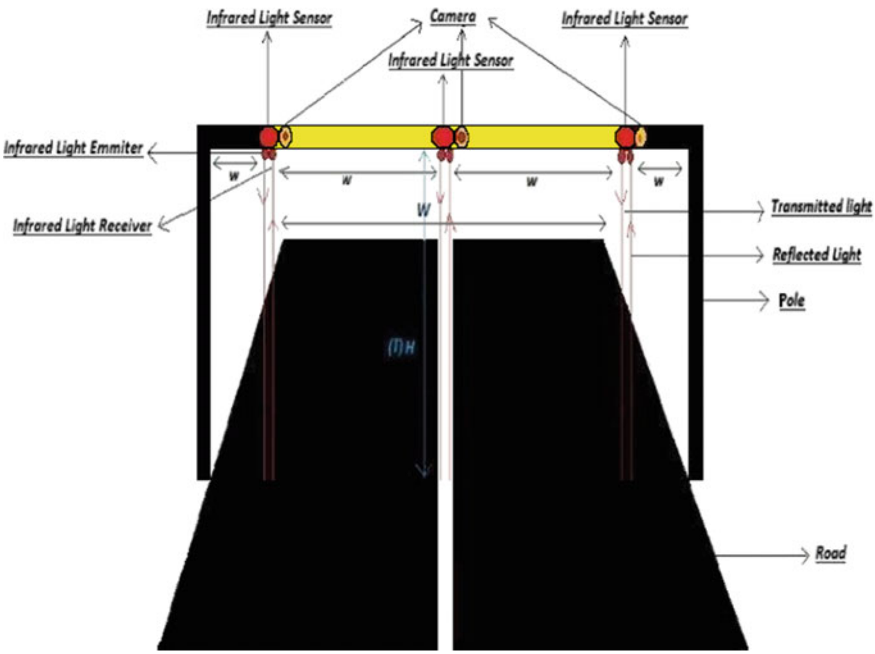

Fig. 1 When a vehicle passes below the sensor then the height h of the vehicle is determined. The infrared light emitted by the infrared light emitter strikes the vehicle and is reflected and detected in time t by the infrared light receiver

emit light in the infrared region. We use infrared light due to it being harmless for living beings and also because it is blocked and reflected by surfaces which might otherwise not block higher energy lights. This emitter when emitting infrared waves, the light will strike a surface and reflect, thus producing a receiving capability for the infrared light receiver. The light emitted will continuously travel toward the road and will return back when no vehicle is passing at some instance of time (as shown in Fig. 1). However, whenever a vehicle passes on the road and below the infrared light sensor, the path to the road will be obstructed and light will travel lesser distance to travel back, thus giving a potential computation for the height of the vehicle that passed by.

Infrared light receiver. The infrared light receiver will detect when it comes back after reflected back from road or vehicle (as shown in Fig. 2). The light will travel more distance when there is no vehicle passing by and travel less when there is a vehicle passing by. The difference in the time required to come back to the receiver by the light will be used to determine the height of the vehicle, as the height determines the toll tax the driver has to pay for his vehicle.

In order to determine the height of a vehicle traveling on the road, we need an infrared light sensor. The light sender will be used to detect the vehicle sensor. The device will emit infrared waves to detect the vehicles. The light will continuously

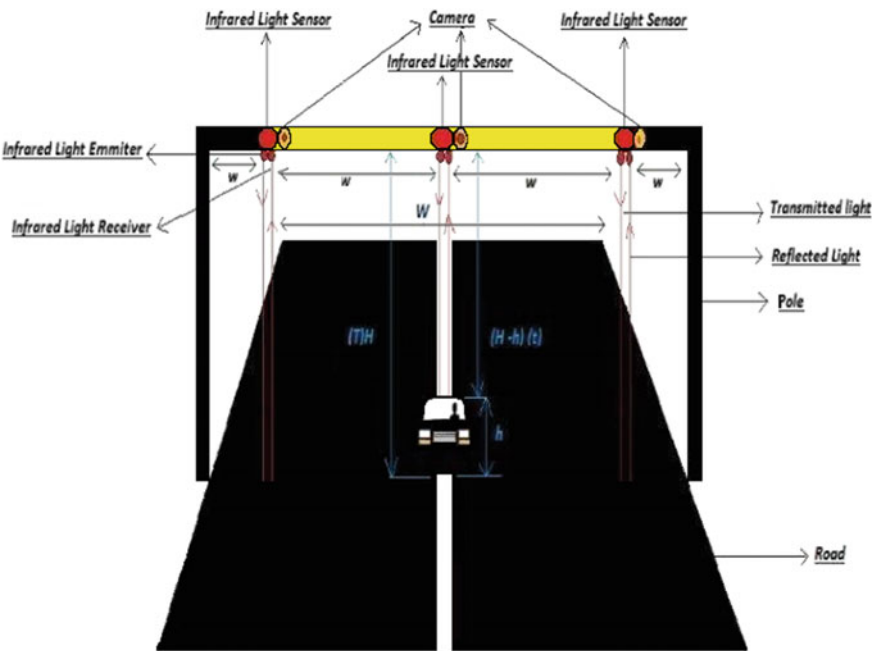

Fig. 2 Normal condition of the road where no vehicle passes by. The infrared light emitted by the infrared light emitter strikes the road below at a distance H from the sensor and reflects back, reaching the sensor in time t, and is detected by the infrared light receiver

travel toward the road and will return back. Whenever a vehicle comes, the path to the road will be obstructed and light will travel less distance to travel back.

3.2 Camera

We also need to detect the vehicle number in order to determine the details of the person whom that vehicle belongs to. This is to enable the digital toll payment system. So, we use cameras, with preferably wide-angle high resolution, to click images of the highway road at successive time intervals and use a vehicle number detection algorithm which involves image processing to detect the number printed on the number plates of the vehicles. After the camera captures the images of the vehicles, we apply the Genetic Algorithm to determine the characters present in the number plate of the vehicle. We use contours and shape information of the pixels, with a Digital Board (DB) with window panes which recognizes each character uniquely. Character pixels are mapped into the panes as lines on the second level. This vehicle number information is sent to the database where, according to the vehicle type and vehicle number determined, the toll amount is deducted from the person's account. This image reading is an imperative phenomenon for the database to keep track of the vehicles in order to implement the automated toll system.

However, there are certain problems with this approach that have to be addressed. At the time of capturing images, there can be a possibility of two side-by-side vehicles coming at the same time. So, how will we know which vehicle came under which light sensor? For that, we have to fix one camera to each infrared light sensor. So, the number of cameras is equal to the number of sensors used, that is, W/w. We trim out the pixel columns in the image which are beyond the minimum width of a vehicle, that is, w. So, effectively, the image captured by the camera has the pixel width such that only one car in a row is present in the image of one camera. Hence, each camera can span a width of only w, which is same as the minimum width of a vehicle.

After the first case is tackled, there is still another case left unsolved. The case which we need to tackle wisely is when the camera will click images of two vehicles not side-by-side this time but one behind the other. So, we need to identify which vehicle is the one under the sensor and which vehicle is behind the sensor while the vehicle numbers of both the vehicles being present in the image at the same time. To sort out this problem, we consider the number information to process for the vehicle nearer to the sensor as the one whose number plate occupies the lower pixels and the vehicle farther from the sensor as the one whose number plate occupies the upper pixels of the image. In the image, the pixels of the vehicle which are identified to occupy the lowest positions are, thus, contemplated as the nearer vehicle and as the number plates occupy upper positions in the image the vehicle is considered to be farther.

3.3 Database

A database is required to keep the information of the vehicle types, vehicle numbers, and the owner names. This information is stored in a secured place. The digital payments will play a major role to pay the tolls in advance, and the payment information will be kept in the database to ensure the safety of data.

Security is a major issue for almost any type of application, be it computer science or any other field. Thus, by providing security to our database, we protect the data from any type of vulnerability or manipulation by any factor and deal with this issue.

4 Linking the Components

The setup is simple; however, we ought to link all of these components so that they work in cohesion. The toll payment check poles are fixed with infrared light sensors and cameras. The infrared light sensors contain infrared light emitters and infrared light detectors (or infrared light receivers). One camera is set with each infrared light sensor, so the number of cameras is equal to the number of infrared light sensors. These infrared light sensors and cameras are connected to a highly secure database in order to keep track of records of payments of toll taxes, vehicle types, and vehicle numbers. For the identification of each vehicle uniquely, the camera captures images frequently. The number of sensors present on the pole is decided by the average width of the vehicles arriving on that road. For the checking of each vehicle, high-quality sensors and high-quality cameras for capturing good quality images are set. Each vehicle is identified by its height, and the image clicked by the camera at the time of the arrival of that vehicle will fasten the payment procedure with the help of digital payments. The records have to be kept at high-security levels in the databases. The system needs proper management to keep the cameras and sensors well working. To provide the energy to the sensors and the cameras, solar panels are used.

5 Working

The working of the system is based on optics. Initially, infrared light waves will be emitted from infrared light emitter toward the highway road. Depending on the presence of the vehicle below the infrared light sensor, there will be two cases.

Case 1: When there is no vehicle passing below the infrared light sensor, which is also the normal condition, then the path of the emitted infrared light is unobstructed between the road and the infrared light sensor. So, the infrared light will travel by its universal velocity c (speed of light in vacuum or air). The infrared light strikes the road and then reflects back to the light receiver. If the time taken by the infrared light to return back to the receiver, in this case, is denoted by T and the distance between road and receiver is denoted by H, then

$$c = 2H/T. \tag{1}$$

Case 2: In this case, when a vehicle arrives between the infrared light sensor and the road, the light travels lesser distance. If the time taken by the light to return back to receiver, in this case, is denoted by t and the unknown height of the vehicle is denoted by h, then

$$c = 2(H - h)/t. \tag{2}$$

Since the speed of light remains constant in vacuum, we equate (1) and (2) to get

$$2H/T = 2(H - h)/t. \tag{3}$$

$$h = H(1 - t/T). \tag{4}$$

Since we know the values of T, H, and t, the value of h can be computed. However, as the vehicle passes below the infrared light sensor, the infrared light will fall on different parts of the vehicle, thus giving different height values. So, we get a set of values of h for a certain vehicle which comprising of different heights. For example, the front and the back part of a vehicle may be having a lesser height than the middle part of the vehicle. So, this problem has to be sorted out. Hence, we keep updating the height value every time once we encounter height values more than the current height value. Hence, the highest value, which we now have, is actually the required height of the vehicle.

When the camera capture the image of a vehicle, the Genetic Algorithm processes the image and the characters of the number plate are determined, and this data along with the vehicle height are sent to the database where the toll amount to be paid is determined and the record is saved. The same method is applied for the next vehicle once the height value, H, is obtained; then the value storing the height of the vehicle is reset to process for the next vehicle. The database is kept at a high-security level to keep the information of the vehicle owner safe and accessible only through the officially permissible persons [24, 25].

6 Future Scope

The total system involved in making the tollbooths system intelligent and smart will make the highway traffic management chaos free to a certain extent. However, the security needed to keep the data safe in the database is a major errand. Day by day, data security is becoming a major concern. The energy that is provided to the infrared light sensors adds to the total cost. The increasing growth in microelectronics promises to provide efficient and less energy-consuming sensors. Usage of an alternative power supply, by using solar panels and using sunlight, to run the sensors and cameras instead of using electricity, or using better physical principles by avoiding the usage of so many sensors conjointly might make the Internet of Things-based traffic system an even more robust and cost-efficient technology. Adverse weather can be a major problem in the case of vehicle detection because the cameras may not be able to click proper images in stormy weather thus affecting the accuracy of the Genetic Algorithm for image processing. Proper maintenance of cameras is also a major task to keep the information updated in the database by clicking images. So, better and sophisticated techniques can be developed to overcome such issues.

7 Conclusion

The Internet of Things can solve many problems associated with undisciplined drivers, improper collection of toll taxes, improper collection of road taxpayers, automation of traffic management system, and the like. This will definitely revolutionize the whole class of tollbooths systems and highways (and such roads) throughout the world. Apart from keeping the traffic at a good pace, it is also cost-efficient and provides a simple and easy system development. So, this would serve as a boon in the modern times where Internet of Things is already playing a major role to solve the problems faced by living organisms, be it any part of life. This paper promises a better future for the automation of such toll systems involving the processing of vehicles and also for humanity.

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A New Face Recognition Technique by Landmark-Based PCA Modeled Scheme in Unconstrained Environment

Naresh Kumar

Abstract There is ever scope of real-time face recognition in various applications ranging from social to commercial sectors. The methods of face recognition for these applications show considerably good performances in restricted conditions. The sounding benchmark demonstrates that all these methods are not adequate for randomly changing environment. The limitations of holistic method divert the researches' attention to more local features and largely robust set of non-monotonic distortions. In this paper, an attempt is made to develop a method for face recognition that refines the recognition rate in the unrestricted environment. The originality derives from weight generation are considered the landmarks in facial images by computing the ratio of inter-variance to the intra-variance. The cumulative sum of weights supplements to find the distinctive features in the facial images and thus the matched person get the highest weight. Our experimental results show that the proposed framework achieves better accuracy for recognition of face than others highlighted techniques on the globally accessible challenging database.

Keywords Linear discriminant analysis (LDA) · Scale-invariant feature transform (SIFT) · Principal component analysis (PCA) · Local binary patterns (LBP) Histogram of oriented gradient (HOG)

1 Introduction

The growth of face processing is exponential, comprising many technical areas including image processing, surveillance, suspicious activity analysis, and security, telecommunication, sign language recognition and human–computer interaction [1]. This common application includes control of facilities, tools and information. To put forward an example, robust face recognition [2, 3] is used by hotels and casinos

N. Kumar (✉)
IEEE & Computer Society of India (CSI), Department of Mathematics,
Indian Institute of Technology, Roorkee, India
e-mail: atrindma@iitr.ac.in

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to recognize fingerprint recognition and blacklisted of individuals. These determinations can also provide useful information on identity, age, ethnicity, etc., of a person. The objective of this work is to propose a method which is compared with three famous other techniques of face recognition: (1) Principal component analysis (PCA) which is a statistical pattern recognition technique for feature extraction and dimensionality reduction [4], (2) Linear discriminant analysis (LDA) [5], which removes the limitations of PCA methods by incorporating the Fisher's linear discriminant scheme which is aiming at maximizing the ratio of determinant of the samples of between-class scatter matrix to that of with-in class scatter matrix, (3) Histogram of Oriented Gradient (HOG) [6], which are the well-known local descriptors based on gradient images.

The rest of the paper is organized that Sect. 2 presents the summary of existing works and the details of the different components of the proposed methods are figured out in Sect. 3. The analysis of database description and experimental results of the proposed model is presented in Sect. 4. Last section refers the future scope of the problem and conclusion regarding the proposed model.

2 Related Work

Face recognition in 2D can be categorized as holistic and feature-based methods. Holistic-based methods use the global information from face images in order to perform the recognition task. The PCA locates the principal components of the original component of face image space which finally provides optimal transformation for face representation [7]. The only challenge with PCA is that it is sensitive to illumination, expressions and other variations. The result of the incapability due to illumination to discriminate images is that the same person can be classified as two distinct people, whereas, LDA reduces with-in class variance, while emulsifying the between-class variance of a given set of the images using linear transformation [5]. In feature-based methods [8–12], face images are processed to extract the distinctive features first then recognition task [3] involves matching of features taken from different areas of face considering multiple images. There are different types of feature descriptors, some of the most frequently used are histogram of oriented gradient (HOG) [6], local binary patterns (LBP) [13], scale-invariant feature transform (SIFT) [14] and Gabor filters [15]. The features extracted by pyramid of histogram of gradient (PHOG) and local histogram of gradient (LHOG) are have been proved the state of art in the domain of biometric [7] and sense classification. It is very tough to recognize emotions when partial face occurs in unconstrained environment [8, 16], in which Gabor Ternary pattern and without alignment of facial points, and a new multi-key point descriptor is developed. Furthermore, Pinto et al. [11] raise the issues of computational efficiency due to huge size of natural image face datasets, which is opening the scope for simple feature so that size of dataset may remain under control.

In literature survey, SIFT-based face recognition addresses the two main aspects of key point pruning and illumination invariant key point detection. As far as computation is concerned they are similar but both have different applications. SIFT is used to identify of specific objects using bag of words model for example, whereas HOG is used suitable for classification.

3 Proposed Methods

3.1 Affine Transform

Geometrical perspective of images can be presented by operands and projected sets due the transformation applied on training set of images. Affine transform is one of geometrical transforms which depicts its nature by the preserving the feature points, set parallel lines and planes but it does not guaranty for angle and distance between the line in an image. The most effective properties preserved by affine transform are collinearity, convexity, parallelism and ratio of lines in the images. The sounding affine transforms for images are seared maps, rotation, reflection, scaling and translation. In this work, it has been applied rotation and shearing transform at landmark template which is used to generate model PCA of the training set of face images. Mathematical aspect for processing on landmark model is presented 2-D sheared transform (1) in x- and y-axis directions and 2-D and 3-D rotational transform (2) and (3) where α, β and γ are angle rotations in x-, y- and z-axis directions, respectively.

$$S_x(\alpha) = \begin{bmatrix} 1 & \alpha \\ 0 & 1 \end{bmatrix}; \quad S_y(\beta) = \begin{bmatrix} 1 & 0 \\ \beta & 1 \end{bmatrix} \tag{1}$$

$$R(\theta) = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}; \quad R_x(\alpha) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\alpha & \sin\alpha \\ 0 & -\sin\alpha & \cos\alpha \end{bmatrix} \tag{2}$$

$$R_y(\beta) = \begin{bmatrix} \cos\beta & 0 & \sin\beta \\ 0 & 1 & 0 \\ -\sin\beta & 0 & \cos\beta \end{bmatrix}; \quad R_z(\gamma) = \begin{bmatrix} \cos\gamma & \sin\gamma & 0 \\ -\sin\gamma & \cos\gamma & 0 \\ 0 & 0 & 1 \end{bmatrix} \tag{3}$$

3.2 Shape Alignment of Face Images

All the face images are aligned by gradient booting technique of ensemble learning which is based on minimization of loss function defined by weak learning of training set. Before proper alignment of face images, it is mandatory to normalize the facial data. The normalized shape $T_I^{\circ}I$ (4) is obtained from the input shape I where $\bar{I}$ is mean shape of input shape I.

$$T_I = \arg\min_T \|\bar{I} - T^{\circ}I\|_2 \tag{4}$$

In testing phase, from initial shape I° cascading normalized techniques (5) is used for updating the she,

$$I_t^k = I_t^{k-1} + T_{I_t^{k-1}}^{-1\,\circ} T_I \tag{5}$$

The stage processor is k and I_t^k is new shape at stage k. It is notable that we have sheared and rotated the images using affine transform.

The schematic diagram of the proposed model diagrammatically is repeated for both training and testing phases. For facial landmark detection, we are using constrained local neural field model. The number of landmarks used in this experiment is 68. We apply affine transformation to the assembled landmarks obtained from the dataset. At every landmark, a matrix set of 64 $\times$ 64 pixels (patch) is generated so as to calculate variation in the nearby locations. Finally, the weight is assigned to each landmark which is computed by the ratio of inter-variance to intra-variance and the PCA model of each of 68 landmarks is generated. The affine transformation, thereafter applied, refines the distortions by various physical elements. Further for each landmark apply PCA model and find the nearest person that is found to be matched. The algorithmic steps of experimental work are represented by block diagram in Fig. 1.

4 Experimental Results Discussion and Analysis

4.1 Performance Measures

(a) *Euclidean distance*

The Euclidean distance of test face image to each face image is defined for two face matrices. If x and y be two face images represented as $x = (x^1, x^2, x^3, \ldots, x^{MN})$ and $y = (y^1, y^2, y^3, \ldots, y^{MN})$, then the Euclidean distance is given by Eq. (6)

$$d_E^2(x, y) = \sum_{k=1}^{MN} \left(x^k - y^k\right)^2 \tag{6}$$

where x^k is a vector describing the kth face class.

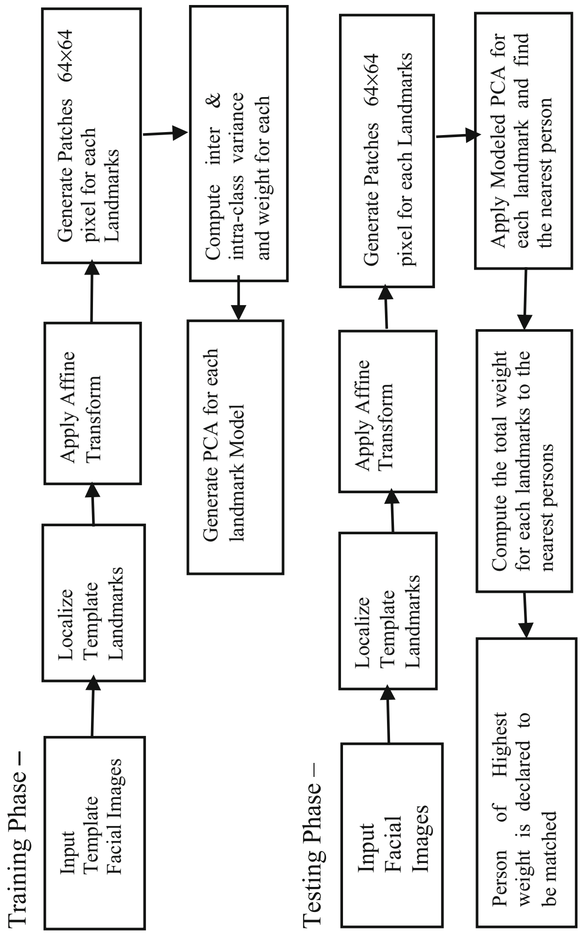

Fig. 1 Systematic diagram of proposed model

(b) *False Positive Rate (FPR) and True Positive Rate (TPR)*

The sensitivity and specificity of the methods have been evaluated for ensuring the success rate of the methods. Sensitivity and specificity are defined as the probability of correctly recognizing a face and probability of correct rejected represented in (7) and (8), respectively.

$$\text{Sensitvity} = \text{TP}/(\text{TP} + \text{FN}) \tag{7}$$

In general, positive means identified and negative means rejected. Therefore, false positive rate is defined in terms of True Negative (TN) and False Positive (FP).

$$\text{Specificity} = \text{TN}/(\text{TN} + \text{FP}) \tag{8}$$

Each of terms used in (7) and (8) False negative (FN), False positive (FP), True negative (TN) and True positive (TP) has its meaningful importance like incorrectly rejected, incorrectly identified, correctly rejected and correctly identified, respectively.

(c) *Receiver Operating Characteristics (ROC)*

An ROC curve is a plot of a test's sensitivity (or true positive rate) versus false positive rate (or 1-specificity). This is the reason why it is preferred over simple estimates of sensitivity of specificity. The performance testing of algorithms is represented by drawing ROC curve which lies between True Positive Rate (or Sensitivity) and False Positive Rate (or specificity) and the further studies suggest that ROC curve which has a high sensitivity and specificity predict the better performance.

4.2 Performance Measures of the Proposed Method on ORL Database

The number of grayscale images of 40 persons is 400 in the AT&T database in which 10 images belongs to single person, with the resolution of 112 × 92 pixels. The sets of images were captured against a dark and homogeneous background, with scale variation up to 10% and tilt rotation up to −20° [17].

The training of ORL dataset. Figure 2 contains whole dataset while 20% of each individual are used as a testing samples. Figure 3 clearly shows that the area under the curves (AUC) corresponding to overall accuracy, illustrates that the proposed algorithm has maximum sensitivity and specificity as compared with other reported algorithms. In Table 1, the maximum recognition rate is 98.61 for PCA, PHOG and LHOG methods using Face95 database.

However, the maximum recognition rate with proposed method has been obtained as 98.95 for the same database. Referring this table, the minimum

Fig. 2 Sample image set of a subject in ORL database

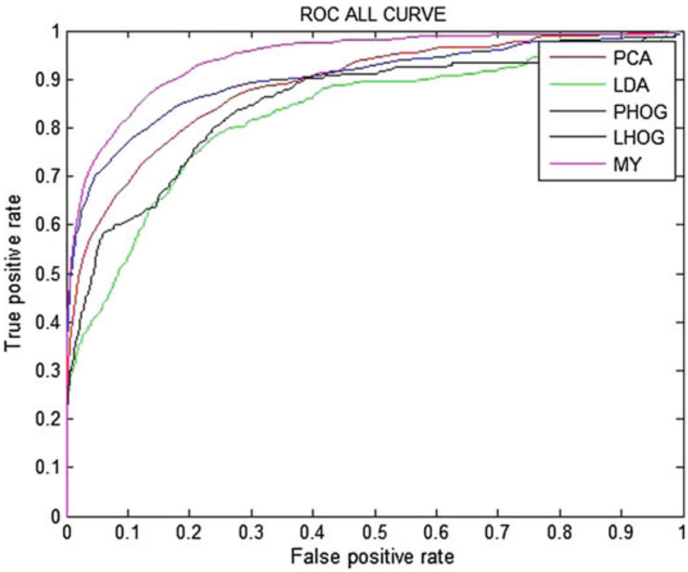

Fig. 3 ROC plot for performance of face recognition algorithms on ORL database

Table 1 Performance comparison of our model on different database

Different datasets	PCA	LDA	PHOG	LHOG	Proposed method
ORL	91.13	97.46	94.43	97.46	98.73
Face94_female	87.50	90.75	86.25	87.50	88.50
Face_95	98.61	92.23	98.61	98.61	98.95

recognition rate obtained with PHOG methods is 86.25 for Face94_female database. From the above discussion, the proposed method offers better recognition rate than other reported techniques.

4.3 Performance Proposed Method on Face94 Database

The Face94 database is grouped into three directories such that the female (20), male (113) and male staff (20) of total 153 individuals. There are 20 images of each individual having a resolution of 180 × 200 pixels. The images of the individuals have been taken under considerable expression variation. All the images were captured against a plane of green background, with minor variation of head turn, tilt and slant [14]. Figure 4 shows the variation in the curve. It is reported in Table 2 that PHOG feature is stronger at ORL and Face_95 database. PHOG features are much more important in the domain of temporal analysis of facial matrices.

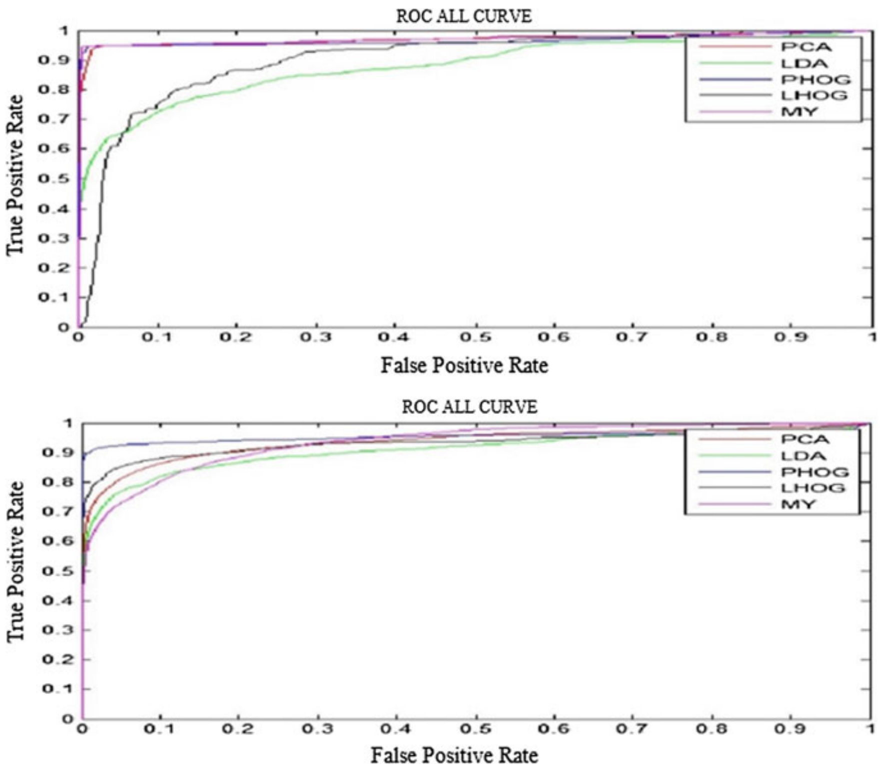

Fig. 4 ROC for performance comparison of PCA modeled algorithms on Face_95 and Face94_female database

4.4 Performance of the Proposed Method on Face95 Database

This is reported that local histogram of gradient (LHOG) is outperforming at PHOG, PCA and LDA for all the datasets. Our modeled PCA-based features are better than LHOG features which adds contribution marks for novelty to this work. PHOG and LHOG are good features which can extract very sensitive information to work in face biometric, sensitivity analysis and scene localization of any secured spatiotemporal data. It is shown in Fig. 4 by ROC curve for Face_95 and Face94_female database that the proposed modeled PCA architecture outperforms at the state of art for to recognize face in unconstraint environment.

5 Conclusion and Future Scope

The paper study was inspired by PCA, LDA, SIFT and HOG techniques available for face recognition. The proposed method in observation table generated shows that the proposed algorithm performed comparatively a contributed result in the state of art of the present scenario considering in unrestricted environment. Further studies and more real-time applications of the technique are highly encouraged and the improvement is being made to get further better results. The future scope of this work encourages the facial expression analysis and suspicions human facial action recognition in unconstraint environment using deep learning criterion.

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WordNet-Based Text Categorization Using Convolutional Neural Networks

K. Premchander, S. S. V. N. Sarma, K. Vaishali, P. Vijaypal Reddy, M. Anjaneyulu and S. Nagaprasad

Abstract Text Categorization is a task of assigning documents to a fixed number of predefined categories. Concept is the grouping of semantically related items under a unique name. Dimensionality space and sparsity of the document representation can be reduced using concept generation. Conceptual representation of a text can be generated using WordNet. In this paper, an empirical evolution using Convolutional Neural Networks (CNN) for text categorization has been performed. The Convolutional Neural Networks exploit the one-dimensional structures of the text such as words, concepts, word embeddings, and concept embeddings to improve the categorical label prediction. The Reuter's dataset is evaluated with Convolutional Neural Networks on four categories of data. The representation of a text with word embeddings and concept embeddings together results to a better classification performance using CNN compared with word embeddings and concept embeddings individually.

K. Premchander (✉) · M. Anjaneyulu
Department of Computer Science, Dravidian University, Kuppam, India
e-mail: kpc.1279@gmail.com

M. Anjaneyulu
e-mail: anjan.lingam1@gmail.com

S. S. V. N. Sarma
Department of CSE, Vaagdevi College of Engineering, Warangal, India
e-mail: ssvn.sarma@gmail.com

K. Vaishali
Department of CSE, Jyothismathi Institute of Technology and Sciences, Karimnagar, India
e-mail: vaishali5599@gmail.com

P. Vijaypal Reddy
Department of CSE, Matrusri Engineering College, Hyderabad, India
e-mail: drvijayapalreddy@gmail.com

S. Nagaprasad
S.R.R. Government Arts & Science College, Karimnagar, India
e-mail: nagkanna80@gmail.com

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Keywords Text categorization · Convolutional Neural Networks
Word embeddings · Concept embeddings · WordNet

1 Introduction

With the advent of Internet, the usage of Internet users was a big explosion in the history of information technology. As the availability of information increased and people were unable to utilize large amounts of information. Text Categorization is the main source for handling and organizing text data in which it assigns one or more class labels to a document according to their content. WordNet contains a set of synsets. A synsets are group of words having similar meaning. In WordNet, it establishes different relationships such as hyponym, hyponymy, or ISA relation among synsets. WordNet can be used in various applications such as Natural Language Processing (NLP), Text Processing, and Artificial Intelligence.

Deep Neural Networks have been the inspiration to various NLP tasks, and the Recursive NN considers the semantics of a sentence through a tree structure which reduces the effectiveness when we want to consider the whole document. To find a solution to this problem, in latest studies the Convolution Neural Network (CNN) model is used for NLP. The problem of high dimensionality and sparsity of data is addressed using Deep Neural Networks [1]. Word embedding is a generation of concepts from words. There are many tools available for word embeddings such as word2vec, Sen2Vec, and Glove. Word embeddings are an important concept in deep neural networks. In Bag-of-words model, the document is represented as a vector which contains words and their weights. The word embedding is used to generate concept vectors for a given word vectors. By using concept vectors, a semantic relationship among the objects is established.

The paper has organized into five sections. The related work has explained in Sect. 2. The proposed model is described, the detailed flow of work explained in Sect. 3. The description about the dataset, the performance evaluation measures, and the experimental evaluations are presented in Sect. 4. The inference from the obtained results and possible extensions to the proposed work is presented in Sect. 5.

2 Related Work

The text documents are represented using linear approaches such as bag-of-words approach and *n*-gram approach as in [1, 2]. But, the nonlinear approaches are proved to be more effective for text categorization in [3, 4]. In this paper, the focus is on Convolutional Neural Network approach for text categorization as proposed in [5].

For Text categorization, the documents are represented with set of features such unigrams, bigrams, *n*-grams. But the traditional methods to represent the document using bag-of-words representation suffer with the problem of identifying the semantically relationships among the terms in the document. There are some features such as second-order *n*-gram tree structures [6], proposed to capture the semantic relations among the terms in the document. But these features are suffered with the problem of data sparsity which reduces the performance of the classifiers. Nowadays, the developments in the deep neural networks and word embeddings lead to address the problems such as data sparsity in NLP tasks. As in [7, 8], word embeddings capture the semantic and syntactic relations among the terms in the document. As proposed in [9], the Recursive Neural Network (RNN) is more effective for sentence representation in semantic space. But RNN uses tree structures to represent the sentence in a document which is not suitable for long sentences. Another drawback is its heavy time complexity. RNN model stores the semantics of the term for each word using hidden layers as in [10].

Text Categorization contains three topics such as feature engineering, feature selection and machine learning algorithms. The Bag-of-Words (BOW) model is used for feature engineering. Some other features such as noun phrases, POS tagging have proposed in [11] and tree kernels in [12]. Identification of the suitable features from the documents can improve the performance the classification system. The commonly used process for text classification is elimination of stop words from the document. There are some approaches such as information gain, chi-square indexing, mutual information is used to identify the importance of the features in [13]. There are various machine learning algorithms which are used to build a learning model for classification. These methods lead to the problem of data sparsity. Deep neural networks as in [14] and representation learning in [15] are proposed to come out from the high dimensionality space and sparsity of data problems in the document representation as in [6, 16].

The representation of a word in the form of a neuron is known as embedding of word in the form of a vector. The word embedding is used to measure semantic relationship between two words using word vectors. With word embeddings in neural networks, the performance of classification models is improved. As in [17], semi-supervised recursive auto-encoders are used to identify sentiment terms from the sentences. As in [18], RNN is used to predict the paragraph detection. As in [19], the sentiments in tensor networks are explored using recursive neural tensor networks. As in [20], the language models are built using RNN. In [21], RNN is used for dialogue act classification.

3 Proposed Work

The proposed model consists of various phases such as preprocessing the training and testing dataset, constructing a vector space model using word embeddings and concept embeddings of the document and finally building a classification model

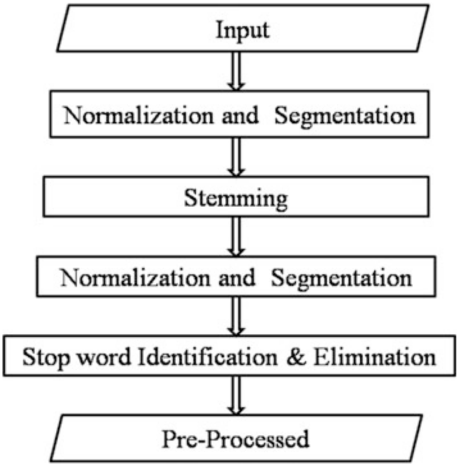

Fig. 1 Preprocessing for the document

using CNN and assigning a class label to the test document using the classification model. The various steps are explained as follows:

3.1 Preprocessing

There are four steps involved in preprocessing the documents. In the first step, the non-content words are removed from the text. In the second step, the words are converted into their root forms. In third step, Part-Of-Speech (POS) tagging is assigned to each of the words. In the last step, stop words are removed from the text. The flow is shown in Fig. 1.

3.2 Proposed Model

The proposed model has presented in Fig. 2.

3.3 Convolutional Neural Network

Convolutional Neural Network (CNN) was proposed for handling various applications on digital image processing in [5]. CNN is a feed-forward neural network which contains a set of layers with a combination of pooling layers. In CNN, data are presented in the form of dimensional vectors in each layer. These low-dimensional vectors are called word embeddings. Using these embeddings, the

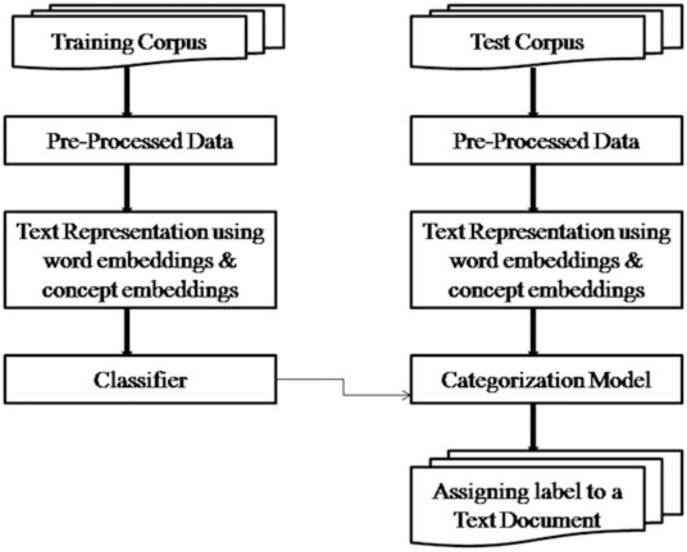

Fig. 2 Proposed model for text categorization

features which are presented in various layers can be identified. In CNN, the document is represented as a sequence of layers. The data presented in the layers are grouped into small regions. These regions are represented using low-dimensional vectors which are called word embeddings. The pooling layer in CNN combines the region of a word embeddings to represent a document vector to achieve maximum value per component. This method is proved to be better in performance for various applications compared with existing approaches.

3.4 Word2Vec

Each word in the text can be represented as a dimensional vector. These vectors are called word embeddings. Representation of words with its corresponding word embeddings is called Word2Vec model. The Word2Vec model is basically of two types such as Continuous Bag-Of-Words model (CBOW) and the Skip-Gram Bag-of-words model (SBOW). In CBOW model, the target words are derived from source context words, and in SBOW model, source words are predicted from the target words. CBOW model generates a smoothed curve on distributional information. The CBOW model is more useful for smaller datasets. SBOW model is more useful in the context of larger datasets. For text categorization, CBOW model is used to produce concept and word embeddings.

3.5 WordNet

WordNet is a thesaurus for the English language. It has many applications in various fields such as NLP, text mining, and information retrieval. WordNet is useful to find the semantic relationship among the words in a document. Many algorithms consider the height and depth of a word in the WordNet using synsets to get the closeness among the words based on its meaning. WordNet-based texts categorization has two stages. The first stage is learning phase, in which we get a new text by combining the terms with their relevant concepts. This enables to create categorical profiles based on characteristic features, and the second stage relates to the classification phase in which weights are given to the features in the categorical profiles.

3.6 Algorithm

Input: Training dataset and Test dataset

Step 1: Preprocess the data for both training and test datasets using various preprocessing techniques.
Step 2: Identify content terms from the training dataset and test dataset.
Step 3: Identify unique concepts using WordNet from content terms.
Step 4: Generate word embeddings and concept embeddings for content words and concepts derived from WordNet using Word2vec.
Step 4: Represent each document of training and test datasets in vector space model using word embeddings and concept embeddings.
Step 5: Construct a classifier using vector space model of documents with convolution neural networks.
Step 6: Identify the class label of test document by inputting the vector space model to the classification model.

4 Evaluation and Discussions

In this paper, Reuter's dataset is used to carry the experiments to label the documents with predefined categories. The precision, recall, and F_1 measures are used to measure the performance of proposed classification model.

4.1 Dataset Description

In this paper, the experiments were performed on the Reuter's dataset. It contains four categories of dataset namely CRAN, CISI, CACM, and MED. For empirical evaluations, 800 documents are considered based on the minimum number of sentences in the document. From 800 documents, 640 documents were considered as training set and the remaining were considered as test set. After applying various preprocessing techniques, the vector representation of the documents with their word embeddings and concept embeddings are inputted to CNN model for classification model generation.

4.2 Evaluation Measures

The performance of the obtained classification model is measured using precision, recall, and F_1 measures. The formulas for calculating precision, recall, and F_1 measures are as follows:

$$\text{Precision} = \frac{X}{X+Y}$$

$$\text{Recall} = \frac{X}{X+Z}$$

$$F_1 = \frac{2 * \text{Recall} * \text{Precision}}{\text{Recall} + \text{Precision}}$$

X is the number of documents retrieved and relevant, Y shows the number of documents retrieved but not relevant, Z is the number of documents relevant but not retrieved for a given query. F_1 measure is calculated using precision and recall.

4.3 Results

The efficiency of a classifier is measured on the test set by using precision, recall, and F_1 measures. Out of 800 documents, 640 documents are considered as training set and the remaining 160 are documents as test set. The results of our experiments are given in Table 1.

From the results, it is observed that the learning a classification model using word embeddings gains better precision, recall, and F_1 measure values compared with classification model with concept embeddings only. But combining word embeddings and concept embeddings together to train the Convolutional Neural Network leads to best classification performance.

Table 1 Precision, recall, and F_1 measure values using Convolution Neural Networks approach for word embeddings, concept embeddings and with their combination

Document representation	Precision	Recall	F_1 measure
Word embeddings	0.85	0.92	0.88
Concept embeddings	0.79	0.84	0.81
Word embeddings + Concept embeddings	0.89	0.95	**0.92**

5 Conclusions and Future Scope

The proposed model captures contextual information and constructs the representation of text using a Convolutional Neural Network for Text Categorization. It demonstrates that our model of Convolutional Neural Network gives best results using four different Reuter's datasets. In this paper, a new approach for Text Categorization is proposed by considering concept embeddings using WordNet. The experimental results with Reuters 21,578 dataset proved that the background knowledge to establish the relationships between words leads to effective classification performance. A possible extension to the proposed work is utilization of more suitable weighting techniques for representation of terms and concepts. It is also required to experiment with various possible Deep Neural Network approaches for different term representation techniques.

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DTFA Rule Mining-Based Model to Predict Students' Performance

Sushil Kumar Verma, Shailesh Jaloree and Ramjeevan Singh Thakur

Abstract Nowadays data mining plays an important role in various fields. This field may be related to education, agriculture or medicine. Education is an important part of human life. With the help of data mining in education called educational data mining, we achieve quality education, which is very essential not only for growth of students as well as country. Based on quality education, we achieve and improve performance of students. We can use the different data mining techniques to improve performance of students. This paper's contents indicate the sort out the performance of students basis on 12th and graduation level marks, previous semester marks (PSM), mid sem marks (MSM), attendance (ATT) and end semester marks (ESM). Using attributes, conclude the recital of students in end semester. In this paper, for classification, we used decision tree algorithm, and for fuzzy association mining, we used the modified Apriori-like method. In this paper, we will merge these rules which are generated from decision tree algorithm and Apriori-like algorithm.

Keywords Educational data mining (EDM) · Knowledge discovery
Decision tree · Classification · Fuzzy association rule mining

S. K. Verma (✉)
S.A.T.I, Vidisha, Madhya Pradesh, India
e-mail: sushilverma81@gmail.com

S. Jaloree
Department of Applied Mathematics and Computer Science,
S.A.T.I, Vidisha, Madhya Pradesh, India
e-mail: shailesh_jaloree@rediffmail.com

R. S. Thakur
Department of Computer Applications, Maulana Azad National Institute
of Technology, Bhopal, Madhya Pradesh, India
e-mail: ramthakur2000@yahoo.com

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1 Introduction

In the present day, data gathering is no longer costly and hard job. As an effect, datasets are growing explosively. To take out the knowledge from these datasets has attracted a great deal of scientific attention and has become an important research area. "Data mining is a flourishing research field and has become a synonym for the process of extracting hidden and useful information from datasets" [1–3]. Data mining in education belongs to Educational Data Mining that investigates information from data which find out from educational environments [4–6]. One of the main concerns of higher educational system is evaluating and enhancing the educational organization. These days' higher educational organizations are placing in a high competitive environment and are aiming to get more competitive advantages over the other business competitors [7–9]. The focus of higher educational institutions is to serve merit education to its students. Educational data mining uses many techniques such as decision trees, neural networks, *k*-nearest neighbor, naive Bayes, support vector machines and many others. Using these techniques, various kinds of knowledge can be discovered such as association rules, classifications and clustering [9–11]. In this paper, student's performance is figured out with the help of decision tree algorithm and fuzzy association rule mining. For classification, we used decision tree algorithm, and for fuzzy association mining, we used the modified Apriori-like method.

2 Rules Generated by Decision Tree

2.1 Preparation of Data

The data used in this work was acquired from SATI, Vidisha (Madhya Pradesh) and size of the data is 50. Here, we have described only few student records as shown in Table 1 [12]. Here, PAR means previous academic records, PSM means previous semester marks, ATT means attendance, MSM means mid sem marks and ESM means end semester marks (Fig. 1).

Table 1 Student record dataset

S. No.	Sch. No.	12	Graduate	PAR	PSM	ATT	MSM	ESM
1	MCA/19373	75.61	80.39	78.00	77.00	81	18	65.00
2	MCA/19353	71.11	72.89	72.00	82.00	80	15	65.00

Fig. 1 Extracting information from data [12, 19]

2.1.1 Data Cleaning

The dataset which is collected from SATI Vidisha needs to undergo cleaning. All the predictor and response variables which were derived from the database are given in Table 2 for Refs. [11–14].

2.1.2 Data Transformation

Transform of student data record is shown in Table 3 [12, 14–16]. Data transformation such as PAR is split into four class values: first $\geq 60\%$, second $\geq 45\%$ and <60%, third $\geq 33\%$ and <45%, Fail <33%.

2.1.3 Rules Obtained by Using Decision Tree

if PSM = first then ESM = first
if PSM = second, if PAR = first, if ATT = poor then ESM = second
if PSM = second, if PAR = first, if ATT = good|average then ESM = first
if PSM = fail then ESM = fail
if PSM = third, if PAR = second then ESM = third
if PSM = third, if PAR = first then ESM = second

Table 2 Highlighted records after data cleaning process

S. No.	PAR	PSM	ATT	MSM	ESM
1	78.00	77.00	81	18	65.00
2	72.00	82.00	80	15	65.00

Table 3 Data transformation

S. No.	PAR	PSM	ATT	MSM	ESM
1	'first'	'first'	'good'	'good'	'first'
2	'first'	'first'	'good'	'average'	'first'

Define fuzzy set → Data Transformation → Fuzzy Normalization→ Frequent Itemset→ Analysis of Result→ Knowledge Discovery

Fig. 2 Schematic view of frequently closed itemset discovery [17, 18]

Above rules are generated using decision tree on dataset50 with 100% density. We can observe from the above rule that if the student fails in last semester or got third division and PAR is second then ESM will be third division.

3 Rules Generated by Fuzzy Association Rule Mining

Fuzzy association rule mining is separated into different steps [17, 18] (Fig. 2).

3.1 Rules Obtained by Using the Apriori-Like Algorithm

if MSM = good then ESM = first
if PAR = first, if MSM = good then ESM = first
if ATT = poor, if MSM = poor then ESM = fail
if PAR = third, if MSM = poor then ESM = fail

Above rules are generated on dataset50 with highest percentage support count and confidence. We can observe from above rule that student is good in MSM then he/she will be first in ESM.

4 Proposed Methodology

In this section, the classification based on decision tree and fuzzy association rule mining algorithm is used to evaluate student's performance.

4.1 Algorithm

Input: Training quantitative data D, parameters control: minsup.
Output: Rules Generated by Decision Tree and Fuzzy Classification Association mining.

Preprocessing Phase:
The dataset D needs to undergo cleaning.

Method:

Step 1: In order to use student data record D for generating rules, the data is to be transformed. So another set of records D1 with same attributes is used but, in this case, the numeric values are converted into string values according to the given criteria given is Sect. 2.

$$\mathrm{D1} := \mathrm{DataTransform}(\mathrm{D});$$

Step 2: Apply the decision tree algorithm as defined in Sect. 2 on the data D1 received from the previous step. We also supply Target_Attribute C and Attribute_List L to the decision tree algorithm. The output of this step is the rules generated by decision tree. Store these rules to variable R1.

$$\mathrm{R1} = \mathrm{DecisionTree}(\mathrm{DataSetD1}, \mathrm{Target\ Attribute\ C},\ \mathrm{Attribute\ List\ L});$$

Step 3: Recent dataset D2 enabling the mining of fuzzy association rules has to be built out of the data D. For every fuzzy set that we have defined in Sect. 3, there is one column in the new database containing the grade of membership of the single items to the specific set.

$$\mathrm{D2} = \mathrm{FuzzyDomain}(\mathrm{D});$$

Step 4: The quantitative attribute showed by fuzzy sets D2 may contribute more than one in rows. Here, the fuzzy normalization procedure takes place. So in this step, fuzzy normalization is applied on the dataset, which yields normalized data DN.

$$\mathrm{DN} = \mathrm{Normalization}(\mathrm{D2});$$

Step 5: In this step, we apply improved Apriori algorithm based on matrix and vector multiplication and support matrix to identify frequent itemset. The rule generated by this step is stored in variable R2.

$$\mathrm{R2} = \mathrm{Apriori}(\mathrm{D2});$$

Step 6: Merge the rule generated by Step 2 and Step 5, to find out the best appropriate rules that present in first or second or both techniques.

$$\mathrm{Rules} = \mathrm{R1} \cup \mathrm{R2};$$

Based on the rule generated in Step 6, we can conclude the knowledge that describes students' potentials in end semester examination. It helps to identify the poor students who need of observation.

5 Result and Discussion

Table 4 depicts the statistics of test dataset. On different densities, methods were able to discover all closed patterns for both the database. The results show that our method outperforms rules generation and provides the minimum running times in all cases, especially when the number of rows is higher. It observed that number of rules and entropy of dataset increased when we increase the density of dataset. The Gini index measures the impurity of dataset, a data partition or set of training tuples. We can see from the table when the density of dataset50 increases, values of Gini Index also increased means impurity of dataset50 also increases but when the density of dataset154 increases, values of Gini Index decreased means impurity of dataset50 decreases.

It was observed that the as the percentage of minimum support and minimum confidence increases, infrequent itemsets are removed that lead to decreasing in no. of rules generated. We can also observe from table that increases execution time is conversely proportional to minimum support, since it grows as minimum support diminishes. We depict that the effect of no. of rules obtained and execution time with respect to minsup and minconf (Figs. 3 and 4).

Table 5 depicts merged decision tree and fuzzy rule mining results, and this will helpful for the students to enhance academic performance.

Table 4 Performance test using proposed method

Dataset	Density (%)	Entropy	Gini index	Time (s)	Rules
Dataset50	25	0.77323	0.27219	0.04899	04
Dataset50	50	1.4692	0.6112	0.06885	10
Dataset50	75	1.7083	0.69252	0.08351	12
Dataset50	100	1.9790	0.7432	0.13302	15
Dataset154	25	1.1487	0.52465	0.07293	09
Dataset154	50	1.0850	0.51138	0.09253	11
Dataset154	75	1.0197	0.47893	0.09981	11
Dataset154	100	0.94812	0.43793	0.1426	19

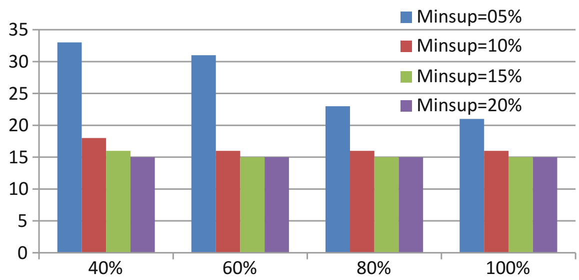

Fig. 3 Representation of minsup, minconf on no. of rules on dataset50

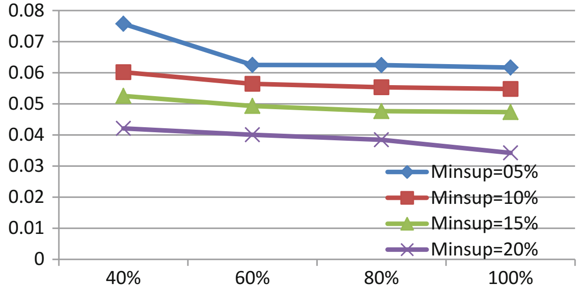

Fig. 4 Representation of minsup, minconf on time on dataset50

Table 5 Rules obtained by proposed DTFA mining on Dataset50

S. No.	Rules generated by DTFARM
1	if PAR = first, if MSM = good then ESM = first
2	if PSM = fail then ESM = fail
3	if PSM = first then ESM = first
4	if PSM = second, if PAR = first, if ATT = average then ESM = first
5	if PSM = second, if PAR = first, if ATT = good then ESM = first
6	if PSM = second, if PAR = first, if ATT = poor then ESM = second
7	if PSM = second, if PAR = second, if ATT = average then ESM = second
8	if PSM = second, if PAR = second, if ATT = good then ESM = second
9	if PSM = second, if PAR = second, if ATT = poor, if MSM = average then ESM = second
10	if PSM = second, if PAR = second, if ATT = poor, if MSM = poor then ESM = third

6 Conclusion

There is large amount of work to do, especially on fuzzy association mining algorithm. In first place, its quality has to be investigated by comparing results of decision tree to the results of fuzzy frequent itemset discovery method. Comparing these algorithms would make it possible to evaluate the quality of the implemented proposed algorithm by finding out whether it discovers all relevant itemsets or not. Also, the speed of both methods is still to be compared because it is not known whether the proposed algorithm is as efficient as other algorithms in a fuzzy context. In this paper, we have proposed a novel and efficient method to find out the frequent closed itemsets on the dataset50 and dataset154.

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Toward Smarter Hadoop's Slaves Nodes by Deploying Game Theory Strategies

Ahmed Qasim Mohammed and Aman Singh

Abstract As each one of us recognized the high speed of evaluation in the technologies field, the result of which is generating a huge amount of data which is known as Big Data. For this Big Data, there is need for an efficient distributed system to process this data and here came the Hadoop. Hadoop is one of the important frameworks in distributed system that has many other applications to process data. There are many researchers working to improve the performance of Hadoop, but in all literature the main focus is to improve the Master node, while it is important to try and provide a smarter Slaves node that can cooperate or predict what other Slaves node strategies to pick up the Job. In this paper, our study focuses on Game theory domain such as Nash equilibrium and bargaining strategy, second is Artificial intelligent to propose a smarter system even slave nodes in it can take a decision, especially that the core of Hadoop System is adopting a pull-scheduling strategy. We believe our work is going to improve resources utilization and minimize the processing time of Jobs.

Keywords Hadoop · Nash equilibrium · Bargaining strategy · Big data
Artificial intelligent · Resource utilization

1 Introduction

From long back, organization has been generating data, but as uprising of the new technologies (Social Media, Smart phones, etc.) more and more data is being generated, according to a survey that shows 90% of data was generated in last five years. For example, most people have a cell phone; whenever your cell phone is switched on it is connected to service provider towers as you are changing your

A. Q. Mohammed (✉) · A. Singh
Savitribai Phule Pune University, Pune, India
e-mail: Ahmed.altaj@yahoo.com

A. Singh
e-mail: be.cse.aman@gmail.com

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place you will be connected to different towers and this generates data which is beneficial for the service provider to find dead spots in the coverage, many another example such as in social media where they analyze your data to predict what are you looking for so they will show you advertisement related to your preferences.

The increase in the amount of data leads to a problem of how the data will be stored and processed, etc. Many useful things can be done by using Big Data but before all of that, there is need for an efficient framework to store and process this messy amount of data; developers at Google published various research papers which were the first step toward one of the important frameworks nowadays which is known as Hadoop.

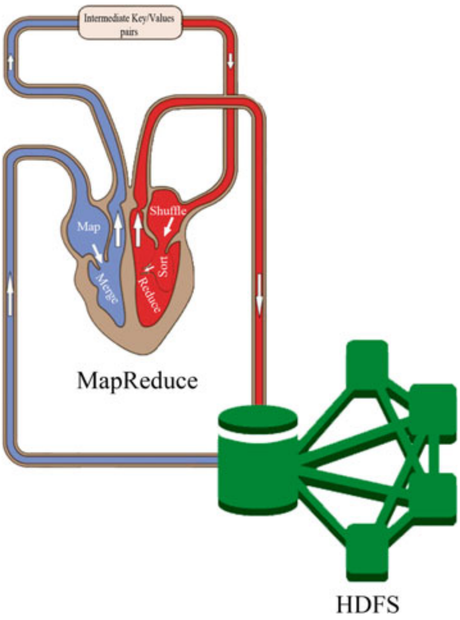
Hadoop [1–6] came to life in 2006 with the help of Yahoo and many other researchers. Day after day, Hadoop continues growing as an open-source system to be used now by thousands of companies, as there were many others projects growing up parallel with Hadoop. This growth led Hadoop to be the kernel of an operating system for Big Data and many other tools were added in Hadoop framework, to make processing of data easier by these tools and MapReduce.

Hadoop core project consists of mainly two parts which we like to call them heart and memory of Hadoop.

- MapReduce [1] is the heart of Hadoop where all data are processed.
- HDFS [1] (Hadoop Distributed File System) is the memory of Hadoop and has very important features which work to make Hadoop a fault tolerance system.

As it's shown in Fig. 1 the Hadoop Processing Diagram. Hadoop consists of many software that made its environment easier to be used even by

Fig. 1 Hadoop processing diagram



non-programmer users such as Pig, Hive, Impala, and HBase. In this paper, our main focus is how to deploy Game theory strategies such as Nash equilibrium so here we are going to take look on Game theory. Game theory is taking care on any case where there are two or more factors or organization, etc., both of them taking some strategies that effect on the other side. Game theory it's one of the important science which was very efficient in the strategies of the cold war, in economics taking decision etc., it started by the Mathematician John von Neumann in 1943. Mathematicians were wrong when they consider the one party will always be selfish while taking any strategies; here, John Nash invented his law bargaining strategy [7] and said his revision on Adam Smith had said: In competition, individual ambition serves the common good. But John said that each party must cooperate to let each one win and no one crosses others line, so all will be the winner and this form of bargaining strategy became a theory and we are going to deploy it into Hadoop framework.

Scheduling task in MapReduce is one of the critical issues. Therefore, many researches have been done in this area to improve performance of Hadoop, such as The Capacity Scheduler [8] which proposed by Yahoo!, Hadoop Fair Scheduler [8] which worked to share resources between tasks, Qauincy scheduler [9] provided for Dryad environment [10]. There is DynamicMR framework to optimize slot allocation in MapReduce v1. Also, there is effort to propose new schedulers with a different idea such as PRISM [11] algorithm which schedules phases instead of the task to increase parallelism and uses management law to manage the queue of a task which leads to finding way of balancing between Makespan time and total completion time [12].

2 Motivation

All previous researchers were working on improving the scheduling algorithms, dynamic slots configuration, tuning parameters, or job ordering. All previous techniques are important to improve but no one went into giving more authorities to Slave node to take decision and pick up the most utilize job to give the best process to it and all this process will be under control of master node. In our proposed system, slave will be cooperative or the will have others slave features to be able to predict the best decision and this will increase resource utilization, will minimize overload on Mast node, and minimize processing time.

3 Proposed System Architecture

Our proposed system is significant as nobody before us went toward giving an ability to slave node to take the decision, according to our research and the uprising in the hardware field this made slave node much powerful. The proposed system

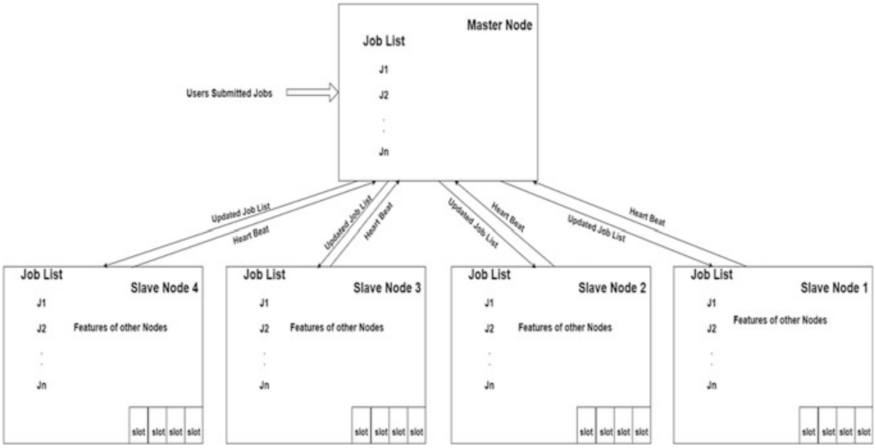


Fig. 2 System architectures

depends on game theory strategies, especially on the Nash equilibrium where everyone will do best for himself and for the group so all will win. Figure 2 is the proposed architecture for deploying Nash equilibrium in the infrastructure of Hadoop.

The work of proposed system explained following:

- Master node will receive jobs in the same strategies that default Hadoop follows.
- Jobs in Master node will be listed in Job list and will be updated periodically to the Slave node.
- Master Node will update all other slave nodes periodically with node features of other nodes.
- Each Slave node will update master node with a HeartBeat message periodically to update master node with new features which will be distributed to another node.
- Slave node will work according to data which was updated from Master node, and Slave node will work according to two conditions to pick up job and start processing
  - Compare local node features with the job requirements, if this node is able to process that job, it will compute the second condition.
  - Is that job will maximize resource utilization? If yes it will continue to process it otherwise it will give to another node which will have more utilized resources while processing that job.
- Always Master node will be in the position to control all this process to guarantee the best result.

The example explains our proposed system more clearly. There are four porters each one of them has different capacity to carry different weight, and there are four different types of goods with different weight. If the powerful porter will carry lighter weight and he will finish his job quickly but he has to wait for other three to complete the job, so in this case, there will be waste of time and consumption for other three Porter's power. But if each one of porter will be cooperative with others, they will complete the work with minimum time and waste less power.

4 Conclusion and Future Work

The high speed of rising in the technologies field which generates enormous data every day need more efficient system to process and store data, for that there is Hadoop but even the successes of Hadoop there is need to improve the performance of Hadoop, there are many researchers trying to improve scheduling algorithms, I/O, and much other technique. But no one goes toward slave nodes to make them smarter and able to take decision instead of processing only. So in this paper, we are proposing a significant system architecture that will improve Hadoop performance by deploying game theory strategies in default Hadoop. Future work will continue in implementing our proposed system with adding more characteristics such as dynamic slot configuration and monitoring job processing in each phase of MapReduce. Also, we are doing more research to understand more strategies of game theory.

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An Abstract Model for Adaptive Access Control in Cloud Computing

Amardeep Kaur and Amandeep Verma

Abstract Cloud computing is a paradigm that presents network access to pooled configurable computing resources on demand. Resource management has an immense role in authorization and access control. In computing clouds, it is desirable, to avoid underutilization and over-utilization of computing resources because these may result wasting of resources or leads to lengthy response times. The factors related to operational and situational awareness can affect an access control system and ultimately the utilization of resources. The present study is intended to develop an adaptive access control model. The user behaviour is assessed in terms of the usage of resources by characterizing the cloud workload. This assessment is stored in the knowledge base. A recommender system uses the knowledge base to make the decisions about the adaption of access control policies, in order to get effective usage of the resources of cloud. The present paper presents an abstract representation of such model and its operational behaviour.

Keywords Access control model · Cloud computing

1 Introduction

Cloud computing [1, 17] is a paradigm that presents network access to pooled configurable computing resources on demand. The resources can be physical resources like CPU, memory and storage and/or logical resources like operating system, applications and API. An access control system controls and decides the activities of legitimate users as per the specifications of access permissions and privileges in access security policy. It consists of a set of components and methods. The cloud computing environment requires that the access control should have the

A. Kaur (✉) · A. Verma
Punjabi University Regional Centre, Mohali, India
e-mail: amardeep_tiet@yahoo.com

A. Verma
e-mail: vaman71@gmail.com

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capability and flexible enough to handle the diversity of services, versatility and randomness in behaviours of consumers. Resource management [2] deals with the management of the objects, their characteristics and relations among such objects. It is deemed to be a component of authorization management and access control in access control policy. Resource management has an immense role in authorization and access control. The number, categories and granularity of resources affect the representation of access control policy and the effect of access control. Resource allocation [3] often allocates more computing resources in order to meet the requirements of the particular application in its peak load. Overall, the underutilization of computing resources is a consequence of such peak-load-based static resource allocation. So to enhance the utilization of resources and reduction of the user usage cost, the allocation of the resources among the cloud computing applications is dynamic. Generally, in the duration of application, its workload fluctuates. The workload varies in amount and/or composition. Users most of the times overestimate the resources needed to compute a task. Generally, resource utilization and submission pattern varies significantly from user to user [4]. The complex nature of cloud workload broadens the gap between resource allocation and its demand and can be the reason of resource underutilization [5]. For the obvious reasons, avoidance of wasting of the resources that are by reason of underutilization, and reduction in lengthy response times that are because of over-utilization, is advantageous [6]. The aspects concerned to operational and situational responsiveness can influence an access control system. Audit is an essential phase for access control systems for the assessment of such factors. In access control systems, an audit has to record decisions, i.e. either grant or deny, and also accounts the grounds for such results. A flexible access control [7] decision system made future access decision decisions on the basis of outcomes of access control system. Depending on such decisions, access of the user to the resource should be correspondingly relaxed or restricted. The present study is intended to develop an adaptive access control model. The user behaviour is assessed in terms of the usage of resources by characterizing the cloud workload. This assessment is stored in the knowledge base. A recommender system uses the knowledge base to make the decisions about the adaption of access control policies, in order to get effective usage of the resources of cloud. The present paper is a part of this study and presents an abstract representation of such model and its operational behaviour.

2 Related Work

A self-adaptive system (SAS) is adaptable to dynamic user requirements, operating environment and resource availability [8]. Self-adaptive systems change their behaviour whenever the monitoring shows the system accomplishment is diverting from its stated purpose or its performance is below than expectation. Self-adaptive systems in general exercise a feedback mechanism for self-adaptation. The feedback loop involves four modules. The first module is to gather the essential data for self-adaptation. The application of model on gathered information performs the analysis in the second module. A decision to adapt the system so as to attain the desired state is the functionality of the third module. The implementation of re-configured system settings as a result of the decision made is the job of the fourth module. Another self-adaptive access control model [4] relied on feedback loop was proposed. The essential components to come to a decision on access requests are monitor, analyse, plan, execute parts and knowledge base, and the knowledge base is used. The knowledge base enrichment and enhancement with the passage of run-time of the system lead to the continuing improvement of the efficiency of access control decisions. Initially, the knowledge base consists some basic rules without any judgement knowledge a priori. The contents of knowledge gradually strengthened with the passage of time. The analysis of various performance features at hardware and software level workload modelling [4] was used. The workload performance analysis is a methodology to conclude the relationship involving the requirements of the user and the number of requests issued by the user, the variety of operations and other relevant workload parameters.

A hierarchical model [10] with three layers—users, application and services—was devised for unified workload modelling of the varied applications with different users for a range of services in a cloud environment. Performance analysis and by this means, the assessment and amendment of policies with workload modelling [11] can be performed. The assessment of resource management policies agreed to better of cloud QoS. A method for workload estimation [12] for improving resource management decisions in the cloud was suggested. A generic black-box approach [13] for the establishment of relationship for resource attributes users' behaviour was presented. For optimization of the resource reallocation decision, a dynamic allocation of virtual resources among the cloud computing processes using threshold method [3] was presented.

3 Abstract Model for Adaptive Access Control

The model shown in Fig. 1 consists of number of components. The structure and interaction of the various components are as follows.

3.1 Abstract Model Representation

Various components of the model are defined below.

User This component consists of two modules, namely user profile and request profile. The inputs to this component are the credentials of the user that are used to verify the user and the request profile specify the request by the user. The user profile basically involves the user id, role, request submission rate, number and type

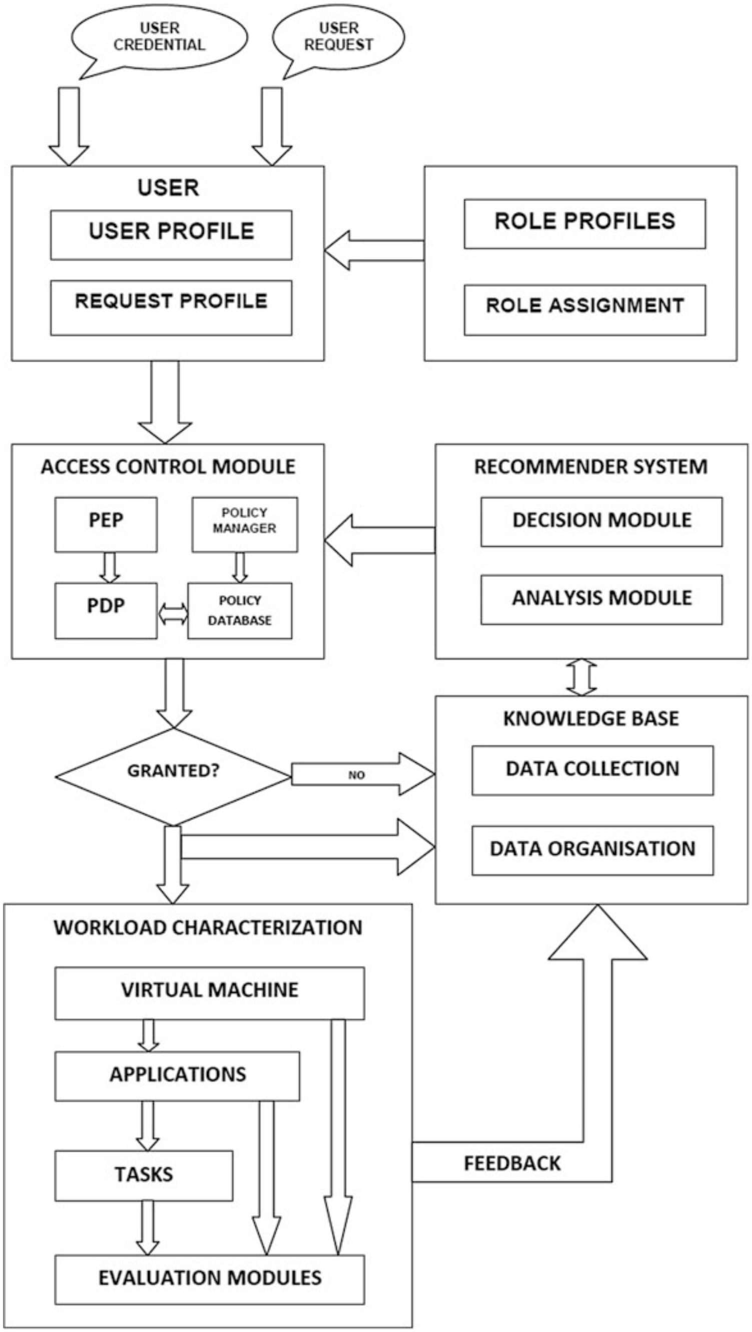

Fig. 1 Abstract model for adaptive access control

of submitted requests and any other information required by the access control module. The request profile gives the details of the request in terms of the type of request, number and types of resources and amount of resources required. This module is substantiated with the roles component for role profiles and role assignments. The role profile basically consists the type of tasks allowed for the stated role, and the role assignment is used to assign the roles to various users. This component is supported by the literature [10]. It is the user and the assigned role(s) that has direct effect on the access control and usage of the resources.

Access Control The access control component has policy enforcement point (PEP), policy decision point (PDP), policy database (PD) and policy manager (PM). The PEP is responsible for the enforcement of the defined policies. The PDP is to make a decision about the grant or denial of a request by the user. PD is a repository for defined policies, and the PM is attributed to administer the PD. This architecture is supported by a number of studies [7, 14]. This part is adaptive access control as it adapts to the behaviour of the user and role profiles. It is the central component of the model as it has the overall control over the access of resources of the cloud.

Workload Characterization Workload is a specification of a chosen VM together with its detailed application configuration, as well as the expected input and resource demands. Workload modelling is to analyse performance characteristics of a given system, both on the hardware and software levels. Workload characterization mainly has the evaluation module to characterize the workload on a cloud in terms of virtual machine, application and tasks with metrics like CPU usage, assigned memory, observed real memory usage, response time, input–output time and disk space for task monitoring [15]. A variety of references are based on it [4, 11, 12, 16]. This is the most important component of the model as the righteous behaviour of proposed model relies on the perfection of the workload characterization.

Knowledge Base It has two modules: one is to collect the data for the knowledge base and other is to organize such knowledge in order to create the knowledge base. This component is based on the idea presented in the paper [18]. A proper transformation of data to information and from information to knowledge is one of the goals of this component. An appropriate organization of the knowledge for accurate, multidimensional and quick access to the knowledge is desirable.

Recommender System It is with analysis and a decision module. The analysis is to analyse the knowledge bases for any recommendations to the ACM, and the decision module is to decide whether to apply the recommendations or not. The rationale behind this component is on the bases of studies in the literature [8, 9]. It is a suggestive module for an adaptive access control model for efficient utilization of the resources of the cloud.

Requirements of the Model The basic requirements of the stated model are as follows:

- All users have at least one role
- There are number of users with the same role
- A user may have number of requests
- A request belongs to single user
- A request may use number of applications for its purpose
- An application may be the requirement of number of requests
- An application may consist one or more tasks
- A single task may be the requirement of one or more application execution
- A task may use variety of resources for its completion
- A single resource may be virtually allocated to number of tasks

3.2 *Operational Behaviour*

User submits the credential and the request to user module. The credentials submitted by user assist in designating role. The user is supposed to have some role assigned by the role assignment with the role profile before any request for the usage of services. The request is about the task the user wishes to perform on the cloud. The request is in terms of resource and/or application requirements. The access control module ascertains whether to grant or denial of services to the user depending on the user profile, request profile and the policies defined in the system. The decision in any case is logged into the knowledge base. The suggestions by recommender system for updates to access control policies are also part of this module. This property makes the access control model adaptive in nature. It is also possible to make the system self-adaptive, but there may be some circumstances where it is not recommended to update the policies as per recommendations. The granted requests are evaluated for the characterization of the workload in terms of the resource usage or consumption (CPU utilization, RAM used, storage and network bandwidth) at various levels, i.e. VM, application and task [4, 5, 11, 15]. The workload is characterized by the assessment of behaviour at various stages together with utilization parameters as listed above. The evaluated results are sent to knowledge base as feedback. The workload characterization in the case of the cloud depends on the type of services, i.e. IaaS, PaaS or SaaS. The recommender system analyses the knowledge in the knowledge base and makes decisions if any recommendations to the access control module for the improvement of the resource management. The dimensional model for knowledge representation is shown in Fig. 2.

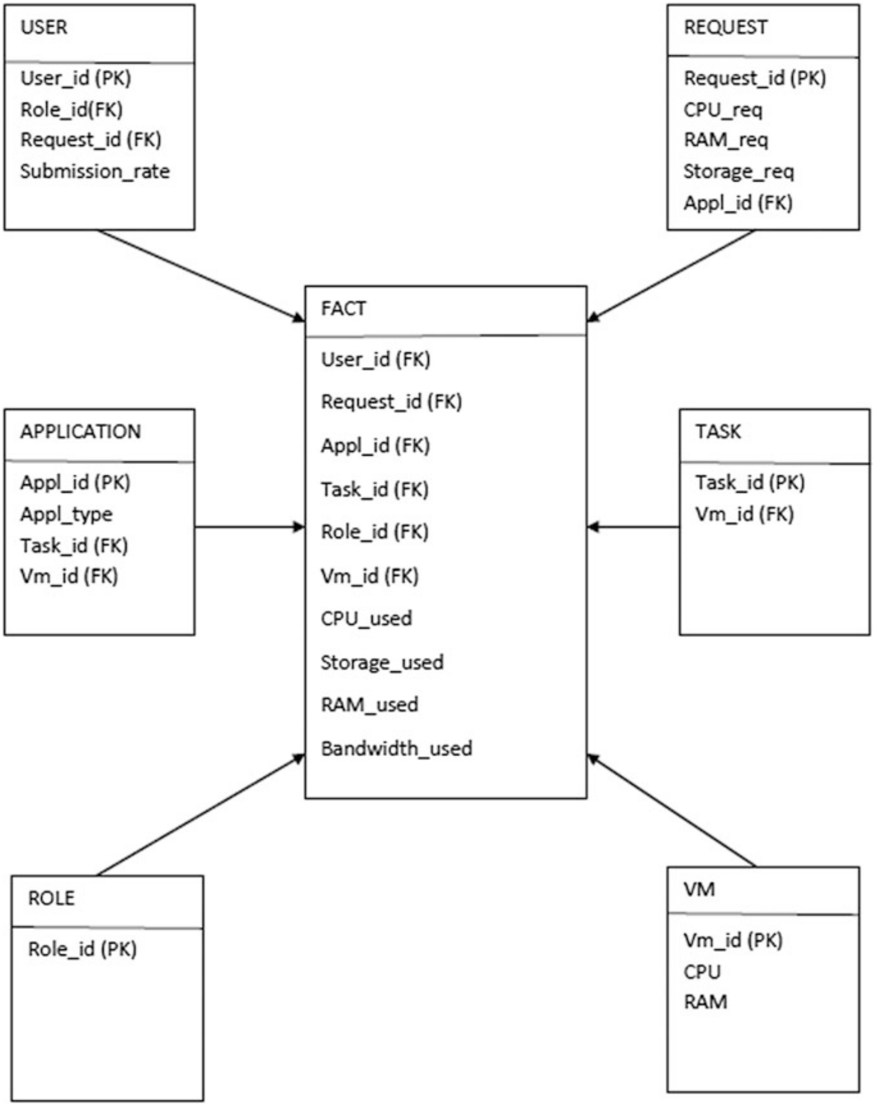

Fig. 2 Dimensional model for knowledge representation

3.3 Advantages and Applications

The presented model helps in the efficient usage of the resources of cloud that might be underutilized due to over-allocation of the cloud resources. Moreover, this model also helps in the allocation of more cloud resources to users/process that were under-allocated. The dimensional model view of knowledge representation helps to analyse the workload from various dimensions or perspectives. The application of such model is in the area where access control policies, apart from their security purposes, used to control the allocation of resources for better utilization.

4 Conclusion and Future Work

The paper presents an overview of the adaptive access control model for cloud computing to reduce the wastage of resources due to underutilization by characterizing the workload with the behaviour of users and thus may lead to an effective resource usage and its better utilization. The future work is to present the concrete implementation of this model.

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Role of Electric Field on Peristaltic Flow of a Micropolar Fluid

M. K. Chaube

Abstract Peristaltic transport of a micropolar fluid is investigated in the view of an electric field. Debye-Hückel linearization is employed to simplify the problem, and electrical double layer (EDL) is considered very thin so that the effect of applied electric field is represented in terms of the electroosmotic slip velocity (i.e., Helmholtz–Smoluchowski velocity) at the channel walls. Axial velocity is achieved in the form of closed expression through low Reynolds number and long wavelength approximations. The effects of electric field and coupling number are shown by plotting graphs based on computational results. It is found that the axial velocity enhances with the electric field applied in the flow direction and diminishes with the electric field applied against the flow direction.

Keywords Peristaltic flow · Micropolar fluid · EDL · Helmholtz–Smoluchowski velocity

1 Introduction

The fluid flow induced by periodic contraction and relaxation of the wall of the conduit carrying a fluid is termed as peristaltic transport. Naturally, peristaltic transport occurs in the flow of urine from the kidney to the bladder, chyme in the gastrointestinal tract, food bolus through the esophagus, ovum in the female fallopian tube, and blood through small blood vessels. This principle is used in industry to develop roller and finger pumps to make the flow of the fluids like foods, slurries, corrosive fluids, and blood without being contaminated due to contact with pumping machinery. First, Chakraborty [1] investigated electroosmotic augmented peristaltic transport considering thin electric double layer (EDL) where

M. K. Chaube (✉)
Dr. SPM-IIIT, New Raipur, Chhattisgarh, India
e-mail: mithilesh@iiitnr.edu.in

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the effects of charged surface, i.e., EDL phenomenon, are assumed negligible. Later on, several researchers [2–5] made improvements in this study considering EDL effects, MHD effects, power-law fluids, and couple stress fluids. In these studies, it is concluded that peristaltic pumping can be enhanced with applied external electric field. The literature lacks with the study of electroosmotic modulated peristaltic pumping of a micropolar fluid. Micropolar fluid represents the randomly oriented particles suspended in a viscous medium. It is applicable in physiological fluids transport where the suspension of particles plays an important role like in blood (suspension of RBC, WBC, and platelets). The concept of a micropolar fluid was first presented by Eringen [6]. After that, some researchers investigated peristaltic transport of a micropolar fluid [7–11]. In these studies, the effects of coupling parameter and micropolar parameter on peristaltic flow characteristics are discussed.

In this paper, electroosmotic augmented peristaltic transport of a micropolar fluid via a channel with sinusoidal wave trains traveling down has been discussed. Debye-Hückel linearization is employed to simplify the problem, and electrical double layer (EDL) is considered very thin so that the effect of applied electric field is represented in terms of the electroosmotic slip velocity (i.e., Helmholtz–Smoluchowski velocity) at the channel wails. Axial velocity is achieved in the form of closed expression through low Reynolds number and long wavelength approximations.

2 Mathematical Statement of Problem

We have taken the electroosmotic augmented peristaltic transport of an incompressible micropolar fluid via a microfluidic channel of width $2a$. Let $Y = \pm H$ be the outer and inner boundaries of the channel. The movement is thought to be incited by sinusoidal wave trains spreading through the channel dividers with a steady speed c. The schematic diagram of the problem under consideration is depicted in Fig. 1 and mathematically considered as:

$$H = a + b\sin\frac{2\pi}{\lambda}(X' - ct'), \tag{1}$$

where b is a wave amplitude, λ is a wave length, and t' is the time. The stream is precarious in the laboratory outline (X', Y'), while it is consistent if seen in the coordinate system (x', y'), named as wave frame, moving through the wave speed c. The changes between aforesaid two coordinate systems have been expressed as:

$$x' = X' - ct', \quad y' = Y', \quad u' = U' - c, \quad v' = V', \tag{2}$$

where (u', v') and (U', V') are the speed segments that are considered as part of wave and laboratory frames.

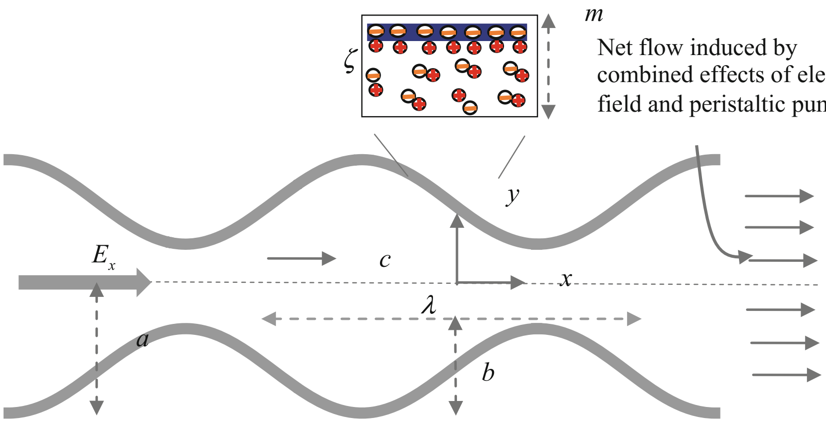

Fig. 1 Schematic diagram of physical problem

Without body forces and the body couple, the representing conditions for the steady flow of an incompressible micropolar fluid driven by combined effects of peristaltic pumping and electroosmosis are expressed by

$$\frac{\partial u'}{\partial x'} + \frac{\partial v'}{\partial y'} = 0, \tag{3}$$

$$\rho\left(u'\frac{\partial u'}{\partial x'} + v'\frac{\partial u'}{\partial y'}\right) = -\frac{\partial p'}{\partial x'} + (\mu+\kappa)\left(\frac{\partial^2 u'}{\partial x'^2} + \frac{\partial^2 u'}{\partial y'^2}\right) + \kappa\frac{\partial w'}{\partial y'} + \rho_e E_x, \tag{4}$$

$$\rho\left(u'\frac{\partial v'}{\partial x'} + v'\frac{\partial v'}{\partial y'}\right) = -\frac{\partial p'}{\partial y'} + (\mu+\kappa)\left(\frac{\partial^2 v'}{\partial x'^2} + \frac{\partial^2 v'}{\partial y'^2}\right) - \kappa\frac{\partial w'}{\partial x'}, \tag{5}$$

$$\rho J'\left(u'\frac{\partial w'}{\partial x'} + v'\frac{\partial w'}{\partial y'}\right) = -2\kappa w' + \gamma\left(\frac{\partial^2 w'}{\partial x'^2} + \frac{\partial^2 w'}{\partial y'^2}\right) + \kappa\left(\frac{\partial v'}{\partial x'} - \frac{\partial u'}{\partial y'}\right), \tag{6}$$

where u' and v' are the velocity segments in the corresponding x' and y' directions, ρ is the thickness of the liquid, p' is the pressure, w' is the microrotation speed component in the direction normal to both the x' and y' axes, J' is the micro-inertia constant, μ is the viscosity constant of the classical fluid dynamics, κ, γ are the viscosity constants for micropolar fluid, E_x is the outer electric field.

For further examination, we utilize the accompanying non-dimensional factors and parameters:

$$\begin{aligned} &x = \frac{x'}{\lambda}, \quad y = \frac{y'}{a}, \quad u = \frac{u'}{c}, \quad v = \frac{v'}{\delta c}, \quad \delta = \frac{a}{\lambda}, \\ &w = \frac{aw'}{c}, \quad t = \frac{ct'}{\lambda}, \quad J = \frac{J'}{a^2}, \quad p = \frac{a^2 p'}{c\lambda\mu}, \quad \phi = \frac{b}{a}, \\ &h = \frac{H}{a} \\ &\mathrm{Re} = \frac{\rho c a}{\mu} \end{aligned} \tag{7}$$

where Re, δ and c represent the Reynolds number, wave number, and wave velocity, respectively. For thin EDL and weal electric field, the electrokinetic body force term may be dropped from momentum equation and it can be realized in terms of the electroosmotic slip velocity at the wall. Employing the non-dimensional variables in Eqs. (3–6) and using the low Reynolds number and long wavelength approximations, we get:

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0, \tag{8}$$

$$\frac{\partial^2 u}{\partial y^2} + N\frac{\partial w}{\partial y} = (1 - N)\frac{\partial p}{\partial x}, \tag{9}$$

$$\frac{\partial p}{\partial y} = 0, \tag{10}$$

$$-2w - \frac{\partial u}{\partial y} + \left(\frac{2 - N}{M^2}\right)\frac{\partial^2 w}{\partial y^2} = 0, \tag{11}$$

where $N = \kappa/(\mu + \kappa)$ is the coupling number $(0 \le N \le 1)$, $M^2 = a^2\kappa(2\mu + \kappa)/(\gamma(\mu + \kappa))$ is the micropolar parameter. The boundary conditions are imposed as:

$$u(x, y) = U_{HS} - 1, w(x, y) = 0 \quad \text{at}\, y = \pm h(x), \tag{12}$$

U_{HS} is electroosmotic slip velocity.

Solving simultaneous partial differential Eqs. (9) and (11), with boundary conditions (12), the axial velocity is obtained as:

$$u = \left(\frac{1-N}{2-N}\right)(y^2 - h^2)\frac{\mathrm{d}p}{\mathrm{d}x} + \frac{N}{M}\left(\frac{1-N}{2-N}\right)h\frac{\mathrm{d}p}{\mathrm{d}x}\frac{(\cosh Mh - \cosh My)}{\sinh Mh} + U_{HS} - 1 \quad (13)$$

3 Result and Discussion

In this section, graphs are drawn showing effects of electroosmotic slip velocity and coupling number on axial velocity based on numerical results. Figure 2 shows the effect of electroosmotic slip velocity on axial velocity at $\phi = 0.6$, $x = 1$, $\mathrm{d}p/\mathrm{d}x = -5$, $M = 2$, $N = 0.1$. From Fig. 2, it is observed that the fluid velocity enhances with the electric field applied in the flow direction but diminishes with the electric field applied against the flow direction. Figure 3 shows the variation in axial velocity with coupling number at $\phi = 0.6$, $x = 1$, $\mathrm{d}p/\mathrm{d}x = -5$, $M = 2$, $U_{HS} = 1$. From Fig. 3, it is observed that the fluid velocity decreases with increase in coupling number.

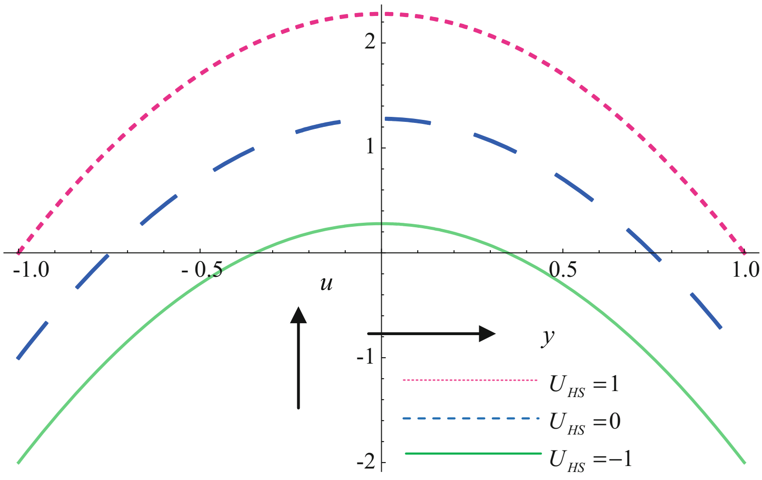

Fig. 2 Velocity profile at $\phi = 0.6$, $x = 1$, $\mathrm{d}p/\mathrm{d}x = -5$, $M = 2$, $N = 0.1$ for different values of U_{HS}

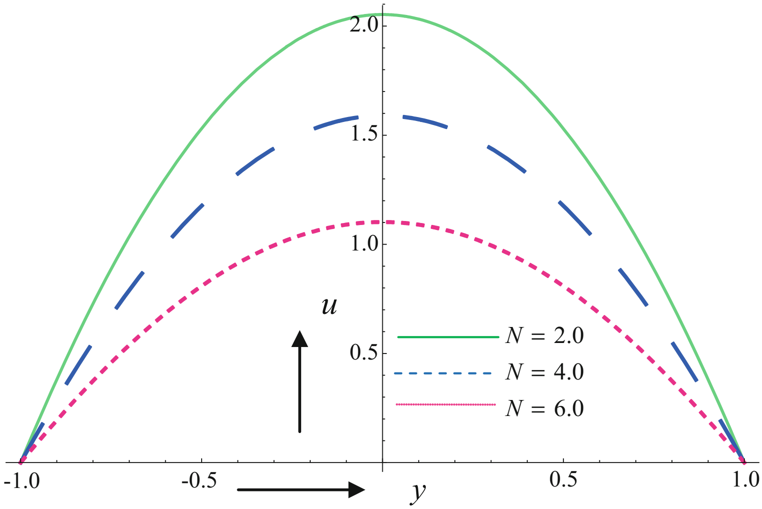

Fig. 3 Velocity profile at $\phi = 0.6$, $x = 1$, $\mathrm{d}p/\mathrm{d}x = -5$, $M = 2$, $U_{HS} = 1$ for different values of N

4 Conclusion

- The fluid velocity can be controlled by applying external electric field.
- The fluid velocity enhances with the electric field applied in the flow direction.
- The fluid velocity diminishes with the electric field applied against the flow direction.

The fluid velocity decreases with the increase in the coupling number.

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Prevention of DOS and Routing Attack in OLSR Under MANET

Madhvi Chaurasia and Bhanu Pratap Singh

Abstract The flourishing packets delivery up to destination is necessary for better network performance. In MANET, group of nodes is capable to create a temporary dynamic link without the support of any centralized administration and stuck infrastructure. In this research, we focus on and proposed security against DoS and routing attacks. The DoS attack and routing attack is a type of attack that are work together in dynamic network and performing misbehavior by consume link capacity and drop of data packets. However, in network if sender has begun data transmission, then in that case, both of the attackers' mutual malicious behavior has produced a remarkable dump performance. In proposed security analysis, we proposed a novel detection and prevention security algorithm against both mutual attacks. In this research, we compare the performance of four protocols: first normal OLSR routing, OLSR routing with mutual attack, R-OLSR, and P-OLSR (proposed). The proposed scheme is able to provide secure communication and also improves the network performance. Through our proposal, we present secure as well as reliable communication in network from wormhole attack and compare the performance of different scenarios on the bases of parameters such as packet delivery magnitude relation, throughput, and routing load.

Keywords MANET · Security · OLSR · P-OLSR · R-OLSR
DoS · Routing · Attacker

M. Chaurasia (✉) · B. P. Singh
Department of Computer Science, Vindhya Institute
of Technology & Science, Satna, India
e-mail: maddy.26oct@gmail.com

B. P. Singh
e-mail: bhanu.baghel@gmail.com

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1 Introduction

A MANET could be a collection of mobile devices that are connected by wireless links while not the use of any mounted infrastructures or centralized access points. In MANET, every node acts not only as a bunch however additionally as router to forward messages for different nodes that is not among identical direct wireless transmission range. Routing protocols in MANET are classified into two categories: reactive protocol and proactive protocol. In proactive routing protocols, all nodes got to maintain an even read of the constellation. Once a constellation changes, individual updates should be propagated throughout the network to apprize the amendment. Reactive protocols for mobile ad hoc networks also are known as "on-demand" routing protocols. In a very reactive routing protocol, routing ways are hunted once required. Problems with OLSR are that it wants a lot of bandwidth and energy resources, overhead, no support for multicast and security. OLSR does not specify any special security measures. As a result, OLSR is at risk of varied forms of attacks such as flooding attack, link withholding attack, replay attack, DOS attack, and colluding mis-relay attack [1–7].

2 Literature Survey

Shivanakar and Thorat [8]—In this title, we observe the network vulnerabilities of a pre-active routing protocol. Analyzing attacks on optimized link state routing (OLSR) protocol which is proactive, we propose a reputation-based mechanism for prevention attacks. This mechanism is useful for securing the OLSR protocol against the denial-of-service attacks and is capable of finding whether or not a node is presenting correct network topology data or not by confirming its hello message. This mechanism brings few modification and still compatible with the OLSR protocol.

Vidhya and Priya [9]—In this title, we tend to analyze the vulnerabilities of a proactive routing protocol referred to as optimized link state routing (OLSR) in MANET. We tend to investigate the various routing attacks that may be launched in OLSR. Analyzing the attack, we tend to propose a mechanism to secure the OLSR protocol from specific routing attack referred to as node isolation attack.

Deshmukh and Kaushik [10]—In this title, early adds MANET analysis has mainly targeted on developing an efficient routing mechanism in such a extremely dynamic and resource unnatural network. Above all, we tend to examine routing attacks, like link spoofing and colluding mis-relay attacks, furthermore as countermeasures against such attacks in existing MANET protocols.

Bhavani et al. [11]—In this title, we introduce a solution to protect OLSR protocol from node isolation attack by using the same strategy used by the attack itself.

Varghese and Sankar [12]—In this title, we consider a specific type of DoS attack called as the node isolation attack in OLSR, a proactive routing protocol. A technique called eliminating malicious node in OLSR (EM-OLSR) is considered in which we detect and eliminate the malicious node in the network with the help of control packets and then protect these packets using Hardy algorithm.

Jelba and Gomathi [13]—Overview of OLSR, features of OLSR along with the attack detection and mitigation techniques comparisons are made.

Kannhavong et al. [14]—This title identifies a new routing attack, referred to as node isolation attack, against OLSR protocol, one among the four normal routing protocols for MANETs. As a primary step to defend against the attack, they present an easy technique to notice the attack and establish the source of the attack.

Yuvan Shankar et al. [15]—In this paper, we suggest a solution to defend such a type of attacks in the OLSR protocol from the DOS attack by using denial contradiction of fictitious node (DCFN) mechanism; by using this, we can access the fictitious nodes in network. We suggest a solution for this type of isolation attacks and also other similar DOS attacks on OLSR and the system recovery without system reconfiguration.

Sharma and Singh [1]—In this title, a detection mechanism has been proposed to find out the attacker that fools the opposite nodes within the network by exploitation over one identity at a time. The detection approach is predicated on the fact that everyone, the illegitimately no inheritable identities of an attacker, travels along on one physical device.

3 Proposed Work

Proactive routing in mobile ad hoc network is suitable while node motion is controllable manner, because it works on table-driven-based approach. In the table-driven or proactive routing, it generates the table in shortest path mechanism. While the communication breaks through some reasons and searches the route after some time, then the sender initially route searches within the previously created table, and if destination not found, then re-broadcast the route and established new path that is drawback of the proactive routing protocol. But security is a one measure challenge, because networks which are de-centralized manner spread over environment, where attacks from physical layer to application layer are open. In our proposed approach, our basic objective is to control the network and data link layer attacks under optimal link state routing (OLSR); in previous work security mechanism, only routing layer securities are detected but in our mechanism, more enhanced methods are used to prevent dual-layer security. For that purpose, we analyze the network behavior for identifying different attack under different layers, which helps to detect network and data link layer attacks and provide strength to prevention mechanism. During the data link layer attack, attacker node spreads the unwanted data in exponential manner and captures the ideal nodes from the network, which spread over the whole network in gradual manner that type of symptoms sets as denial of attacks and detects based on network traffic identification as well as unwanted data flood by per second manner and further prevent it. Next attacker is a network layer attack and that is difficult to detect because in the network layer, various type of attacks are present, i.e., black hole, wormhole, grayhole, and route capturing but symptoms nearly common to all that is node ip modification and gaining the benefits by the data capturing from sender nodes, network layer attacks are detected by ip tracing mechanism, while ip address of destination is updated, it means network layer attackers modified the routing table for self gaining. Those attacks detect through watching the profile of network and then apply prevention mechanism, preventer nodes those are selected whose motion is slower and cover the maximum nodes, which treated like packet and behavior watcher of its entire neighbor. While the sender sends the data or routing packets through intermediate node and that node updates the routing table/modified destination node or drop data or captures, then preventer node immediately responses to sender regarding false node, so eliminated route are established else preventer node blocks the attacker node that behavior under the route attack; another attack is denial-of-service attack that type of attack protect through data analyzing or filtering methodology and blocking, in this type of attack, attacker spread unwanted data with unrecognized format data in unlimited range with every seconds while that packet traced by the preventer node than initially watch its symptoms and it match with unknown type of data than preventer block that type of packets and identifies the attacker node id, while detected the attacker nodes than block it and remove the denial-of-service attack from the network.

3.1 Proposed Algorithm

In this section, we describe proposed algorithm for prevention of denial-of-service and routing attacks using IP modification detection and data filtering methodology.

Initialization:

W: set of mobile nodes
T: transmitter nodes
R: receiver nodes
C: intermediate nodes
Ψ: radio range
U: attacker node
ipr: destination ip address
ipt: transmitter ip address
rtable: route table
rpkt: route packet
P: preventer node

```
Output: type of attack, attacker node, pdr, throughput
Routine:
        Execute OLSR routing for route establishment
        T search route in rtable
        If R exist in rtable then
                Send data (T, R, data)
                 Else
                         Bcast_rpkt_OLSR (T, R, rpkt)
                         While C in Ψ && C ! =  R do
                                 C ←  create rtable entry (T, R, C)
                                 Forward (T, R, C, rpkt) to next C
                         End do
                         If C  == R then
                                  R ←  update /create rtable(T,R,C)
                                   Send data (T, R, data)
                         End if
        End if
Attack Detection and Prevention
P execute to watch its neighbors
        If C in Ψ && C!  =  R then
                 P check C ip address
                 Store ip of C in p_table
        While T brorcast rpkt do
                 C ←  U
                 C ←  update (ip_c  =  ip_r)
                 C ←  send acknowledge to T
        P found (C update ip_r as ip_c)
                 Block the C as U node
        End do
If U broadcast unknown packet to W-1 nodes then
        W_i ←  ideal
        W_i receives unknown packets
        P check (U data)
                 If (data!  =  tcp||udp) then
                          U data as unknown
                          P block the U node
                          Broadcast U information to W-1 nodes
                 End if
End if
End if
```

4 Simulation Parameters

The simulation parameters considered for simulation are mentioned in Table 1. According to these simulation parameters, the simulation of normal OLSR routing, DoS with routing attacker in OLSR routing, existing R-OLSR, and proposed security against DoS in OLSR routing are performed.

5 Result

DoS and Routing Attacker Analysis
The DoS with routing attacker detection in detected by proposed security scheme is mentioned in Table 2. In this table, the node number, packet capture by attacker, and attacker loss percentage are mentioned. About one-third of the 100% is only degraded by attacker; rest of the normal performance is affected when attacker is not counted.
In Table 2b, the malicious performance of routing attacker is evaluated by proposed security scheme and observed that two nodes are detected as malicious that drop the data packets, and their percentage ratio is also about 41%. The proposed scheme improves and blocks that attacker performance.

Packet Delivery Ratio Analysis
The performance in terms of percentage ratio of data packet receiving from sending is calculated through packet delivery ratio (PDR) in dynamic network. The packetdropping from sending shows the lesser amount of packets receiving in network. That degrades the network performance. The performance in presence of attack is almost negligible in network but performance pdf proposed prevention (P-OLSR) is highest in network; it provides about 95% data delivery (Fig. 1).

Table 1 Simulation parameters

Network simulator Tool	NS-2.31
Mobile nodes	50
Dimension of simulation	800 m × 800 m
Network protocol	OLSR, R-OLSR, P-OLSR
Simulation time	100 s
Traffic type	FTP & CBR
Attack type	Denial-of-service attack, routing attack
Prevention type	Header identification and node blocking
Per packet size	1024 bytes
Number of connections	6
Node speed	Random
Transmission range	250 m

Table 2 Proposed security scheme

	Packet capture	Percentage of infection
(a) DOS attacker		
49	1450	36.6
(b) Routing attacker		
28	990	24.99
34	658	16.61

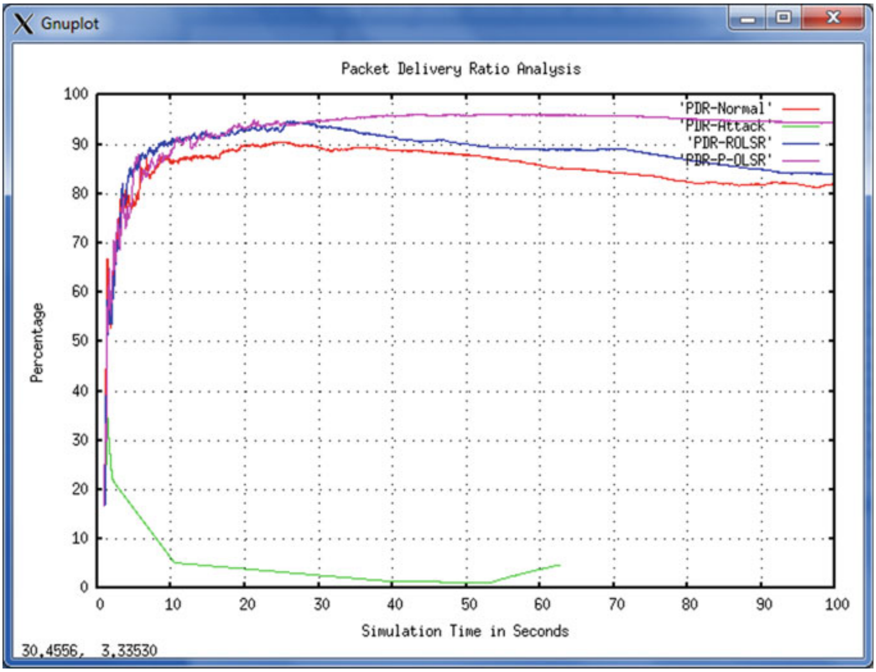

Fig. 1 PDR performance analysis

Attack Percentage Analysis

The DoS with routing attacker detection in detected by proposed security scheme is mentioned in given graph. These behaviors are to consume the data packets sending by senders in network. In this graph, loss percentage in case of routing (R-Infection %) is maximum 41% and malicious performance of DoS infection and calculate infection about 36 and 15% in network (Fig. 2).

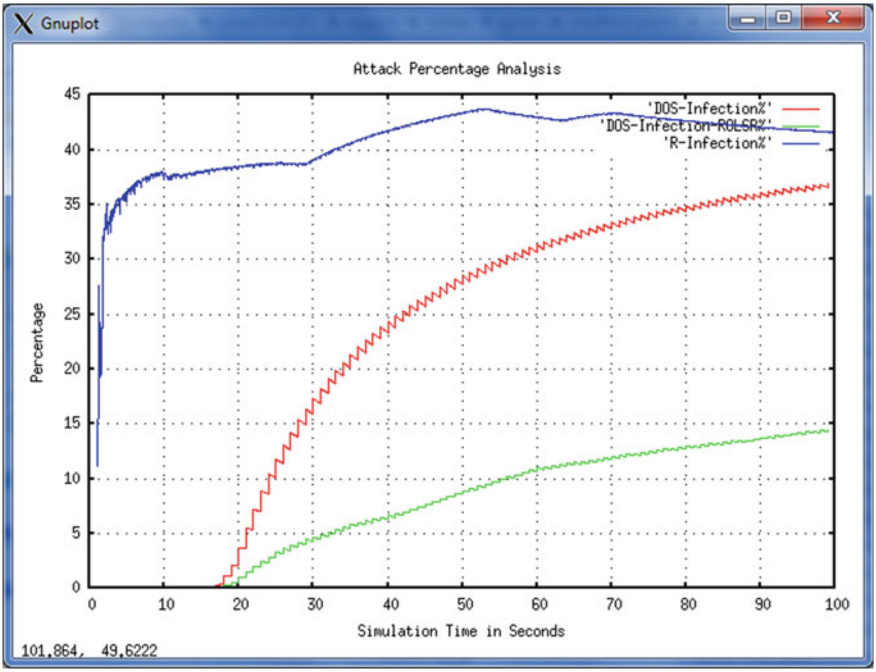

Fig. 2 Attacker loss percentage analyses

6 Conclusion and Future Work

The attacker position is not fixed in MANET because it is necessary to apply the security scheme to catch the attacker's malicious activities. In MANET, a variety of attacks exist, but in this research, we consider the mutual effect of DoS attack and routing attack. This attacker's attack performed the malicious activity by flooding of unwanted packets and dropping data packets by forward false reply of link on path in between sender and receiver. This protection scheme provides the protection against DoS attack and routing attack and provides secure communication in dynamic network. However, proposed IPS scheme improves makeable performance or more than traditional OLSR routing. The normal performance is evaluated through traditional OLSR, the attacker mutual effect is measured from Attack-OLSR, the third one is the recent security scheme which is considered, i.e., R-OLSR, and at last the performance of P-OLSR is evaluated. The proposed scheme reduces the packet dropping that occurs due to presence of attacker's mutual effect and also improves the packet receiving. The performance of proposed scheme (P-OLSR) is better than R-OLSR existing secure routing technique in MANET.

In future, we tend to additionally examine the mutual behavior of different attacks like Jamming attack and Selfish attack and take a look at to create the protection schemes on that and additionally consider the performance of different routing protocols such as AODV and DSDV in presence of attack.

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A Simulation-Based Comparison on Code Excited Linear Prediction (CELP) Coder at Different Bit Rates

Swati Joshi, Hemant Purohit and Rita Choudhary

Abstract A better speech quality is necessary for transmission of speech in mobile communication systems in Digital Telephony. Nowadays, the conversion of analog speech signals into digital format is required for effective transmission of speech over different channels at far ends. The technique for conversion of speech in digital form is very old and ordinary one which is termed as pulse code modulation (PCM), but the bandwidth of the digitally converted data is too large, so a better level of compression is needed to reduce the bandwidth and enhance the capacity of channel. The compression of speech in nowadays is performed by a procedure called speech coding. In this paper, the code excited linear predictive (CELP) coding is summarized with different bit rates. The MATLAB R2016a version is used for simulating the 9.6 and 16 kbps CELP coder, and performance analysis is done with parameters MSE and SNR.

Keywords Speech coding · LPC · CELP

1 Introduction

The speech coding is a procedure to represent a digitized speech signal with its minimum bit format necessary to transmit it over different channels. Speech coding is a wide area of research from late 80s to present. The advancement in speech coding techniques is necessary due to rapid increase in users of mobile communication and limited bandwidth of channels. The speech coders are creating a

S. Joshi (✉)
Tula's Institute, Dehradun, India
e-mail: joshi92swati@gmail.com

H. Purohit · R. Choudhary
JIET Jodhpur, Jodhpur, Rajasthan, India
e-mail: hemant.purohit@jietjodhpur.ac.in

R. Choudhary
e-mail: rita.choudhary@jietjodhpur.ac.in

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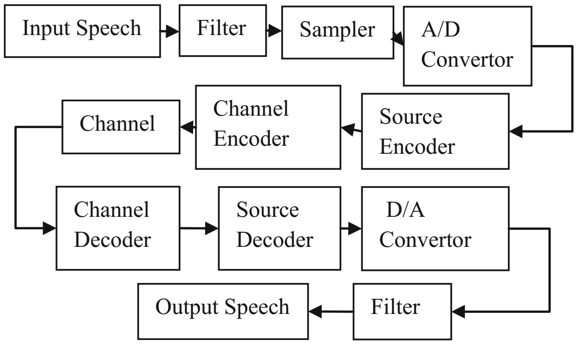


Fig. 1 Block diagram of speech coding system

competitive environment between the telecom provider giants; better speech quality with lower bit rates is demanding one. The basic building blocks for speech coders are shown in Fig. 1. The low bit rate and high speech quality are the main requirements to design a speech coder [1, 2]. The speech coders are classified into two terms.

(a) Waveform coders—pulse code modulation (PCM), differential pulse code modulation (DPCM), adaptive differential pulse code modulation (ADPCM).
(b) Parametric coders—linear predictive coding (LPC), residual excited linear prediction, mixed excited linear prediction, code excited linear prediction (RELP, MELP, CELP).

2 Literature Survey

The research on speech coding starts at Bell laboratories, and the first electronic voice synthesizer was invented by Homer W. Dudley in 1930 for secure voice transmission during world war. Motivation for speech coding research at that time is to design a system which is bandwidth efficient for telegraph cables. Dudley practically demonstrates the speech and figure out the redundancy in speech and finally set up with the new procedure of analysis by synthesis method for designing of speech coder [3].

The basic idea behind the first coder was to analyze speech in terms of its pitch spectrum by band-pass filter to analyze the periodic and random analysis of speech. The improvement on speech coders had been done during 1940s–1960s [4].

The early vocoder system is totally based upon the analog signal, and the digital representation gains interest because of its best encryption and better fidelity over long-range transmission. In 1940s, a new term introducing the speech coding named as pulse code modulation (PCM). PCM is a direct method for representation of discrete time and discrete amplitude of analog signals. The more advancement in this technique is started, and the best quantization capabilities were developed in differential PCM, delta modulation, and adaptive DPCM were developed and speech coding in PCM with 64 kbps and with ADPCM 32 kbps become the standard of Consultative Committee for International Telephony and Telegraphy (CCITT) [2].

A great innovative invention was done by Prof. Fant in 1950s, the linear speech source system. The mode consists of linear time-varying coefficient of speech signals excited by periodic impulse train for both voiced (speech) and unvoiced (noise) signal, and this model becomes the basic building block for new generation linear predictive speech coding [4, 5].

Theoretical and practical aspect on linear predictive speech coding is analyzed by Markel and Gray in 1970s. In between 1970s and 1980s, the rapid growth in speech coders was done because of drastic boom in VLSI technology.

In the duration on 1980s–1990s, the low rate high-quality speech coders were planned to design. The invention of code excited linear prediction coding was major improvement in speech coders, CELP is originally proposed by M. R. Schroeder and B. S. Atal in 1985. CELP was capable of producing low rate speech for communication purpose [6, 7].

The concept for hybrid code is finalized with the use of different structured codebooks in CELP. An 8 kbps hybrid coder was first hybrid coder which was selected for North American Digital Telephone Network. The hybrid coders are also selected for satellite systems.

The research on this field is still going on and researchers continuously working on to increase the capacity of systems at minimal bandwidth.

3 Linear Predictive Coding

LPC technique is the most used technique in speech coding. LPC technique provides extremely accurate estimates of speech data sequence. Basic idea of linear prediction is that the current speech sample can be closely approximated as a linear combination of past samples, the block diagram for LPC filter is shown in Fig. 2.

The algorithm for LPC is given by the formula given below:

$$y(n) = \sum_{(i=1)}^{N} ay(n-i) \tag{1}$$

The efficient estimation of LP coefficients is based on the Levinson–Durbin algorithm which uses a forward and backward prediction for speech samples.

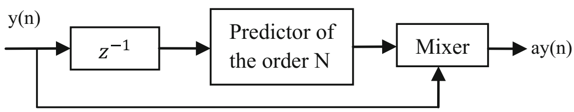


Fig. 2 Block diagram of linear predictive filter

The formula basically used for both forward and backward samples is:

$$r(i) = \sum_{n=0}^{N-1-i} s(n) \cdot s(n+i) \tag{2}$$

where r is a positive-definite matrix

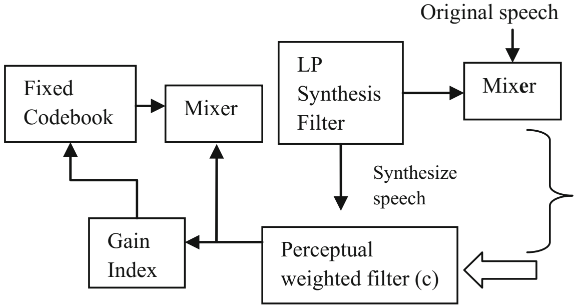
$$r{=}[r(1)r(2)\ldots r(n+1)]$$
$$\begin{pmatrix} r1 & r2 & r(n) \\ r2 & r1 & r(n-1) \\ r(n) & r(n-1) & r1 \end{pmatrix} \begin{pmatrix} a1 \\ a2 \\ a(n+1) \end{pmatrix} = R(n) \tag{3}$$

4 Code Excited Linear Prediction (CELP)

Parametric coding is based on LP analysis, and CELP is standardized as parametric coder by CCITT in 1991 which is formally known as FS1016 CELP [8] and given the bit rate of 4.8 kbps. Advancement in this technique is observed in 1992, and an another big achievement was successfully done by International Telecommunication Union (ITU), and another version of CELP is finalized as ITU-T G.728 LD-CELP with bit rate 16 kbps and abbreviated as low-delay code excited linear predictive coder (LD-CELP) which was designed to provide delay of less than 20 ms.

The block diagram in Fig. 3 shows the basic building block of CELP. In CELP, coder a fixed codebook is designed to provide initial code vectors for data bit comparison and hence the high quality of speech is attained at much lower bit rate then waveform coders; thus, the bandwidth is optimized as compared to waveform coders. The perceptual weighted filter is used to provide a fixed delay for each sample, and it is a constant value in between 0.1 and 0.9.

Fig. 3 Block diagram of CELP coder



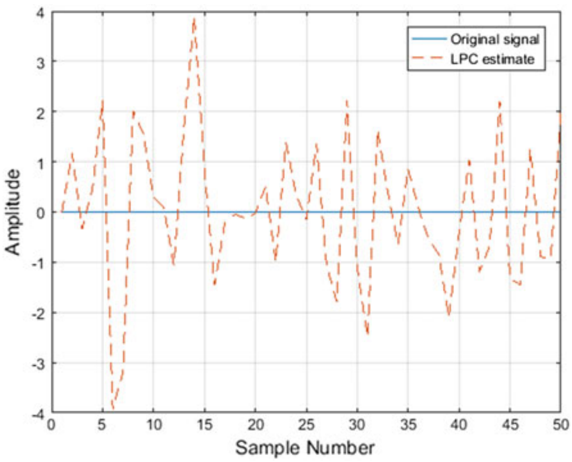
5 Evaluation and Analysis

Analysis of 16 and 9.6 kbps CELP is done with the MATLAB simulating software version R2016a. The coder is designed to take audio speech samples at 8 kHz, and output is observed in 16 and 9.6 kbps. The 'hello' file is taken as input audio and 'xhat1' is decoded sound file in 16 kbps sampled format and 'xhat2' is 9.6 kbps decoded sound for CELP. Finally, the experiment is performed for a constant value of $c = 0.25$ and 0.65. The original sound is standard sound in ITU-T test signal library. The signal sampled in 86,169 samples and the 50 LP coefficients are calculated randomly from 86,169 samples. Fig. 4 shows the LP estimation of original speech. Similarly, Figs. 5 and 6 show the comparison graph between 16 kbps CELP and 9.6 kbps CELP with $c = 0.25$.

6 Performance Comparison

SNR is abbreviated as signal to noise ratio, and MSE is abbreviated as mean square error estimation of speech signals. The two signals 'xhat1' (16 kbps) and 'xhat2' (9.6 kbps) CELP are compared with 'hello' original signal, and values for SNR and MSE are shown in Table 1.

Fig. 4 LP coefficient estimate



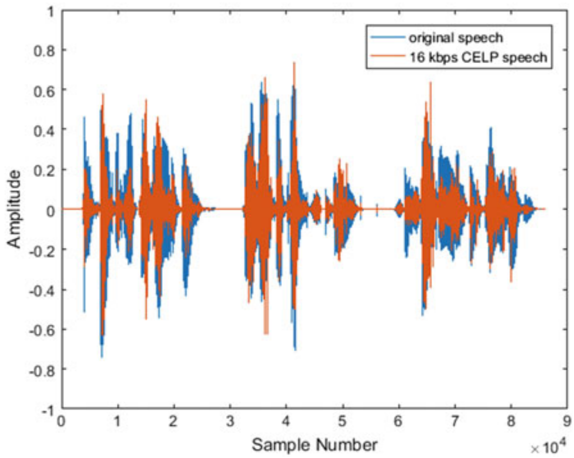


Fig. 5 Graph between 16 kbps CELP and original speech with c = 0.25

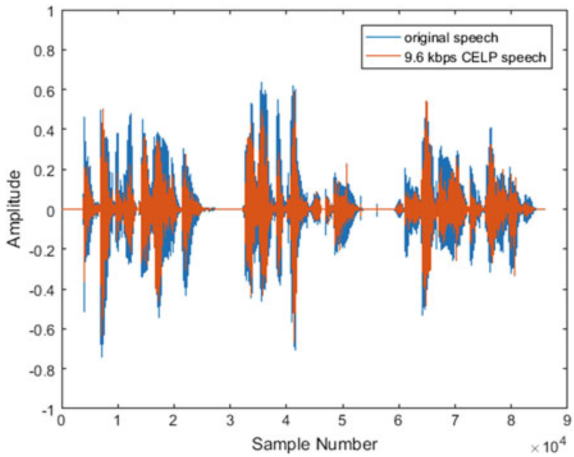


Fig. 6 Graph between 9.6 kbps CELP and original speech with c = 0.25

Table 1 SNR and MSE parameters for 16 kbps/9.6 kbps CELP coder

Perceptual weighted constant	Different bit rates			
C	16 kbps CELP		9.6 kbps CELP	
	SNR	MSE	SNR	MSE
0.65	1.2815	0.0047	0.2769	0.0175
0.25	**4.2851**	**0.0016**	**3.5234**	**0.0132**

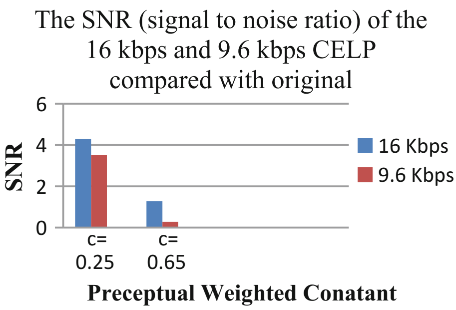


Fig. 7 SNR of the 16 and 9.6 kbps CELP compared with original

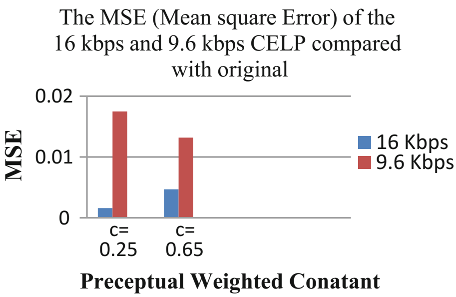


Fig. 8 MSE of the 16 and 9.6 kbps CELP compared with original

7 Result and Discussions

Here, a detail performance analysis of 16 kbps CELP and 9.6 kbps CELP with perceptual weighted value $c = 0.65$ and $c = 0.25$ is presented. This analysis is totally based on the value of perceptual weighted constant '*c*.' The factor '*c*' is highly affecting factor for the quality of speech coders. These simulation-based comparative analyses illustrate the output speech quality in terms of signal to noise ratio (SNR) and mean square error (MSE), and from the comparison, it is clear that lower value of *c* is needed for better results. In Figs. 7 and 8, the graphical representation for both parameters is shown for various values of *c*.

8 Conclusion

From the above experimental test it is clearly analyzed that at lower the value of *c* better the SNR and similarly at lower values of *c* MSE is lesser. From both 16 and 9.6 kbps, the ratings for 16 kbps are better than 9.6 kbps. It is clearly shown that at $c = 0.25$ values for both SNR and MSE among both the better results are considered for 16 kbps CELP.

The 16 kbps CELP is a parametric coder and best for audio speech processing. The exponential growth in telecom field needs a better version of speech and video processing both at same time for real-time implementation so research in this section is continuously growing and better quality of speech or video coder is implemented. The enhance voice services (EVS) and iLBC are example of it [9, 10].

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A Survey of Feature Extraction for Content-Based Image Retrieval System

Neha Ghosh, Shikha Agrawal and Mahesh Motwani

Abstract Content-based image retrieval system (CBIR) is a challenging domain which is used in various fields of research today, such as scientific research, medical, Internet, and other communication media. CBIR is an approach that allows a user to obtain an image depends on a query from large datasets holding a huge amount of images. Images play a big role in any of the media today, where communication and data transmission held using the specific formats of data. Thus, for making communication and information sharing via images, it is needful to perform its extraction and then further processing with information content. A survey has been done on various content-based image retrieval techniques which are derived by the various authors for the feature extraction of images and which are further used for classification.

Keywords Content-based image retrieval (CBIR) · Feature extraction of image Image preprocessing

1 Introduction

Images have continuously been an assured unit of human communication and its roots millennia in the past. Pictures build the communication method more user-friendly and clear [1]. CBIR is the way toward finding images from huge datasets or a library of computerized images as indicating the images. In different phrases, it is the retrieving of images which have identical content of color, textures, or shapes. Processing with too amount of content commonly required bulk amount

N. Ghosh (✉) · S. Agrawal · M. Motwani
Department of Computer Science & Engineering, UIT-RGPV, Bhopal, India
e-mail: nehaghosh61@gmail.com

S. Agrawal
e-mail: shikha@rgtu.net

M. Motwani
e-mail: mahesh.bpl.7@gmail.com

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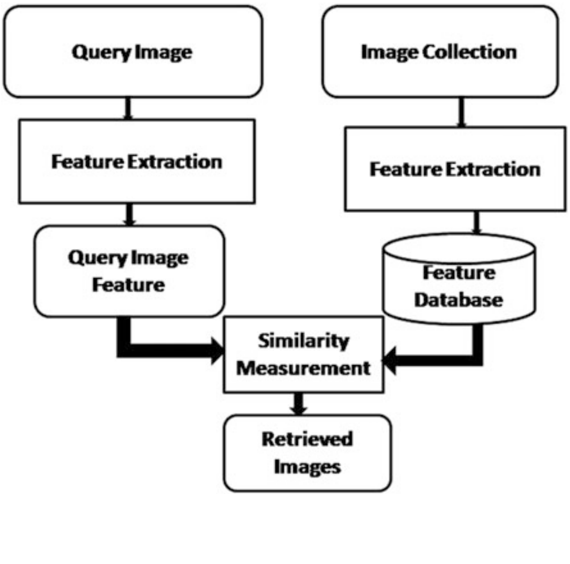
of memory, computational power, and time. This overfits the training data and generalizes poorly new samples. So feature extraction is needed to solve these problems, which constructs combined set of elements still describing the overall information of images with adequate accuracy. In CBIR system, the image features are mainly grouped into three main classes: color, texture, and shape [2, 3]. Theoretically, those features must be united to produce a better distinction in the similarity measurement process. The overall architecture of CBIR system is shown in Fig. 1.

When a query image comes to the CBIR system, firstly its features are extracted, after that similarity measurement is done by using query feature vector and target image feature vector in which feature space/feature vector of the query image is compared with those feature space which already exists in the database. Color has an ease nature of retrieving color information form image [4, 5] that is why in CBIR; generally, the ordinary visual feature is color. Features play a complicated and expensive task on the perspective of shape and texture [6] which are generally produced by color features after the initial filtration. Several applications demand basic strategies for differentiating images from one to another, primarily based on universal looks. A universal solution for this problem is color histogram [7, 8] which represents the gray-stage or color division of an offered image, and they may be effective as computationally, but usually inconsiderate in small pixel areas. But there are some issues related to color histograms. A color histogram gives not any specific statistics; it simply represents the colors which are present within the images and the amount of color. The main function which is required to design the histogram-based techniques is suitable color space, a representation of histogram, a scheme for color quantization, and a comparison metric [9]. Most of the famous search engines provide image retrieval offering the uses of conventional textual content-based approach (i.e., captions) called text-based image retrieval (TBIR) [10].

Fig. 1 Block diagram of content-based image retrieval



When a user gives a query as a text for target images in search engine, user's query engine typically compares keywords with indexed terms related with database image. Textual-based image retrieval approaches are using a guide image notation by users and particularly based on the metadata. Tagging or notations are an indefinite and time-expended process. Text only is not enough for retrieving the images, to recover the disability CBIR uses the visual content of images.

2 CBIR and Feature Extraction

The overall framework of CBIR starts with the user. Firstly, an input image is put into the system as a query. Then query image as well as all the images which are present in database further processes in an identical way for relevant image retrieval. Secondly, a few preprocessing approaches are probably carried out on the images, which regularly depends upon a certain goal for better retrieval.

Preprocessing: "Image preprocessing is an approach for improving images previous to computational processing." The aim of image preprocessing is to enhance the visual appearance of images and database manipulation.

Feature Extraction: When input information to an algorithm is very large to being operated and it is supposed to be redundant, then it can be transformed into reduced set of important features named "Feature Vector" shown in Fig. 2.

This process is called "Feature Extraction." The extracted features hold all relevant information from the input data, so all the desired task can be executed by using reduced set of features instead of overall feature.

Color, texture, local descriptors, and shape are few basic retrieved features [11]. When a query image comes to the overall system, its feature space is compared with feature database [12]. According to the gap measure, most applicable images are returned. The retrieved images are generally shown according to the position of relevance. The relevancy degree of extracted images can determine through some techniques which give satisfaction measurement called relevance feedback. From Fig. 3, we can easily understand the overall process of a CBIR system with relevance feedback. By refreshing the query and comparison measurement, this will upgrade the efficiency of the overall extraction system. For decreasing the user

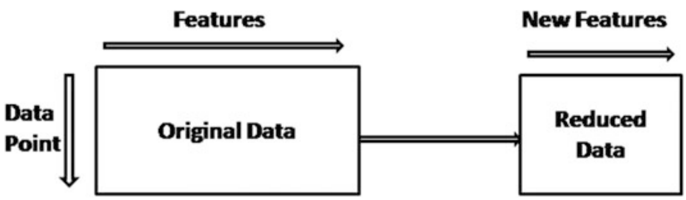


Fig. 2 Image feature extraction

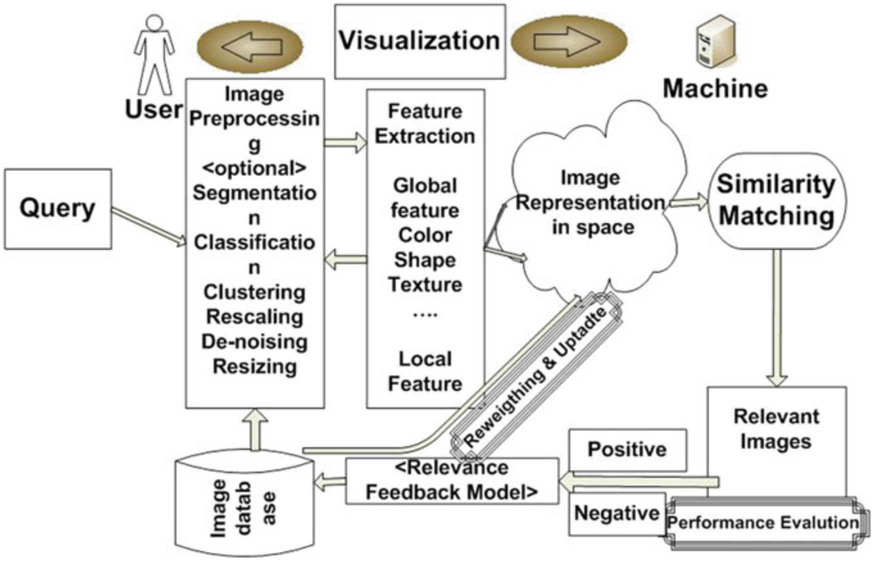


Fig. 3 Content-based image retrieval

involvement and ignoring filtration of multiple iterations, computerized feedback and device self-training are used.

3 Literature Survey of Content-Based Image Retrieval Technique

In CBIR literature, some studies and surveys have shown to mark and analyze the very difficult issues generate on particular method. The survey on [2] has showed few facts about system engineering like system analysis, system architecture, and overall database. A scheme offered in [13] in terms of technical facts on the functionality of lots of images retrieval technique along with querying, feature extraction of image, comparing similarity, knowledge representation, and result in display. They have technically matched unique systems instead of basic architectures. Mechael et al. [14] present different reviews involved about content-based digital facts extraction and analyzed their task for contemporary studies guideline and limitations. Liu et al. [15] discussed a deep study inside the CBIR on unique facts to extra highlight on area-based retrieval of image, containing low-degree feature extraction of image, similarity dimension, and puts high-degree of semantic properties. Jun et al. [11] proposed a scheme for CBIR using color and texture merge feature of an image. The color space is used in the global and local histogram of color and both are applied to obtain color feature of the image. Lakshmi et al.

[16] use a technique that shows a better retrieval interpretation using the global distribution of local feature, then this feature which shows the global nature of image alone. The method combines the global texture (curvelet) and color feature with local features derived from the salient feature. Priyatharshini et al. [17] have concentrated on a type of technique for analogous-based image feature extraction which united visual sign and textual sign, and their ranking process is used in the area of CBIR. Different studies showed especially related facts like relevance feedback [18], high-dimensional indexing [19], and image extraction learning [20]. Jenni et al. [12] prefer a method which is majorly concentrated on database classification and efficient image representation which helps to raise retrieval time and accuracy of the overall system. Feature extraction is done by using color string coding and comparisons. Jing-Ming et al. [21] worked in order—dither block truncation coding ODBTC for CBIR. ODBTC is used to compress the images into quantizer and bitmap image, further used to generate the color co-occurrence feature (CCF) and bit pattern feature (BPF), respectively, which are together used as feature vectors. Jing-Ming et al. [22] describe error diffusion block truncation coding feature which is applied over images which give two outputs—color and bitmap quantizer, which are further processed using vector quantization for generating the image feature descriptor. After that, color histogram feature (CHF) and bit pattern histogram feature (BHF) are computed by using color quantizer and bitmap image quantizer. Anu et al. [23] proposed a method of image retrieval using local texton XOR patterns. The method uses local binary pattern and texton which shows the overall structure feature of the image. Firstly, the RGB value of query image is changed into HSV value. After that, V space from the HSV value is divided into 2 * 2 sub-blocks and texton of the image is calculated. Then the XOR operation is executed on each pixel of texton image with its neighbor pixel. HSV histogram and local XOR pattern histogram are used to construct feature vector. Manno et al. [20] offer existing sketch-based image retrieval (SBIR) systems execute at a decreased level on real-life images, where background information may control image descriptors and retrieval results. Angelescu et al. [24] proposed SQL-based CBIR which is used to improve the query process on CBIR system. It is a portable solution written in the SQL programming language. Mack et al. [25] work in process for searching images from large database and they use a multi-page hashing scheme. Using the image itself to not only is efficient for identical images, but similar images to some degree of fuzziness and degree of similarity as well. Douik et al. [26] based on upper–lower of local binary pattern (UL-LBP) depend on local binary pattern (LBP) which is used to describe global features of overall image.

4 Comparisons of Various CBIR Techniques

In above section, we mention various (CBIR) techniques proposed by various authors. Now we compare some of these techniques to show distinction between them, and their advantages show why they are useful for those approaches. Table 1 shows short description on such schemes, and Table 2 describes advantage and disadvantage on such schemes, which helps to identify value of representing schemes and what is the importance of the particular method.

Table 1 Description of several CBIR methods

S. no.	Technique name	Authors	Description	Year
1.	CBIR using color- and texture-fused feature	Jun Yue, Zhenbo Li, Lu Liu b, Zetian Fu	This paper used color and texture feature together of an image for CBIR. global color histogram and local color histogram both are used to extract color feature, and co-occurrence matrix is used to extract the texture of an image	Year—2011
2.	CBIR using color string comparison	KommineniJenni, Satria Mandala1, MohdShahrizalSunar	In this paper, the proposed method mainly concentrated on database classification and efficient image representation which help to improve retrieval time and accuracy. The method for CBIR based on support vector machine (SVM) classifier	Year—2015
3.	ODBTC for content-based image retrieval	Jing-Ming, *Senior Member*, *IEEE*, and HeriPrasetyo	In this paper, ODBTC encoding is applied to compresses the image into quantizer and bitmap images which are used to generate the color co-occurrence feature and bit pattern feature used as feature vector	Year—2015
4.	EDBTC feature for content-based image retrieval	Jing-Ming, *Senior Member* IEEE, HeriPrasetyo, and Jen-Ho Chen	In this paper, EDBTC is used to extract the feature of the image. EDBTC coding is applied to generate quantization to generate the image	Year—2015

(continued)

Table 1 (continued)

S. no.	Technique name	Authors	Description	Year
			feature descriptor. Color quantizer and bitmap quantizer is used to generate CHF and BHF	
5.	Content-based image retrieval using local texton XOR patterns	AnuBala, TajinderKaur	In this paper, local binary pattern and texton which gives the overall structure feature of an image. RGB value of query image is converted into HSV which helps to find the textons. Then XOR operation is performed and feature vector is constructed with HSV histogram and local XOR pattern histogram is used for similarity measurement	Year—2015

Table 2 Comparison among several CBIR methods

Schemes	Advantage	Disadvantage
CBIR using color- and texture-fused feature [11]	Fused features are used which gives better visual retrieval than the single characterized feature retrieval	Spatial distribution of color information is lost
New curvelet features for image indexing and retrieval [16]	Redeem the problem which arise to characterize local feature by global feature	Calculation overhead in global space of local feature
CBIR using color string comparison [12]	Use database classification thus computational complexity is decreased	Computational overhead in string to string comparison in similarity measurement
ODBTC for content-based image retrieval [21]	Offer low level of computational complexity in bitmap image and two quantizer's generations	The quantization error cannot be compensated with the ordered dithering halftoning and thus QDBTC generates low image grads
EDBTC feature for content-based image retrieval [22]	Error kernel is used to yield a different bit/halftoning pattern to utilize the dither property for solving the false counter problem	To solve a false counter problem, it takes prolonged processing time
Content-based image retrieval using local texton XOR patterns [23]	The new feature is introduced called local texton XOR pattern which grants the overall structure of query image and database	Ignore color appearance of much complexity and choose single color

5 Conclusion

Content-based image retrieval over large image datasets is popular among communication areas. Accuracy and performance time are major aspects of CBIR. In this paper, a survey has been done on some techniques of feature extraction. Some of mention technique got few lacking such as loss of important feature information, prolong processing time, computational overhead. It is found that large datasets always take more time to complete the searching task. That makes the overall system less effective. Thus, an effective, relevant image feature extraction is needed to get better results. If we minimize the problem associated with large dataset, then overall manipulation of the database will be decreased, and it will give better result of an image retrieval process. Therefore, in future our work is going to design a new better approach for better result optimization of content-based image retrieval system.

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A Use of Social Media for Opinion Mining: An Overview (With the Use of Hybrid Textual and Visual Sentiment Ontology)

Chandra Gupta Maurya, Sandeep Gore and Dharmendra Singh Rajput

Abstract In today's world, social media becomes very important for human beings. Twitter is one of them and used as a famous social media platform through which users can express their opinions on various events/matters/objects. These opinions in the form of messages are called as tweets. In this paper, an algorithm is used to find and classify tweets positive or negative with accuracy toward a specific subject. This proposed system is using the training data set dictionary to observe the semantic orientation of tweets. The sentiment analysis in Twitter is used to know how people feel about an object at a particular moment in time and also tracks how this opinion changes over time. Sentiment analysis is most important part for many social media analytics tasks. This type of sentiment analysis is useful for consumers at the time of purchasing and finding the services of any product online as it is helpful to provide the opinion of others for the same product or service. It is also helpful for marketers and manufacturers to research public opinion for their organization/product and services. This paper presents a new concept of hybrid approach (Text and Image) for social media sentiment analysis. The hybrid approach consists of aggregating sentiments for both textual and visual contents.

Keywords Opinion mining · Sentiment analysis · Feature extraction techniques Machine learning · Hybrid classification

C. G. Maurya (✉)
Computer Engineering, GHRCEM, Wagholi, Pune, India
e-mail: cgmaurya.06@gmail.com

S. Gore · D. S. Rajput
Vellore Institute of Technology University, Vellore 632014, India
e-mail: sandeepgore4u@gmail.com

D. S. Rajput
e-mail: dharmendrasingh@vit.ac.in

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1 Introduction

This sentiment analysis is a process to determine the emotions and feelings in the form of words, attitudes, opinions, and emotions expressed within an online mention [1–4]. There are so many researchers who analyze sentiment either through text or through visual. When they analyze textual sentiment, it can cause to miss or loss of visual sentiments. On the contrary, when they analyze the visual sentiment, it can cause to loss of textual sentiments. We present a new concept hybrid approach (Text and Image) for social media sentiment analysis. We are using below process for sentiment analysis.

(a) Information searching and gathering, (b) Shorting, (c) Processing and analyzing.

Generally, facts have objective components but some textual contents are also there which denote the subjective characteristics. Textual contents having subjective characteristics are (1) opinions, (2) sentiments, (3) appraisals, (4) attitudes and emotions. It is very useful technique and applies to develop new applications. At present, there are huge amount of information which is available on micro-blogging sites or social sites like blogs, tweets, and social networks. A picture is worth a thousand words, and the sentiment analysis is very useful for extracting the user's sentiments toward the events individual, product, topics from such a large scale of visual contents. A basic steps or process for opinion mining and sentiment analysis of micro-blogging or social media sites (Fig. 1).

2 Basic Concept and Steps Followed for Sentiment Analysis

Sentiment analysis is a process that finds opinion, views, emotions, and attitudes of people or public from text, image, speech and visual tweets, and database sources through Natural Language Processing (NLP) [1, 3]. The opinions of people as a

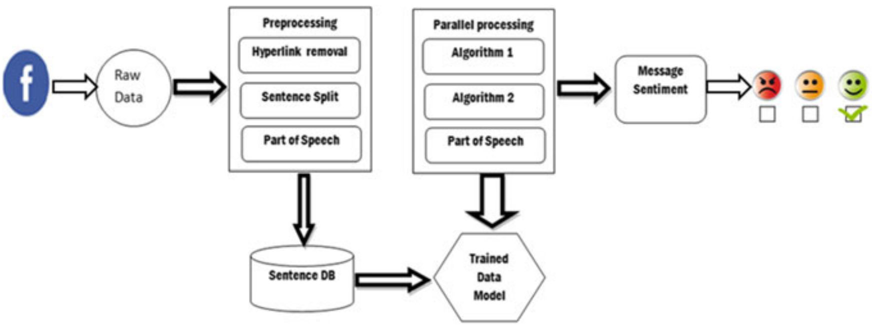

Fig. 1 Process of sentiment analysis and opinion mining

sentiment about any object are divided into three parts. It may be positive, negative, and neutral [1]. The below given basic steps are used for both textual and visual sentiment analyses. It is useful to analyze people sentiments, attitudes, opinion and emotions, etc., toward products, individuals, topics, organizations, events, and various kinds of services [1, 5]. Basic steps for sentiment analysis in hybrid system are as follows:

1. Raw data collection.
2. Processing.
3. Parallel processing.
4. Sentiment scoring.
5. Final results.

Following are the methods used for opinion mining and sentiment analysis [2].

(1) Naïve Bayes classifier.
(2) Support vector machine (SVM).
(3) Multilayer perception.
(4) Clustering, etc.

3 Preprocess of Sentiment Analysis

We measured the valuable opinion data as a combination of verb, adverb, and adjectives in this paper. Training data set or dictionary-based method is used to find the semantic points of reference of verb, adverb, and adjectives [1, 2 6, 7]. The overall blogs sentiments and incorporates emotion intensifiers are calculated by using a linear equation.

3.1 Preprocessing of Tweets Data Sets

We prepare contains file that's called operation or transaction file. It is used to find opinion indicator, namely the verb, adverb, and adjective along with emotions. As an example, there is Table 1, which describes the sentiment text either positive or negative sentiment.

We categorize some emotion intensifiers, namely the percentage of the blog or tweet in caps, the length of repeated sequences (according to Table 1 line no. 6), and the number of symbolic exclamation marks, among others [1, 2, 6, 7]. The preprocess of the tweets is as follows:

(1) Remove hyperlinks and Web URLs, symbols (#topic), source and targets (@username), special character of blogs.

Table 1 Dictionary—set of emotions with their sentiment polarity

Item ID	Sentiment text	Sentiment
1	is so sad for my APL friend…	Negative
2	I missed the New Moon trailer…	Negative
3	omg its already 7:30 : O	Positive
4	I think mi bf is cheating on me!!! T_T	Negative
5	or i just worry too much?	Negative
6	Juussssst Chillin!!	Positive
7	handed in my uniform today. i miss you already	Positive

(2) By using the Dictionary Replace all the emotions with their sentiment polarity.
(3) Count the number of exclamation marks, and remove all punctuations.
(4) By using a Dictionary where we tag the sentiment polarity (negative/positive).
(5) Find the semantic point of reference of adjective, verbs, and adverbs.

3.2 Score of Adverbs and Verbs by Using Semantic Orientation

The sentiment of assured texts can be measured through semantic point of reference of the adjectives, but it is essential to include the adverbs. Because the various types of adverbs are in linguistics (such as "not") so it is very important to consider adverbs properly as it could change the meaning of adjective totally. As it represents the positive or negative point of reference conveyed by people. For example, one person says, "This is a reasonable mobile"; second person says, "This is not a reasonable mobile"; according to this example, if adverb is not considered, then both the sentences will present the same meaning and it will be a positive response toward a mobile. Where as first sentence represents the positive response, the second sentence represents negative response toward mobile. Now, at the other point of view the strength of the sentiment will not be measurable without considering adverb. In simple term, we can say that to consider adverb is essential as the adjective is just a describing word whereas adverb clarifies the intensity of opinion and sentiment [1, 2, 7]. For example, one person says "The quality of this mobile phone is too good." But second person says "The quality of mobile is good." As both the responses are positive, adjective alone cannot represent the intensity of opinion sentiment. So, we need the adverb for finding out the strength or the intensity of opinion toward any object. Adverb with the adjective gives a perfect description of response whether strongly positive opinion, slight positive opinion, or a less positive opinion. For finding the perfect positive or negative opinion, the measuring list or scale of positive and negative adverbs and verbs will be created and then grown by searching WordNet [2, 3]. It will be intuition-based such as "excellent, very good, good, neutral, poor" ranging from 5 to 1 or +1 to −1.

3.3 Procedure (Algorithm) for Predicting Adverb and Verb Polarity

a. Process to find out point of reference (target_Adverb/Verb wi, Adverb/Verb_measuring list or Scale)
b. begin
c. if (wi has synonym's in Adverb/Verb_measuring list or Scale)
d. {wi's point of reference = s's point of reference;
e. add wi with point of reference to Adverb/Verb_measuring list or Scale;}
f. else if (wi has antonym's in Adverb/Verb_measuring list or Scale)
g. {wi's point of reference = opposite point of reference of a's point of reference;
h. add wi with point of reference to Adverb/Verb_measuring list or Scale;}
i. end

3.4 Tweet Sentiment Scoring

We create three types of group.

(1) Adverbs cluster (advi_cluster), (2) Adjective cluster (adji_cluster), (3) Verb cluster (vbi_cluster).

We create a cluster consequently adverb and adjective concurrently and its call the adji_cluster; similarly we create a cluster the consequently verb and adverb concurrently and its call the vbi_cluster. The advi_cluster strength is calculated by the product of adji score and advi score, and the vbi cluster strength as the product of vbi score and advi score. Sometimes, there is no adverb in the opinion cluster, so the *S* (advi) is set as a default value 0.5.

$$S(T) = [(1 + (\mathrm{TPc} + \log(\mathrm{Nr}) + \log(\mathrm{Nex}))/3)$$
$$/|\mathrm{OI(R)}|] * \sum i = 1|\mathrm{OI}(R)|S(\mathrm{AC}i) + S(\mathrm{VC}i) + \mathrm{Ne}i * S(\mathrm{E}i)$$

where

$\|\mathrm{OI}(R)\|$	size of the set of extracted opinion groups and emotions from the tweets,
TPc	fraction of tweets in caps,
Nr	count of recurrent letters,
Nex	exclamation marks count,
$S(\mathrm{AC}i)$	*i*th adjective clusters score,
$S(\mathrm{VC}i)$	*i*th verb clusters score,

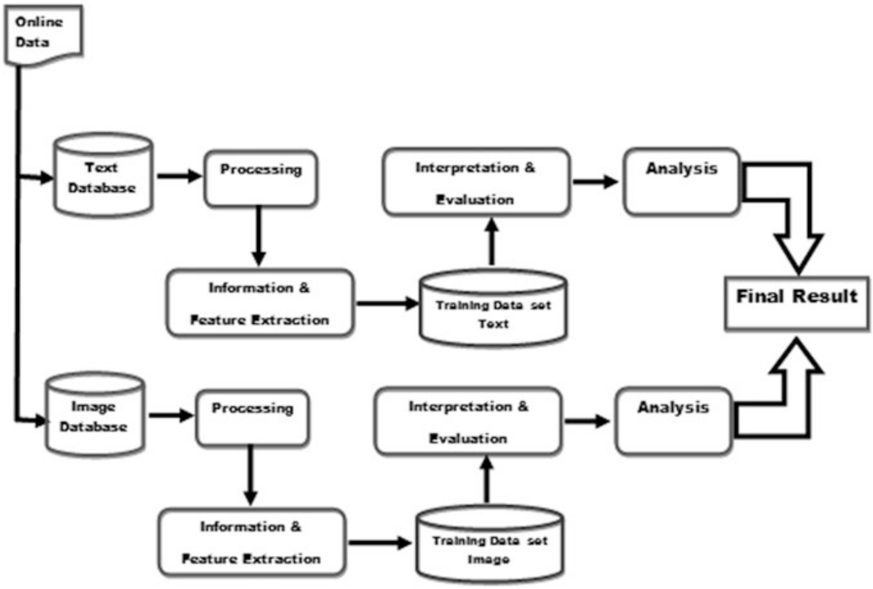

Fig. 2 Proposed hybrid system (text and visual) sentiment analysis

$S(\mathrm{E}i)$ ith emotions score,
Nei the count of ith.

TPc, Nr, and Nex represent emphasis on the sentiment to be conveyed so they can be collectively called sentiment intensifiers. If the calculated score of the tweet is more than 1 or less than −1, the score is taken as 1 or −1, respectively (Fig. 2).

4 Proposed Hybrid System (Text and Visual)

The hybrid approach consists of aggregating sentiments from both textual and visual contents. For textual mining, we are employing an approach such as Natural Language Processing (NLP)-based opinion clustering and analysis using *R*. For visual ontology, we will be using Microsoft Emotion API and Accord.Net machine learning API for image processing [1, 6]. After extracting sentiments from both approaches, they are then clustered and will be made available for analysis. For visual sentiment analysis, we have design architecture. Three major convolutional layers and some fully linked layers are presented in this architecture for the calculation of visual sentiment analysis. Our architectural model attempts to address the weakly labeled nature of the image training database, where some labels are generated by machine, a progressive leveraging training strategy, and a domain transfer strategy to fine-tune the neural network. Our result after evaluation suggests

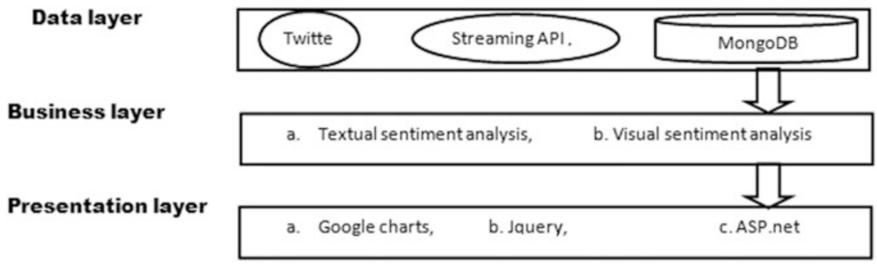

Fig. 3 Data flow of proposed hybrid system (text and visual)

that this strategy is very effective for improving the performance of neural network in terms of generalizability.

The proposed system work, hybrid (textual and visual) sentiment ontology described in 3 layers (Fig. 3).

(1) Data layer, (2) Business layer, (3) Presentation layer.

5 Opinion Mining Using Visual Sentiment Ontology

In this module firstly we extract the image emotions using Microsoft Emotion API and then implement an automated emotion detection system. For developing this system, we have used a series of logical steps. In this automated system, we have used the given below steps. The API is divided into two parts [8, 9]: training database generation (Fig. 4a) and emotion detection (Fig. 4b).

In emotion detection [8–10], the algorithm matches the resulting final output of input image with the already existing templates in the training database [10].

A. **Face Recognition**

This technique is based on genetic algorithms and eigenface technologies. In this technique, the first binary image to be converted from RGB image will be converted. The average value of red, green, and blue (RGB) for each pixel will be calculated, and when the middling value is less than 110, it will be replaced by a black or a white pixel [8, 10]. That means, you can get binary images from RGB images. For the next step, the scanning image will start from midpoint to find a daily image caption [11] and after nonstop black pixel [8, 10, 12] we will try to find uninterrupted whites pixels. Then, you will try to discover the maximum width of a white pixel that will be searched both left and right on both sides of the pole. If you find that if the new width is more than half the previous one or more width, then we will break the scanning process when you reach down arrow. Then, we will cut the image from the beginning of the forehead and its height is 1.5 times of its width [11, 12].

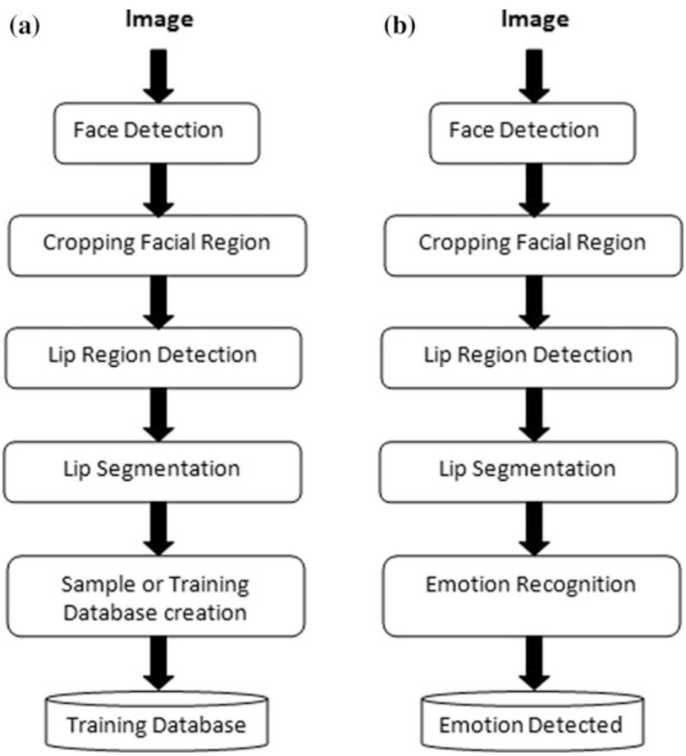

Fig. 4 **a** Training database generation and **b** emotion detection

B. Eye Recognition

In this section, we will transform the face image of red, green, and blue (RGB) pattern into a binary pattern. Scanning will be done from F/4 to F − F/4, and it will be used on two eyes midpoint and high white nonstop pixels and the height between them. The range will be two eyes [8, 9] midpoint.

After that, you will find the top points of the two brushes and they are searching for it vertically. You get the midpoint of F/8 for the left eye and midpoint on $F - F/8$ for the correct figure. There may be some white pixels between eye and eyebrows. Black pixels will be attached to the eye from the wall, the black pixel lines will be kept between mi/2″ to mi/4″, and it will be for the left side eye. Then right eye followed by lines mi + (F − mi)/4 to mi + 3*(F − mi)/4 and black pixel-line height (h-geo) lines starting from the beginning of line)/4.

Here

F width of selected picture,
mi midpoint of two eyes,
h height of the selected picture.

The next step would be to find the lower point of two eyes and that would be done by searching the vertical black pixels. We find the width of mi/4 to mi − mi/4 on the left eye. After, we find the mi + (F − mi)/4 to mi + 3 * (F − mi)/4″ width image then the starting point of the eyebrows downwards; it will have a right eye [8, 9]. Then you will find the left eye on the right and it will be through the search of black pixels that are horizontal so that from the beginning of the initial black pixels to the top of the left eye the beginning of the initial black pixels. Then, the search will be searched for the left side of the left-hand side and we find the beginning point of black pixels between the top and bottom sides of the right eye. Now, we get information on the left side of the left eye, this image is the starting point of the width, and the right eye on the right is the last frame of the image. Now the next step will be to lower the right side of the RGB image, at the lower position, the left side and the two eyes [11].

C. **Lip Recognition**

Lip box for lip detection will be fixed. Lip box will be considered to have lips. The difference between the forehead and the eye is that the height of the eye will be fixed at the height of the eye and the height of the box will be determined, which will be the lip. Now, in the left eye box, the box ¼ of the box will show the starting point of the box and the box on the right side will be shown in the box on the right and show the box’s last height. So, you can say that there is only a lip in the box and there can be a part of the nose in it, and the RGB image will be cut according to the box [8–10].

D. **Emotion Recognition**

For emotion detection, it is essential to search the Bezier curve for both the eyes and lip in an image. After that, the width of the Bezier curve will be converted into 100 and the height will also be converted as per the width. Now when the image feelings, contents, and available information are matched in the training database, the program will know which emotion is the closest one and the closest or matched emotion will be given as final output by the program [8, 9], for example (1) happiness, (2) fear, (3) neutral, (4) surprise, (5) anger.

6 Conclusion

This paper includes a survey which is based on comparisons of sentiment (textual and visual), and there is an analysis of present techniques for opinion mining including hybrid approach for social media sentiment analysis. The hybrid approach consists of aggregate sentiments from both textual and visual contents. The hybrid approach methods are very effective for textual and visual opinion mining. We conclude that more effective and accurate results or data output can be obtained by using hybrid approach. Hybrid approach model provides better sentiment accuracy in comparison with other models. The initiative for the study of hybrid approach technique can be taken to improve the purity of sentiment categorization and adaptive capacity to variety of domains and different languages.

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Learning Contextual Knowledge Structures from the Web for Facilitating Semantic Interpretation of Tweets

Nazura Javed and Muralidhara B. L.

Abstract Tweet analysis can provide valuable insight into societal issues and opinions. The terse, cryptic tweets, however, cannot be interpreted on face value. Interpretation assumes contextual knowledge. We propose a novel methodology of extracting structured contextual knowledge for popular topics/events and building knowledge structures using mining and computational linguistics techniques. We crunch relevant context contents from online sources and structure the same as contextual knowledge structures (CKSs). These automatically extracted CKS are (a) structured as subject–predicate–object triples, (b) they are relevant because they are built by mining contextual Web content, and (c) they are scalable to ontology and can be used for training classifiers. We demonstrate the feasibility and effectiveness of this methodology with an experiment which captures tweets of Indian political leaders, taps the related Web content, and transforms the same into CKS. The novel contribution of this work is its synergistic approach which combines acquisition, organization, and summarization with scalability to contextual ontology for social media analytics.

Keywords Social media mining · Contextual knowledge structures
Text mining · Computational linguistics · Machine learning

1 Introduction

Social media has emerged as an inclusive medium for dissemination, sharing, and exchanging views or opinions. Interpretation of the social media content however has posed challenge because of the unstructured, flexible format, and nonadherence

N. Javed (✉) · Muralidhara B. L.
Department of Computer Science and Applications,
Bangalore University, Bengaluru, India
e-mail: nazuraj@gmail.com

Muralidhara B. L.
e-mail: murali@bub.ernet.in

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to linguistic rules [1, 2]. Mining and analyzing microblogs like Twitter has proved more challenging because of the sparse content [3]. Tweets are brief and thus their interpretation is based on background knowledge. Human beings are able to decipher the sparse and cryptic tweets because they are guided by the *Contextual knowledge* [4]. The knowledge [5] that they possess enables them to interpret the terse and cryptic tweets. Thus, the objective of our work is to arm the machine with knowledge in the form of structured, supporting knowledge structures. These contextual knowledge structures (CKS) can be leveraged for discovering an association between cryptic tweets and the underlying events and thus *enable* the machine classification of tweets.

In our work, we discover the trending topics or events from the tweets and construct a pertinent search phrase for searching the contextual Web content. We capture the Web content and finally extract knowledge structures that represent the contextual knowledge. We automate the process of acquisition and representation of contextual knowledge by using text mining and computational linguistics techniques. We generate subject–predicate/verb–object triples that represent the highlights of any given popular event or topic. These acquired contextual knowledge structures can be potentially leveraged for tweet analysis and interpretation.

The relevance of this contribution is stated below:

(a) Social media mining has assumed tremendous significance and relevance today. Issues are discussed, debated, questioned, and opinionated. Analysis of this dynamic content available online can provide valuable insight into political, social, economic climate, and public sentiments.
(b) Standard KBs containing ontology, for example, DBpedia [6], ConceptNet [7], and yago [8] are available for utilization of research and business communities. However, these may not contain structures pertaining to day-to-day happenings, events, and other dynamic, temporal content. Hence, they may be unsuitable for adding context to the tweets. Thus, tapping the online resources, structuring them, and compiling them into a structured knowledge representation scheme are relevant.
(c) We do not restrict or predefine the domain or topic for context generation. Rather, we discover the popular topics on the basis of the tweets, build context for them, and represent them as knowledge structures. Table 1, for example, contains some sample user tweets in their original form. These tweets are very difficult to mine even after they are cleaned. However, these tweets contain the associated URLs links. They also contain certain *distinct* keywords that can help to identify the underlying topic or event. Thus, if the distinct words

Table 1 User tweets in their original form

S. No.	User Tweet in its original form
1	rt @madhukishwar: puzzle why kanhaiyya arrested prior to investigation into his role while kashmiris who actually shouted tukde tukde slogaâ€¦
2	Heard kanhaiya’s speech many times.amazing clarity of thought expressed.he said wat most people have been feeling.god bless him

pertaining to topic are discovered and structured as CKS, machine interpretation and classification can produce better results.

The remainder of the paper is structured as follows: In Sect. 2, we overview the related literature. Section 3 proposes the methodology for learning knowledge structures. Section 4 describes the experiments and the results thereof. This paper concludes by examining the scope/ boundary of the proposed techniques and future scope for enhancement and research.

2 Related Work

The relevance and challenges of social media analysis are discussed in the works [2, 9–11]. Social media analysis can provide valuable insights. However, we need to deal with several challenges such as semantic inconsistency or inaccuracies, misinformation, lack of structure, size, and dynamic nature [9]. The limited length of a tweet and nonrestrictive writing style results in grammatical errors, misspellings, and informal abbreviations [2, 10]. Tweets contain highly irregular syntax and nonstandard use of English. Thus, tweets need to be normalized and converted into standard form of English in order to make them suitable for machine translation and natural language processing (NLP) [11]. In our work, we preprocess the tweets; we remove stop words and punctuations, convert the phonetically spelled words into correct English words, split the conjoined words into standard form, and separate the hashtags, @tags, and embedded URLs. This makes them more amenable for processing.

Classification of short texts and the problems therein are discussed in [12]. Short texts do not provide sufficient word occurrences, and hence, traditional classification methods such as “Bag-Of-Words” fail. Hence, appending domain specific features to the tweets and enhancing them was the approach used in the above work. We address the problem of sparseness by following a different approach. We build contextual KS (CKS) with the objective of using them for machine learning.

The relevance of Web resources is highlighted in [13, 14]. The work [15] demonstrates the relevance of semantic models in interpretation and inference. In our work, we leverage the Web resources and build semantic structures in the form of KS. These CKS can be used for inferring topics or classifying the sparse tweets.

KBs have been used for tweet interpretation. It is difficult to interpret some tweets in isolation. But if the context of this tweet is available in the KB, then inference and interpretation are possible. Social genome a large real-time social knowledge base was built [3]. This was built, using Wikipedia, a set of other data sources and social media data. A detailed discussion on knowledge structures, their representations and their applicability are discussed in [16]. Our approach of building CKS is similar to this; but in our work, we tap the Web and social media content to extract the knowledge.

There are state-of-the-art KBs like DeepDive [17], NELL [18], and Knowledge Vault [19]. These are very comprehensive and are automatically generated from the Web content. Our CKS is not comprehensive or general. Each set of CKS is generated for one topic only. They are generated with the objective of training the machine with the terms related to a topic. Hence, CKS cannot be compared with these KBs which are general in purpose and comprehensive.

Works [20, 21] showcase webLyzard, a Web intelligence and media analytics platform that compile large archives of Web content from multiple online sources, and provides visual tools to access, and analyze this content [20]. The technique proposed by us is similar to the above work with respect to the aggregation of the Web and social media content for extraction of knowledge. But the methodology followed by us differs in the following respects: (a) We do not restrict the scope of knowledge extraction to a particular topic or event. We discover trending topics and events from tweets with the help of statistical and mining techniques.

3 Methodology

The objective of this work is to obtain relevant, representative knowledge structures for topics which are popular, discussed, questioned, and debated on social media. The proposed methodology enables us to automatically generate CKS for any trending topic or event. Learning CKS involves two main processing tasks: (a) building a filter vector and (b) extracting knowledge structures. These are discussed in the following subsections.

3.1 Building a Filter Vector

Filter vector $\boldsymbol{V_i} = \{\boldsymbol{t}_0, \boldsymbol{t}_1, \boldsymbol{t}_2 \ldots \boldsymbol{t}_n | \boldsymbol{t}_i \, \textbf{\textit{is term}} \in \textbf{\textit{topic}}_i\}$ comprises of relevant and important terms pertaining to a specific topic. $\boldsymbol{V_i} \leftrightarrow \textbf{\textit{topic}}_i$, i.e., there is one vector associated with each topic. We use text mining techniques like vector space model to compute the relevance of the terms and derive this filter vector. Each vector contains only the significant and terms relevant for a particular topic. Since relatively irrelevant content is filtered out before constructing this vector, this step also achieves the objective of dimensionality reduction. The following are the steps involved in this process.

3.1.1 Capturing Popular Tweets

The political leaders with more than a million followers and belonging to different political of India are considered as popular leaders. The twitter messages tweeted by them are termed as “Popular tweets.” Political entities or leaders tweet about the current and relevant events, issues, or policies. Mining these tweets yield popular, trending *topics or events*.

3.1.2 Discovering Popular Topics

They are discovered using the following steps:

i. Hashtags, if present, are extracted from the popular tweets. If the hashtag contains conjoined words, for example, #modibudgettest, the hashtag is split.
ii. A document-term matrix (DTM) with term frequencies (TF) is constructed for all the popular tweets and the terms with the highest frequencies are extracted.
iii. If the terms with highest frequencies are the same as the (split) hashtagged terms; they are selected as "Popular Topics" (PT).

3.1.3 Generating Context Search Phrase (CSP)

The PTs discovered may be specific terms like "Budget2016" or relatively general words like "JNU." In order to build a semantic context corpus, it is necessary to scrap out only the relevant Web content. Search for a general term like "JNU" may yield irrelevant Web content. Hence instead of searching for just the PT, we generate a context search phrase (CSP). We append the PT with the month of tweet, the year of tweet, and the country and generate a search phrase. Then, we use Google Trends for suggestions regarding the above search phrase. CSP is formed by concatenating the suggested words to the PT. CSP = PT $\cup$ Suggestion by Google Trends.

3.1.4 Web Scraping

CSP is used as a search string and the related documents, news, blogs, and articles are searched from the Web. The contents from the retrieved URLs are scraped. These are organized into a corpus such that there is one folder for one topic.

3.1.5 Mine the Corpus

We (a) remove of punctuations, special symbols, and Unicode characters; (b) remove all stop words; (c) perform standardization of proper nouns. For example, Prime Minister Narendra Modi, PM Mr. Modi, PM Modi are the different ways in which Prime Minister Narendra Modi is represented. These nouns are translated into a standard form like "NarendraModi." After preprocessing, we generate a term-document matrix (TDM). One TDM is generated for each folder. The row sum represents the frequency of each term. The higher the frequency, the

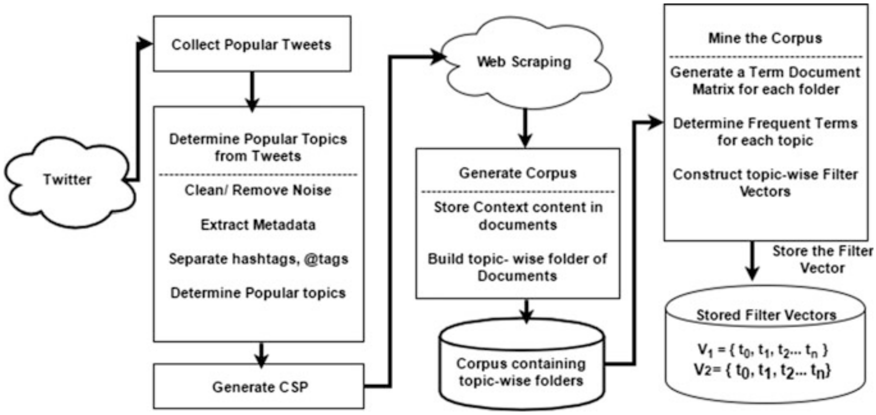

Fig. 1 Generation of topic-wise filter vector

more is the significance of the term. We filter out the infrequent terms for reducing the dimensionality. This is done using the feature ranking method. The frequency of terms is considered as its rank. The top-ranked terms are selected using the Pareto analysis principle. The filter vector is constructed using the frequent terms. Figure 1 depicts the various steps involved in this process.

3.2 *Extracting Knowledge Structures*

We apply the filter vector to each document of the topic folder. This helps us to obtain a subset of sentences which are relevant and important for a specific topic. POS tagging, dependency parsing, and chunking enable us to extract meaningful verb phrases [22, 23]. Figure 2 is a representation of the process.

3.2.1 Filtration and Dimensionality Reduction

The filter vector $\boldsymbol{V_i} = \{\boldsymbol{t}_0, \boldsymbol{t}_1, \boldsymbol{t}_2 \ldots \boldsymbol{t_n} | \boldsymbol{t_i} \in \boldsymbol{topic_k}\}$ comprises of relevant and important terms related to a topic. There is one filter vector for each topic. We apply the associated filter vector to the documents of topic-wise folder. From the documents, we select only the sentences that contain the vector terms and filter out the remaining. This filtration process has two advantages: (a) reduced dimensionality and (b) essence of the corpus is retained.

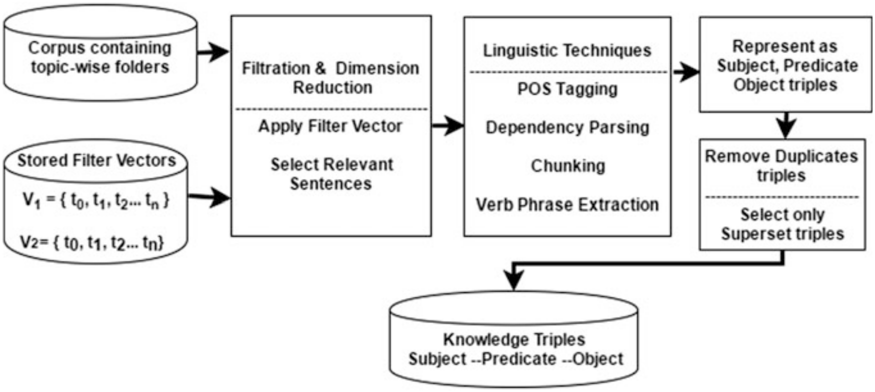

Fig. 2 Extraction of knowledge structures

3.2.2 Computational Linguistic Techniques

We extract CKS from the sentences by making use of computational linguistics techniques. POS tagging tags each morpheme of the sentence with its part of speech. Dependency parsing helps to parse the tagged sentences meaningfully. Dependency parsing considers the verb as the structural center of a phrase. This facilitates isolation of the verb phrases. The nouns are the potential subjects and the extraction of preposition clauses yields the object clauses. The verb phrases extracted are expressed as subject–predicate–object triples.

3.2.3 Duplication/Redundancy Elimination

We use two techniques for duplication elimination. (a) We eliminate the nonunique triples. (b) We filter out the triples which are a subset of others, i.e., $eliminate\ triple_i\ ,\ if\ triple_i \subset triple_j$. For example, “create” “asset or infrastructure” “in rural area” is a superset of “create” “infrastructure” “in rural area.” The remaining triples form the CKS.

4 Experiment and Results

We collected the tweets of the popular political leaders from India like Prime Minister of India, Mr. Narendra Modi, Chief Minister of Delhi Mr. Arvind Kejriwal, President of the Congress party, Mr. Rahul Gandhi using Python twitter Search API. We collected 482 tweets by them during the period of February 2016 to April 2016. We performed comprehensive preprocessing and built a clean corpus [20]. “JNU,” “Mannkibaat,” “MGNREGA” were identified as the PTs. We derived

Table 2 Verb phrases generated using MontyLingua tool and the extracted KS

Relevant sentences from corpus	Verb phrases (extracted using MontyLingua)	Contextual Knowledge Structures (CKS) Subject–predicate–object
In the Union Budget for 2016–17 the finance minister Arun Jaitley announced an allocation of Rs 38,500 crore for providing employment under MGNREGA	(“Announce” “Finance Minister Arun Jaitley” “allocation” “of Rs 38,500 crore”) (“Provide” “employment” “under MGNREGA”)	“Finance Minister Arun Jaitley” “announce” “allocation of Rs 38,500 crore” “Employment” “provide” “under MGNREGA”
MGNREGA needed in urban areas too	(“Need” “MGNREGA” “in urban area”)	“MGNREGA” “need” “in urban area”

the CSP by augmenting these PTs. We then used Microsoft Bing API and Web scraping and built our contextual corpus. We had one folder for each PT. Each folder of the corpus was converted into a TDM containing term frequencies (TFs) using R mining tool. The frequent terms were determined and the filter vector was built. The documents were parsed using python code and sentences containing the frequent terms were selected. This yielded a single document which contained only important and relevant sentences. POS tagging and dependency parsing were done using MontyLingua [24]. MontyLingua yielded a comprehensive output comprising of chunks like noun phrases, verb phrases, subject–predicate–object Triples were formed using verb phrases. The triples were sorted, duplicity was eliminated and the resulting CKS were stored in a document. Table 2 shows the output verb phrases generated using MontyLingua tool and the extracted CKS.

5 Conclusion and Future Scope

The proposed technique yields topic-wise CKS. These CKS triples are representative, depictive, summaries which can potentially be transformed into predicate calculus or ontology and used for machine intelligence. The methodology proposed is simple, yet effective, and efficient. It is general and inclusive and can be applied for text analytics and interpretation in multiple areas. Interpretation of tweets, summary generation, and machine learning are some of its applications. The topics and associated domain terms and entities learn from the CKS can be used for Tweet —Topic Mapping. Classification and sentiment mining from tweets using CKS are the next milestone.

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An Efficient Technique for Online Iris Image Compression and Personal Identification

Kamta Nath Mishra

Abstract In this research article, an iris image compression and identification algorithm called Iris Image Compressor and Identifier is proposed which will convert the iris image of eye in the form of Laplace–Beltrami Spectra. Further, this Laplace–Beltrami Spectra will be converted into the form of Strakos matrix, and for these matrices the Eigen values are calculated which will be enough to identify a person. These Eigen values will be stored in the smart card memory for further identification and compression. Therefore, for checking whether two iris images are isometric or not, it is required to compare the first "*n*" Eigen values of the iris image spectra. If two iris images have the same Eigen values or same Riemannian Metrics values then it shows that both the irises are belonging to the same person. If two iris images have different Eigen values or different Riemannian Metrics values then it means that both the irises are belonging to different persons. We conducted the experiments for one hundred iris images of CASIA database. The robustness testing was conducted by modifying few pixels in specific regions and few pixels in overall image. But still the proposed method was able to identify individuals on the basis of their iris image patterns. The results of iris implementation reveal that the proposed method is an efficient and economically feasible.

Keywords Eigen values · Iris image · Laplace–Beltrami operator
Noise removal · Shape matching

1 Introduction

Different pixel images can have different resolutions. But the Eigen values of Laplace–Miller Spectra for the same image with different resolutions will remain the same [1]. If we take different pictures from different angles for the same image

K. N. Mishra (✉)
Department of Computer Science & Engineering, Birla Institute of Technology,
Alld. Campus, Mesra, Ranchi, India
e-mail: mishrakn@yahoo.com

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then also all these pictures of the same image will have the same Eigen values [2]. Laplace–Beltrami Spectra-based method for image compression was used and deployed by Reuter [2] to compress the DNA sequences. Because the spectrum of the Laplace–Beltrami operator contains intrinsic shape information, therefore, it is called 'shape-DNA' [2]. We have seen that this shape-DNA can be used (like DNA test) to identify objects in practical applications. Identical twins exist with different shape but exactly the same shape-DNA. Therefore, shape-DNA-based method alone cannot be used for personal identification of human [3–5].

The basic idea of iris image recognition and its compression was given by Flom and Safir in the year 1987 [6]. After the work of Folm and Safir [6], many other techniques and software systems were developed by many other researchers like Daugman [7], Tisse et al. [8], and Ma [9] using 2D Gabor Filter and Hough Transform. Recently, Fourier Miller Transform-based cryptographically secure personal identification system was developed by SchonBerg and Kirovski [10]. These techniques were having high false rejection rate (FRR) and false acceptance rate (FAR). The objective of this paper is to compress the iris image in such a way that it should take minimum space and comparison time. If once the identity of a person is verified online then the person may be allowed to use the same smart card for different purposes including automated banking and confidential database access.

2 Literature Review

The CASIA dataset [11] became available in the year 2010 and since then it became possible to compare the results of proposed techniques using this dataset [12–15]. In general, face structure or fingerprint or DNA sequence is used to identify a person's identity. But these methods fail to identify a person in case of identical twins. To store the DNA sequence, we need huge amount of memory; furthermore, we cannot use DNA sequence for online identification of a person [4, 16]. Therefore, a technique is required which can identify identical twins and that takes minimum data storage space. The iris image-based personal identification technique can be used for the following purposes: National ID Card, Passport, Smart Card, Criminal Identification, Automated Banking, Credit Card, Government Benefit Distribution, Home Security System, Confidential Database Access, and Home Security System [16, 17]. But the iris image of the eye takes a large amount of memory like fingerprint technique and human DNA sequences. Iris image-based identification technique can be used for National ID Card, Criminal Investigation, Smart Card, Home Security System, and Confidential Database Access. There are certain hurdles that must be overcome before data can be used. The algorithm must not take up too much memory space, and in particular it must consume very little of the RAM. In addition, an acceptable compression speed should be achieved [3, 5, 7, 18].

3 Theoretical Background and Proposed System

In this section, the theoretical background of iris image and Laplace–Beltrami Spectra is described. Online iris image compression technique has three phases:

3.1 Iris Image Recognition

Iris image recognition is an important event in iris image compression method. The iris recognition is the act of taking an input image of the eye and separating it from the surrounding noise disturbances. The noise disturbances include the pupil, the cornea, the eyelashes, the eyebrows, and the surrounding skin. Therefore, we need to separate these noise disturbances from the iris image. The iris image recognition proceeds in three phases. In the first phase, the pupil will be detected as a dark circle in the image and its center will be identified. In the second phase, the outer edge of the iris image will be estimated. In the third phase, the surrounding noise disturbances will be removed from the iris image. There are certain noise disturbance elements which can be removed easily, e.g., skin and eyebrow. But eliminating eyelashes (a type of noise disturbance) is one of the crucial parts of iris image compression [10]. Finally, the exact iris image is obtained which is required for dividing it into different blocks and then these blocks will be converted into Laplace–Beltrami Spectra. Further, this Laplace–Beltrami Spectra will be converted into Strakos matrix by using Lanczos algorithm.

3.2 Transformation of Iris Image into Laplace–Beltrami Spectra

Once the iris image is extracted, it should be divided into different blocks and then it should be transformed into Laplace–Beltrami Spectra. To convert an iris into Laplace–Beltrami Spectra, we may use Laplace–Kirchhoff operator for the well-known color Red–Green–Blue (RGB). The Laplace–Kirchhoff operator is a difference operator on G to a difference function F': $G \rightarrow R$. Here, we identify F and F' with vectors from R^n by $F_i = F(i)$ and get $F' = L \times F$. After that it is possible to represent a gray value image as a node-weighted graph by connecting each pixel with its four direct neighbors, and we will assign each pixel its gray value as a weight [12, 19].

At the time of storing iris data in the smart card we will not store the actual image of iris, instead we will store 1044 Eigen values of the person's iris image [17]. If two iris images are belonging to the same person then the value of Riemannian Metrics (G_{ij}) for both the iris images will be identical. To calculate the value of Riemannian Metrics, we will use the following formulae [2, 20]:

$$G_{11} = 1 + 3 \times F_u^2 \quad (1)$$

$$G_{22} = 1 + 3 \times F_v^2 \quad (2)$$

$$G_{12} = G_{21} = 3 \times F_u \times F_v \quad (3)$$

If two iris images are belonging to the same person but these images are taken from different angles then also their Riemannian Metrics values will be identical. The Riemannian Metrics values of two iris images will be different if both the irises are actually belonging to different persons. If two images share the same Riemannian Metrics values then one image is either the brighter image of the other or it is a negative image of other or it is a rotational image of other [20]. To transform an iris image into Laplace–Beltrami Spectra, we have converted iris image into 1400 $\times$ 200 rectangular blocks. This rectangular block is partitioned into 1044 square rectangular blocks. To extract local image, we will keep the size of each rectangular block equals to 16 $\times$ 16 [17]. Now, each 16 $\times$ 16 block will be transformed into Laplace–Beltrami Spectra. For each block, maximum Eigen value ($\lambda_{\max}$) and minimum Eigen value ($\lambda_{\min}$) will be calculated.

3.3 Converting Laplace–Beltrami Spectra into Strakos Matrix and Calculating Eigen Values

To calculate the Eigen values and Eigen functions, we will use Lanczos algorithm. The Eigen values for Laplace–Beltrami Spectra will be calculated using the following formula [19, 21, 22]:

$$\lambda_i = \lambda_1 + [(i-1)/(n+1)](\lambda_n - \lambda_1)\rho^{n-I} \quad (4)$$

Here, λ_1 will be 0.1, and the value of ρ will be equal to 0.40, or 0.60, or 0.80, or 0.90, or 1.0. The researchers have found that ρ = 0.8 gives higher Eigen values which are suitable for our purpose. All the Eigen values will be ranging from 0.1 to 100. After calculating $\lambda_{\max}$ and $\lambda_{\min}$ for each block, we will calculate its average (λ_{avg}). The λ_{avg} value for each block will be stored as iris image data for further identification. Thus, we need 1044 Eigen values to identify an iris image uniquely. Since, each Eigen value is ranging from 0.1 to 100. Therefore, we need a float variable to store each Eigen value (λ_{avg}). To store 1044 values of λ_{avg} or $\lambda_{\max}$, we need a total of 1044 float type variables [19, 23].

The flowchart for converting an iris image into Eigen values is presented in Fig. 1. To find Max Eigen values and Min Eigen values of a Laplace–Beltrami Spectra, we will convert the Laplace–Beltrami Spectra into Strakos matrix and then Eigen values will be computed using the formula of Lanczos algorithm [19, 21, 22, 24]. If the starting vector has larger weight for the eigenvectors corresponding to the

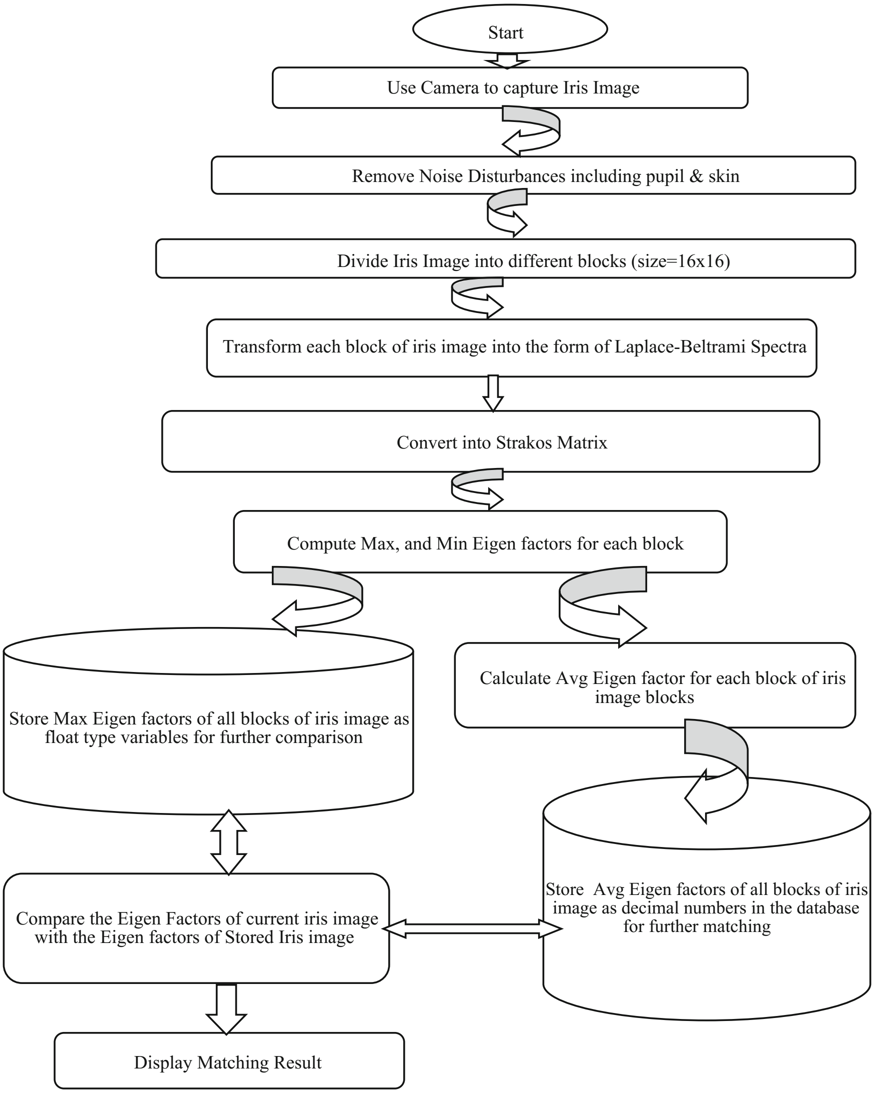

Fig. 1 Iris image compression using Eigen factors

largest Eigen factors then the oblique straight line would move to the right and it will give a better approximation of the largest Eigen value [6, 20, 25]. The Eigen factors will be according to the value of ρ. For getting better results, $\rho = 0.7$ is taken to compute 1044 Eigen factors. It is found that these Eigen factors are floating point numbers. These values can be stored as double or float type variables [19, 24, 25].

4 Proposed Algorithm for Iris Image Compression

The researchers have used KL transformation-based approach to uniquely identify iris images [17]. But the Laplace–Beltrami Spectra-based algorithm can also be used to uniquely identify and compress iris images. For verifying the identity of a person, the Eigen values of person's iris image will be stored in the smart card memory. If a person inserts his smart card in a terminal then the camera of the terminal will take iris image of the person. After completing the phase of iris image recognition, the resultant iris image will be divided into 1044 blocks of same size and further these blocks will be transformed into the form of Laplace–Beltrami Spectra. Now, the Laplace–Beltrami Spectra will be converted into Strakos matrix format by using Lanczos algorithm. Further, Max, Min, and Avg Eigen values will be calculated for Strakos matrix and these calculated Max or Avg Eigen values will be compared online with the stored Eigen values of smart card of the person. If once the identity of a person is verified then only the person will be permitted to proceed with further tasks like Automated Banking and Confidential Database Access. Any two iris images will be considered identical in the following two cases:

Case 1: If all the 1044 stored Max Eigen values are matching with the Max Eigen values of current iris image then it insures that both the iris images are belonging to the same person.
Case 2: If all the 1044 stored Avg Eigen values are matching with the Avg Eigen values of current iris image then it insures that both the iris images are belonging to the same person.

If neither case 1 nor case 2 is true then both iris images will be considered as belonging to different persons.

The iris image comparison method will have the following steps [20]:

- Step 1: Take the iris image of a person.
- Step 2: Remove the noise disturbances from the iris image and divide it into 1044 blocks where block size = 16 $\times$ 16.
- Step 3: Convert each of the block in the form of Laplace–Beltrami Spectra.
- Step 4: Convert Laplace–Beltrami into Strakos matrix.
- Step 5: Calculate Max Eigen value, Min Eigen factor for each block of iris spectra.
- Step 6: Calculate Avg of Max Eigen factor and Min Eigen factor for each block of iris spectra.
- Step 7: Store Max Eigen factor of each block of iris image in the database for further comparison.
- Step 8: Store Avg Eigen value of each block of iris image in the database for further identification and comparison.
- Step 9: Take the iris image of a new person and remove all the noise disturbances.

Step 10: Convert this new person's iris image into rectangular blocks and compute Max Eigen factor, Min Eigen factor, and Avg Eigen factor for each block of the new iris image online.
Step 11: Compare the Max or Avg Eigen factors of new iris image with the Max or Avg Eigen factors of stored iris image.
Step 12: Display the matching result.

5 Result Analysis and Robustness Testing

The proposed technique is similar to Sheng-Wen-Jin [17] technique in terms of expanding iris image into a rectangular block of size 1400×200 and then dividing it into 1044 blocks of same size where the size of each block is 16×16. Further, in the proposed method each block is transformed into Laplace–Beltrami Spectra by using Laplace–Kirchhoff operator, whereas Sheng-Wen-Jin have used KL transform to calculate Eigen values. In the proposed method, Laplace–Beltrami Spectra is converted into Strakos matrix and then Lanczos algorithm is used to compute Max, Min, and Avg Eigen values. These Max and Avg Eigen values of each block will be stored in the smart card memory for online identity verification of a person. The numerical value of Eigen values may vary from 0.1 to 100. The researchers Sheng-Wen-Jin proved in their research paper [17] that these Eigen factors are sufficient to recognize an iris image. In a 16-bit processing system, a float variable takes 4 bytes of memory. Thus, if we store each Eigen value in a separate float variable then to store all 1044 Eigen values of an iris image we will need approximately $1044 \times 4 = 4176$ bytes of memory in a 16-bit processing system. Hence, it is needed approximately 0.0040 MB of memory space in a 16-bit processor for storing the floating point Eigen values of an iris image whose actual size is approximately 459 kB or 0.448 MB [11, 18, 20, 26].

While comparing the results of proposed algorithm with other existing algorithms, it is observed that the proposed algorithm takes approximately 0.0040 MB of memory space to store an iris image which has actual size 0.4–0.5 MB in a 16-bit processing system which is one of the best compression results for iris image compression. The proposed algorithm considers the cases of isospectral and isometric images.

Figure 2 is representing the actual iris image taken from CASIA dataset. The dimension and size of each iris image of Fig. 2 are presented in Table 1. The result comparison of iris images of Table 1 for different quadrants using our proposed algorithm shows that even if we modify approximately 15–18% pixels of an iris image then also the proposed approach is able to identify a person on the basis of iris images. To strengthen the data security, it is worth to add here that it is difficult for hackers to understand and alter the stored Eigen factors of iris images which we are using for unique identification of a person because backtracking is not possible in this algorithm.

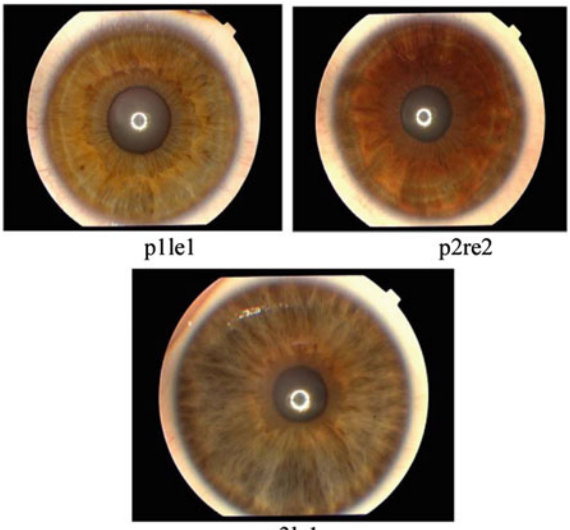

Fig. 2 Raw images of three samples [11]

Table 1 Sample images and its size in KBs

S. No.	Iris image	Dimension of each image	Size (in kB)
1	p1le1	570 × 760	440
2	p2re2	570 × 760	460
3	p3le1	570 × 760	450

6 Conclusions and Future Work

In this chapter, it is shown that iris image compression and identification can be successfully completed using only few Eigen factors. Thus, it is possible to store an iris image in small memory of a smart card and it can be used to verify the identity of smart card holder within few seconds. In the proposed method, Lanczos algorithm is used to compute Eigen factors. In the experimentation, it is observed that the proposed method takes very less execution time (in few milliseconds) to compute, store, and compare Max, Min, and Avg Eigen values which are required to uniquely identify a person.

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Automatic Integration and Clustering of Marathi Documents in Different Formats for Effective Information Retrieval

Sonigara Prachi, Phuge Kirti, Newase Pooja, Sherekar Alisha and Vispute Sushma

Abstract With the advent of the Internet age, there has been an exponential increase in the generation of data due to the easy accessibility of the computational resources. Although the benefits of the information age have been reaped by every strata of the society, some are still lagging behind. One of the sections of society which has not been the main target of the software industry is the farming community. We intend to build a comprehensive product for the farming community wherein the farmer can get all the information he/she needs for the cultivation of crops. The data provided would be in Marathi language, the language of the common farmers in Maharashtra state. This will facilitate the user-friendliness and accessibility to the farmers. This paper presents a system which would accept the data in various multimedia formats and convert it into a common intermediate form. The intermediate form would be a text file. The system built would be capable of categorizing data automatically. The algorithm used for clustering is LINGO.

Keywords Clustering · Integration · Information retrieval · Categorization LINGO algorithm · Data preprocessing · Feature extraction

1 Introduction

In today's age of information overload, data is generated at an ever-increasing rate. The data is generated in diverse multimedia formats. In our system, the diverse data will be converted into an intermediate format that is text file. We can use search engines to get the relevant data but the current search systems output a ranked documents with limited data in response to the query the user wants to be processed. If the user enters the query in a vague and general format, it becomes strenuous to find the document the user wishes to retrieve. The user will have to browse and see a lengthy list of irrelevant search results. The end user of our system

S. Prachi (✉) · P. Kirti · N. Pooja · S. Alisha · V. Sushma
Pimpri Chinchwad College of Engineering, Nigdi, Pune, Maharashtra, India
e-mail: prachisonigra15@gmail.com

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would be a farmer who would type in a query for which he needs relevant results. The query typed and the results provided would both be in Marathi. The search results provided would be the relevant documents clustered by using LINGO algorithm [1].

2 Block Diagram

Figure 1 shows block diagram of the proposed system. It has three main components.

(1) The collection of documents in different formats like Excel, Doc, XML, etc., and transforming these documents into a standard format, i.e., txt files using Pentaho tool.
(2) The second part involves the construction of knowledge base.
Knowledge base creation involves:

- Document preprocessing, i.e., Text filtering, Elimination of stop words, and Stemming
- Formation of clusters using LINGO algorithm based on the user's query.

(3) The final step displays the relevant document as per user's query. Further, the user will also be notified with latest government schemes and current news.

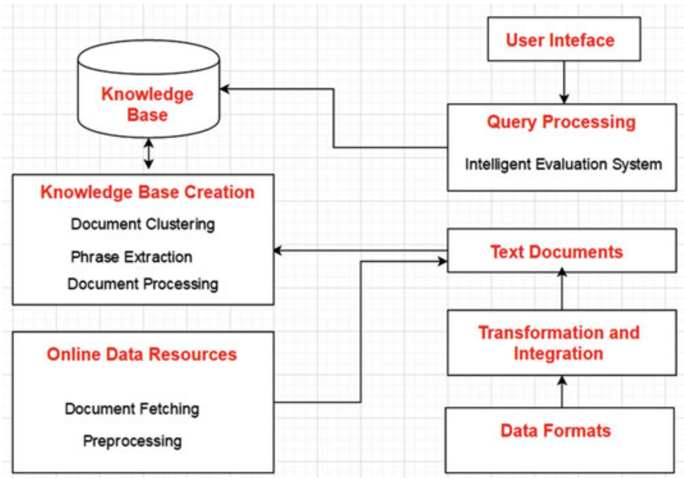

Fig. 1 System block diagram

2.1 Data Preprocessing

It is a vital step in the data mining process [1]. The main objective of the preprocessing is to discard all the letters and words from the input documents that can possibly affect the quality of clusters.

The preprocessing phase includes:

(i) Text Filtering
(ii) Stemming and Stop words marking
(iii) Feature Extraction

(i) **Filtering**

Filtering of all words from input documents that would affect quality of cluster labels. Such terms are:

- Tags such as <PR>
- Special symbols like "$", "%" or "#"

(ii) **Stemming**

Stemming process is the removal of prefixes and suffixes from keywords. Stemming process is important to match the word in any form [2]. For example, consider searching for input keyword "reading" there will be no match found even if its root form can be exists. However, if stemming is applied to the query, "reading" becomes "read", and process will be successful.

(iii) **Stop-Words Removal**

Stop-words are articles such as "the", "a", and "an", prepositions such as "for" and "of", and pronouns such as "I" and "his" in English language. For Marathi language, stop-words are "Aani", "Athava", "Va", etc. These words are not informative and need to remove from documents for better quality of clusters [1].

2.2 Extraction of Features from Documents

This phase includes basically discovery of the features or terms that are able to explain the verbal meaning [2].

For consideration of these features for the label of cluster:

- A term/phrase should satisfy frequency count threshold.
- A phrase should satisfy complete phrase criteria.
- Beginning and ending word should not be a stop word [2].

2.3 Identifying Cluster Label

This phase is used to identify meaningful group descriptions using singular value decomposition of the term-document matrix [2].

There are four steps:

(a) Building of TERM-DOCUMENT matrix: A "$t \times d$" matrix is designed from set of input documents.
(b) Extraction of abstract concepts: SVD decomposition is applied on term-document matrix.
(c) Phrase/Term matching and
(d) "Pruning" and evaluation of cluster label: Remove overlapping labels and find best matching phrase [1].

2.4 Cluster Content Discovery

The input documents/snippets are assigned to the groups that were obtained from label discovery step by vector space model. This assignment resembles the documents searching based on the vector space model. Here, the input documents are matched against every single cluster label. Consider a matrix M, where a column vector is used to represent each cluster label. Let $D = M^{T}X$, where X is the term-document matrix. Element d_{ij} of the D matrix shows the weightage of the jth document in the jth group [3]. If element D matrix exceeds the Snippet Assignment Threshold then that document will be added to the cluster [1].

3 Pseudo-code for LINGO Algorithm

Pseudo-code _LINGO: Pseudo-code of the LINGO algorithm [3]

Input:= D ←Set of documents/snippets= {d1, d2,….dn}/ {s1, s2….sn}
Output:= {C1, C2,….Cm}= Set of Clusters.

I: Preprocessing of each snippet/document
For_all s € S do

(i) Removal of stop words from s;
(ii) Do stemming

End_for

II: Extraction of phrases

(i) P co ←find complete_phrases;

frequency (pc) > Term_Freq
(ii) P_f ← pc;

III: SVD to find group names

(i) MA ← t × d matrix;
(ii) $\sum$, U, V ← SVD (MA);
(iii) kc ← 0; {initialize with zero clusters}
(iv) nc← rank(MA);
(v) Repeat k ← k + 1;
till qc < CLabel Threshold;
(vi) P m← Pf phrase matrix;
(vii) For_all cols of UkTp do

(i) Find largest component mi;
(ii) Cluster label set = Clutser label set U phrase;
labelScore = mi;
End_for

(viii) Cosine distance formula to find similar pairs of group labels;
(xv) Extract label groups those are greater than label threshold;
(x) For_all set of same labels do select label having top rank;
r

IV: Assign documents/snippets to cluster using vector space model

(1) For_all Lb € set of labels do

(i) Form cluster represented by Lb;
(ii) Assign document/snippet to C whose value is greater than threshold.

(2) documents not assigned to any group put in the “Others” label;

V: Find cluster rank.
Calculate cluster scores for all clusters using below formula and merge clusters [2, 3]

$$\text{cluster\_Score} = \text{label\_Score} \times \|\text{Cl}\| \;;$$

3.1 Method of Vector Space Model (VSM)

VSM is an information retrieval method for text mining. Here, every document is represented by multi-dimensional vector. It uses tf-idf method to find a relationship between terms and documents [2].

Tf-idf is given by the formula:

$$w_{ij} = \log(N/df_i).tf_{ij}$$

where,

tf_{ij} #occurrences of term,
df_i #documents in which term i occurs
N #documents in the input set

In VSM, a document-term matrix is represented as $t \times d$ matrix, where t unique terms are described by a collection of d documents [2]. The document vector represents column vectors of the matrix for the documents present in the collection, whereas a term vector represents row vectors of the matrix where the terms are used in the process to index the collection. Here, user-specified query is represented by a q vector in $t \times d$ matrix. Similarities between query q and Doc d are calculated by Cosine distance formula given below:

$$\cos\theta_j = \frac{a_j^T q}{\|a_j\|\|q\|} = \frac{\sum_{i=1}^{t} a_{ij} q_i}{\sqrt{\sum_{i=1}^{t} a_{ij}^2}\sqrt{\sum_{i=1}^{t} q_i^2}}$$

4 Pentaho: A Data Integration Tool

Pentaho Data Integration is the part of Pentaho responsible for the Extraction, Transformation, and Loading (ETL) processes [4]. Even ETL tools can be used in data warehouses, PDI has different applications:

- Migration of different databases
- Export data into text files
- Load huge amount of data into databases store
- Removing unwanted information
- Integration of different applications.

PDI can be used as a stand-alone application. It is the most popular tool available in market which effectively performs all ETL operations. PDI supports a variety of inputs and output formats which include datasheets, text-files along with free and commercial database systems.

4.1 Role of Pentaho

The data is present in different formats like Doc, Excel, and XML. The basic information of crops is present in Doc format, and the pesticide information is present in Excel format. For performing analysis, it is necessary to convert these heterogeneous formats into a homogeneous format. So here, Pentaho tool is used. Pentaho converts these different file formats into text file. As shown in Fig. 2, the Doc consisting of basic information on crops and Excel file consisting of pesticide information are converted into text file. Similarly, all the other documents are converted into text file by Pentaho.

5 Online Fetching of Data Sources

Online fetching is collecting data dynamically from agricultural websites. In this module, the system will be able to fetch online data which gets updated periodically. This is implemented using Java libraries like HttpURLConnection, Socket, Proxy, and URL. The fetched data contains HTML tags also. To remove these tags, we have used regular expressions in java which will replace HTML tags with blank spaces. So, the final output of this code will be required data. Regular expression is a set of sequential symbols and characters which form a pattern to be searched in text.

For example: String s1=s.replaceAll(“\\<.*?\\>”, “”);

where s contains fetched data with HTML tags in it. So this regular expression will match strings with mentioned regular expression patterns and will replace it with blank spaces.

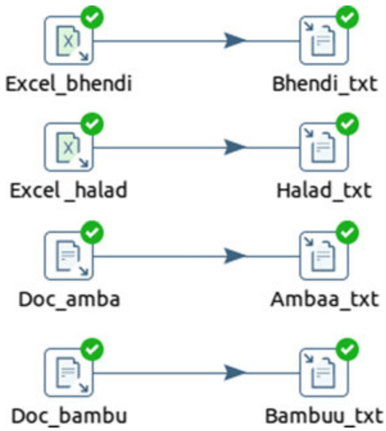

Fig. 2 Pentaho transformation

Category	Precision(%)	Recall(%)	F Measure(%)
Temperature	88.88	100	94.11
Cotton	100	94	96.90
Maize	80	87	83.35
Average	89.62	93.66	91.45

Fig. 3 Performance evaluation results

6 Results and Evaluation

The two popular information retrieval metrics used for evaluation of LINGO: precision and recall. Consider there are total D documents in the database. When user fires query, a number of documents are displayed to the user. Let RL denote the set of relevant docs which are presented in database containing D documents.

Let R_A is the intersection of set R and set A [1].

Precision: Ratio of R_A to the A where R_A and A are defined previously.

$$\text{Precision} = |RA|/|A|.$$

Recall: Ratio of R_A to the RL

$$\text{Recall} = |RA|/|RL:|.$$

F-Score: A measure of combination of precision and recall [1](Fig. 3)

$$F\text{−Score} = (2 * \text{Precision} * \text{Recall})/(\text{Recall} + \text{Precision})$$

User will enter the query in Marathi. Considering the search query as "temperature", the relevant documents of temperature are 48, after firing query the retrieved documents obtained are 54. Out of which all the 48 are relevant and the remaining six are irrelevant to the search query.

Precision obtained is (48/54) = 88.88.

Recall obtained is (48/48) = 100.

The average of precision and recall obtained using LINGO clustering algorithm is 89.08 and 90.42%, respectively. The F-measure average is 89.17% which denotes the accuracy of LINGO algorithm for Marathi documents.

7 Conclusion

As the system proposed would be built in Marathi, it would be very user-friendly for the farmers in Maharashtra. An effective algorithm to group documents has been suggested which would be implemented for the Marathi language. This LINGO algorithm works well in retrieval of data. The system is capable of accepting data in diverse formats which are helpful since the data exists in heterogeneous formats. This makes the system more flexible and comprehensive. Lingo algorithm gives us an average of % for Marathi documents. This shows that Lingo has better accuracy than other clustering algorithms and is effective in classifying Marathi documents. Further scope can be extended for the documents in any other language.

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Frequent Term-Based Text Clustering Using Hidden Support

Harsha Patil and Ramjeevan Singh Thakur

Abstract As the use of Internet increases in all directions, generation of digital documents grow vigorously. Handling of these digital documents challenges the technology to get appropriate response to any query. Many researchers took this challenge and depict their interest to mine these digitalized treasure of knowledge and find hidden information. High dimensionality of text document is always a big challenge for researchers. Handling of high-dimensional text documents for classifying them into clusters with accuracy is another stone of challenge. In this paper, we proposed a method hidden term-based document clustering (HTBDC) which utilized frequent itemset-based mining method. Here in our approach, we try to trade off between high dimensionality with high accuracy of clustering and we got good results. We evaluate our method on the bases of F-score on standard datasets, and the results show that our method performs comparatively better.

Keywords Clustering · Text mining · F-score · Itemsets · Score function

1 Introduction

Document clustering is the process of subsetting text documents. Document clustering broadly can be categorized into three categories: partitioning method [1], agglomerative and divisive clustering [2], and itemset-based clustering [3]. As high dimensionality of text documents is big hurdle for accomplish text clustering, generation of frequent itemsets from text documents helps to solve this problem. A frequent itemset proposed by Agrawal et al. [4] is a set of terms, which are present together in documents frequently and can be better candidates for making

H. Patil (✉) · R. S. Thakur
Department of Computer Applications, Maulana Azad National Institute of Technology, Bhopal, Madhya Pradesh, India
e-mail: harsha.kun.patil@gmail.com

H. Patil
Ashoka Center for Business and Computer Studies, Nashik, India

B. Tiwari et al. (eds.), *Proceedings of International Conference on Recent Advancement on Computer and Communication*, Lecture Notes in Networks and Systems 34, https://doi.org/10.1007/978-981-10-8198-9_37

clusters. For becoming a candidate for making cluster, the frequency of itemset must be equal or greater than a certain user-specified threshold value. The threshold value is use to defined that a particular itemset or term is frequent or not. When we calculate minimum support of any itemset for whole corpus, it is considered as global support. Many researchers worked in this area. Working with frequent itemsets, global support has very import role. If we set high global support, quality of cluster may reduce. In another hand by setting low global support, number of frequent itemsets are increased which causes high execution time. These frequent sets can be efficiently generated by using algorithms such as FP, Apriori [4]. Application of frequent itemset for reducing drastically the dimensionality of the data is efficient way for huge databases.

The framework of this paper is as follows: Sect. 2 discusses prominent work done in area of document clustering. Section 3 provides details regarding proposed method, and Sect. 4 explains regarding experiment details of proposed method. The proposed hidden term-based document clustering (HTBDC) method is evaluated on three standard datasets: Classic4, WAP, and Reuters.

1.1 Document Clustering

Text data is ubiquitous in nature. In the age of Internet, generation of digital documents are very fast. These huge and high-dimensional text documents is big challenge in front of researcher for analyzing and managing it properly. Text mining approaches provide salutary solutions for handling the amplifying text data. Document clustering is one of the widely used applications of text mining. Document clustering is to allocate corpus of text documents into different c groups so that documents in the same group describe the same topic, such as movie description or sports details.

1.2 Document Clustering Process

Document clustering is a step-by-step process. It consist first document retrieval, preprocessing, clustering, and then evaluation (Fig. 1).

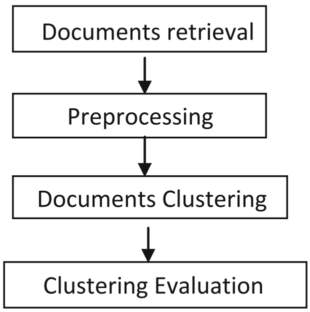

Fig. 1 Steps for document clustering process

The first step of document clustering is locating interesting documents. An IR system accepts a query from a user and responds with a set of documents. This document collection may have some nonrelevant documents. Document collection process may include crawling, indexing, filtering. After retrieving documents, the next step is document preprocessing, which are used to indexing documents to store and retrieve them in a better way, and filter them to remove the extra data, for example, stop words. Preprocessing also includes representing the documents in a way that can be used for clustering. Vector model is mostly acceptable way for representing the documents. Researchers worked on many measures for finding similarity among documents. The last step of Document Clustering is evaluation, which is used to evaluate the performance of the clustering technique.

1.3 Itemset-Based Document Clustering Problem

Frequent pattern-based mining approach is a widely acceptable technique in the field of text mining for finding significant text patterns from documents. Frequent itemsets are terms which appeared together frequently in corpus. In the field of document clustering, frequent itemset is mostly referred as frequent termset as we are dealing with text documents. In this concept, frequent termsets are utilized in place of considering whole high-dimensional text documents for discovering clusters. Here, it is very important to mention that frequent termset is very good tool for providing precise description of a cluster. Frequent termset is also very good tool for describing any cluster. In the field of topic detection itemset, set-based clustering works appropriately.

Analogous to market-basket approach of transactional datasets, documents' keywords are considered as items and the documents can be considered as transactions. So corpus can be described as below,

$$
\begin{aligned}
&d1-[wi1, wi2, wi3, \ldots]\\
&d2-[w(i+1)1, w(i+1)2, w(i+1)3, \ldots]\\
&d3-[w(i+2)1, w(i+2)2, w(i+2)3, \ldots]\\
&\ldots
\end{aligned}
$$

Then, in this representation, frequent termsets, common to a group of documents, represent the same cluster.

2 Related Work

Document clustering is the growing area for researchers and had been widely studied in the computer science literature area of text mining. Researchers had proposed many methods for document clustering. Unweighted Pair Group Method with Arithmetic Mean (UPGMA) [2] is widely accepted agglomerative clustering method [5]. *K*-means and different variation of it are also keenly analyzed by researchers. Bisecting *K*-means proved its better performance among all its variations for partitioned clustering [5]. Nowadays, clustering text documents using frequent itemsets has been an area of widespread research. Researchers [6] discussed that Hierarchical Frequent Term-based Clustering (HFTC) [7] has been the first algorithm in this regard. But HFTC was not scalable. After that Fung et al. came up with Hierarchical Document Clustering using frequent itemsets (FIHC) [3] which leave behind HFTC. It provides a hierarchical clustering with labels to the clusters. In our approach, we present improved version of score function to improve accuracy of clusters.

Then Yu et al. proposed clustering algorithm based on closed frequent itemsets (TDC) [8] which provide improved way for assessing the support correctly. Recently, Malik et al. came up with efficient algorithm Hierarchical Clustering using Closed Interesting Itemsets (HCCI) [9], which utilized benefit of interestingness of closed itemset by which dimensionality of text further reduced. This reduction significantly results in good performance of clustering process and provides better quality clusters. Malik et al. used some measures like mutual information, added value, chi-square for finding interestingness of the closed itemsets. But HCCI results in loss of information, which effects on quality of clustering. Table 1 provides the summarized details of researcher works done in this area. Our approach method HTBDC falls into the category of hard clustering, frequent itemset-based document clustering. HTBDC outputs quality clusters in clustering process.

Table 1 Summarized literature review of different document clustering algorithms

S. No.	Authors	Problem addressed	Clustering concepts	Output
1	Beil et al. [7] Algorithm: FTC, HFTC	High dimensionality of the data, clustering accuracy	Frequent itemset-based	Overlapping clusters with meaningful cluster labels, no semantic discovery
2	Fung et al. [3] Algorithm: FIHC	Quality of cluster in large document set	Frequent itemset-based	Meaningful cluster labels, no semantic discovery, and no soft clustering
3	Treeratpituk and Callan [12]	Accuracy in cluster labeling	Hierarchical document clustering	Automatic generation of labels

(continued)

Table 1 (continued)

S. No.	Authors	Problem addressed	Clustering concepts	Output
4	Hotho et al. [13] Wordnet improves text document clustering	Semantic analysis for text	Partitioning	Semantic discovery, no soft clustering, no meaningful cluster label
5	Malik et al. [9]	Clustering accuracy	Closed frequent itemsets	Loss of information
6	Su et al. [14] Algorithm: MFTSC	Clustering accuracy	Maximal frequent termset clustering	Hard clustering
7	Chen et al. [15]	Semantic analysis for text	Frequent itemsets	Semantic discovery, no soft clustering, meaningful cluster label
8	Kiran et al. [6]	Semantic analysis for text	Frequent itemsets	Semantic discovery
9	Negam et al. [16]	Clustering accuracy, work for improvement in output of association rule mining algorithms	Frequent itemsets	Quality cluster, cluster labels
10	Noor et al. [17]	Clustering quality	Maximal frequent itemsets	Meaning cluster labels

3 Proposed Method: Overview

In our HTBDC approach, we first apply Apriori algorithm on all the documents to mine the frequent itemsets and then start to create initial cluster. These initial clusters are soft clusters; it means they have overlapping of documents. After constructing initial clusters, we move toward creation of final clusters. Final clusters are constructed by using improved score function. Our method is explained in detail in the following part of this section.

3.1 Constructing Clusters

Cohesiveness is important characteristics which are expected in output of clustering; i.e., document under the same cluster should share more common itemsets than those under different cluster.

Set of terms that appear together in more than a specified fraction of the corpus is called global frequent itemsets. A global support for any itemset is a percentage of all documents which support that itemsets. Any global frequent itemsets are called cluster frequent for any cluster *Ci* if they are present in some minimum fraction of documents in *Ci*. A minimum cluster support is used to find cluster frequent items.

Our method constructs clusters in two steps: constructing initial clusters, then finding final cluster for removing overlapping.

3.2 Constructing Initial Clusters

We construct one cluster for each global frequent itemset, which encompass all the documents that have this itemset. So, number of global frequent itemsets determined number of clusters. Since any document may have more than one global frequent itemsets, so these clusters are overlapped.

There are two important properties in these initial clusters:

- All the documents in a cluster contain all the items in the cluster label.
- Document may appear in multiple initial clusters.

3.3 Finding Final Cluster

This step finds final cluster for each document. Final clustering outputs hard clustering. Final cluster is basically most suitable cluster for any document. Similarity between document and cluster defined the final cluster for any document. For finding the similarity between document and cluster, we need to calculate cluster frequent items. A global k frequent item is cluster frequent in a cluster Ci if the item is contained in some minimum fraction of documents in Ci. After that we can compare the global frequent items in a document with the cluster frequent items of each of its initial cluster. Score function proposed by Fung et al. [3] is used to measure the similarity between a document against a cluster.

3.4 Score Function

Score function proposed by Fung et al. [3] has two parts: The first part is rewarding part, and the second one is penalty part. Suppose that any item x appear in doc$j$. If that item also appears in cluster Ci then we reward Ci otherwise we penalize Ci.

$$\begin{aligned}\mathrm{Score}(Ci \leftarrow \mathrm{doc}j) = & \left[\sum_x n(x) * \mathrm{cluster\_support}(x)\right] \\ & - \left[\sum_x n(x') * \mathrm{global\_support}(x')\right]\end{aligned} \tag{1}$$

In next section, we proposed improved version of score function for finding more accurate disjoint cluster.

3.5 Improvement in Score Function

In our method, the improved version of score function has three parts. The first part is rewarding part, and the second one is penalty part. The third part HS is bonus part. The HS is global_support (hidden term) of the hidden term which has less threshold support than global threshold value, but it is present in document and also has a particular minimum support to the cluster label. This minimum support is less than global threshold support but greater than a predefined support. We called it hidden support, and this hidden support is weighted to find accurate cluster of the documents. Hidden term weightage can be taken by only that cluster which has all terms of cluster label supported by hidden term. So if the hidden term is fully supported with the cluster label then only hidden weight will be given otherwise it will be ignored. Proposed score function with semantic benefit is:

$$\begin{aligned}\mathrm{SScore}(Ci \leftarrow \mathrm{doc}j) = &\left[\sum_{x} n(x) * \mathrm{cluster\_support}(x)\right] \\ &- \left[\sum_{x} n(x') * \mathrm{global\_support}(x')\right] + \mathrm{HS}\end{aligned} \tag{2}$$

4 Experimental Evaluation

This section presents the experimental evaluation of the proposed HTBDC, and we are using F-score method to compare its results with its parent algorithm, i.e., FIHC

Data Sets

Classic4, Reuters, and WAP datasets were used for experiment purpose.

1. **Reuters**: This dataset of 21,578 news articles that appeared on Reuters newswire in 1987. Out of 21,578 articles, 8654 articles are uniquely assigned to one of these classes.
2. **WAP**: This dataset has 1560 Web pages collected during WebACE project [10] from the Yahoo! Subject hierarchy. This dataset consists of 20 different classes. Datasets for clustering were obtained from Cluto clustering toolkit [11].
3. **Classic4**: Classic collection consists of four different document collections: CACM, CISI, CRAN, and MED.

Table 2 describes the summary of these datasets.

Table 2 Test data sets

Dataset	Classes	Documents
Reuters	52	8654
WAP	20	1560
Classic4	4	7095

Table 3 Comparison of F-score using our approach

Datasets	TDC	FIHC	HTBDC
Reuters	0.46	0.506	0.591
WAP	0.47	0.391	0.52
Classic4	0.61	0.623	0.594

The experiment results of some algorithms like UPGMA, Bisecting *K*-means, FIHC [3] were taken from the results reported in HCCI [9]. HCCI [9] presents many approaches for clustering; we have taken the best scores out of all of them.

Our hidden term support-based document clustering method reduces the cluster overlapping and produces more qualitative final clusters. In HTBDC method, we work with improvements to existing score function used in FIHC. The Table 3 mentioned the HTBDC algorithm results, which prove that HTBDC algorithm outperform its parent algorithms.

5 Conclusion and Future Work

In this paper, we presented document clustering using frequent itemsets with hidden support. Proposed algorithm also removes duplication of documents and constructs the final clusters. Proposed method also works for trade-off between cluster quality and clustering run time by calculating proper support value using score function. We evaluate our result on three standard datasets and found that our algorithm result is better than its parent algorithm. The Proposed algorithm can be applied to other numerous datasets to evaluate and precisely defined its scope and applicability. The experiment result shows that algorithm performs well in terms of accuracy, efficiency, and scalability. In future, we would like to select hidden term through semantic relation with cluster label.

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Breast Cancer Diagnosis from Digital Mammograms Using RF and RF-ELM

R. D. Ghongade and D. G. Wakde

Abstract Artificial neural network is used as emerging diagnostic tool for breast cancer. The objective of this research is to diagnose breast cancer with a machine learning method based on random forest (RF) and RF-ELM classifier. MIAS database is used for digital mammogram images. Preprocessing is generally needed to improve the low quality of image. The region of interest (ROI) is determined according to the size of suspicious area. After the suspicious region is segmented, features are extracted by texture analysis. Gray-level co-occurrence matrix (GLCM) is used as a texture attribute to extract the suspicious area. From all extracted features, best features are selected with the help of correlation-based feature (CBF) selection. Selected features to improve the accuracy of classification are mean, standard deviation, kurtosis, variance, entropy, and correlation coefficient. RF and RF-ELM are used as classifiers. The results of present work show that the CAD system using RF-ELM classifier is very effective and achieves the best result in the diagnosis of breast cancer.

Keywords Breast cancer · CAD · ELM · Feature selection · Mammogram RF-ELM

1 Introduction

Breast cancer is extensively identified in women worldwide and is one of the primary causes of cancer demise among them. It is the most successive reason for malignancy demise in ladies in less developed regions and second reason for malignancy demise in developed regions after lung tumor. It has been anticipated

R. D. Ghongade (✉)
SGB Amravati University, Amravati, Maharashtra, India
e-mail: rahulghongade@rediffmail.com

D. G. Wakde
P. R. Patil College of Engineering & Technology, Amravati, Maharashtra, India
e-mail: director_prpce@rediffmail.com

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Table 1 Estimated breast cancer cases and casualties in USA, 2017

Estimated new cases			Estimated deaths		
Male	Female	Total	Male	Female	Total
2470	252,710	255,180	460	40,610	4107

that more than 1.6 million cases of breast cancer are registered worldwide in 2010 [1, 2]. The survey of 2013 indicates that 230,815 women and 2109 men in the USA were diagnosed with breast cancer. Anticipated new breast cancer cases and casualties by sex, USA, 2017, are as shown in Table 1 [3].

As per the study at NCI's Division of Cancer Epidemiology and Genetics, breast cancer will raise from 283,000 cases in 2011 to 441,000 in 2030—a more than 50% increase [4].

Early diagnosis is very important for survival, particularly in developing countries where the diseases are diagnosed very late. Mammography is the pre-eminent screening tool that uses X-ray to produce an image of the breast to diagnosis breast tumor. Mammography has been more effectual in screening asymptomatic woman to lessen transience. In some cases, result might be confused when a mammogram discovers somewhat that similar to cancer but turns out to be benign. On mammograms, dense breast tissue looks white. Breast masses or tumors also look white; hence sometimes dense tissue hides tumors. Even qualified and experienced radiologists may miss breast cancers due to the density of breast [5]. The capable markers of malignancy regularly utilized as a part of assessing mammograms are masses and micro-calcifications. Mass detection is a troublesome and testing issue than the recognition of miniaturized scale calcifications; this is because of variation in size and shape observed in a mammogram and also masses often exhibit deprived image contrast [6]. The CAD system developed here will identify the abnormality in digital mammograms and help radiologists to spot the areas of concern. Hence, CAD system for breast cancer has been turned out to be a capable supplementary tool in the battle against breast malignancy. It improves detection rate especially in younger women, where cancer masses are hidden because of dense breast tissue [7, 8]. This paper proposes a novel approach for breast cancer segmentation and detection from digital mammogram images. The approach has been done with the help of morphological operations and artificial neural networks.

2 Literature Review

A literature review showed the recent developments in computer-aided diagnosis system for breast cancer using statistical approaches and artificial neural networks.

Karahaliou et al. [9] proposed a method where they used gray-level and wavelet coefficient texture features of the tissue neighboring MC clusters on mammograms.

Probabilistic neural network is used for differentiating malignant from benign with AUC of 0.989.

Marcano-Cedeno et al. [10] proposed artificial metaplasticity multilayer perceptron algorithm that gives need in refreshing the weights for the less incessant actuations over the more regular ones. AMMLP accomplishes a more proficient training while at the same time keeping up MLP execution. Wisconsin Breast Cancer Database is used in present work. The performance is tested using classification accuracy, sensitivity, specificity, and confusion matrix. Evaluated classification accuracy is to the extent of 99.26%.

Jiji and Marsilin [11] identified the right phase of breast disease from the tumor. Low-level features are extracted. KNN algorithm is used for the classification, and classification rate accomplished is 93.5% accuracy. For pattern relationship, Euclidean distance is used. Retrieval performance is evaluated by comparing Euclidean distance metric and Mahalanobis distance metric.

Ahmad et al. [12] introduce a system for diagnosis of breast tumor with genetic algorithm for concurrent feature selection and parameter optimization of artificial neural networks. This is called GAANN_RP algorithm, which use Wisconsin Breast Cancer Dataset to produce the best and average, 99.43 and 98.29% exact classification, respectively. Performance is evaluated using three variations of BP training, namely the RP, LM, and GD.

Nugroho et al. [13] used multilayer perceptron (MLP) as a classifier and CFS for the feature selection toward breast cancer identification on mammograms. Features are extracted based on histogram and gray-level co-occurrence matrix (GLCM).

Dheeba et al. [14] proposed a novel classification approach based on PSOWNN for detection of breast cancer in digital mammograms. Performance of the proposed system is evaluated by the area under the ROC curve.

Xie et al. [15] presented an imaginative technique for finding of breast disease in view of an extreme learning machine. The performance of proposed CAD system is compared with SVM and PSO-SVM. This framework accomplishes the great execution with precision of 96.02%.

Mohebian et al. [16] presented hybrid predictor of breast cancer recurrence (HPBCR), a hybrid technique including statistical features selection, meta-heuristic population-based optimization, and ensemble learning to predict breast cancer recurrence in the first 5 years after the diagnosis.

3 Methodology

The approach in this research used for the detection of abnormality in mammograms is shown in Fig. 1 and described as follows:

In the present work, mammogram images with 1024 × 1024 pixels are imported from MIAS database. To enhance the contrast of the image and to smoothen image, preprocessing is done which will be helpful in further stages. Then segmenting the breast region is carried out in order to find out the suspicious area from breast

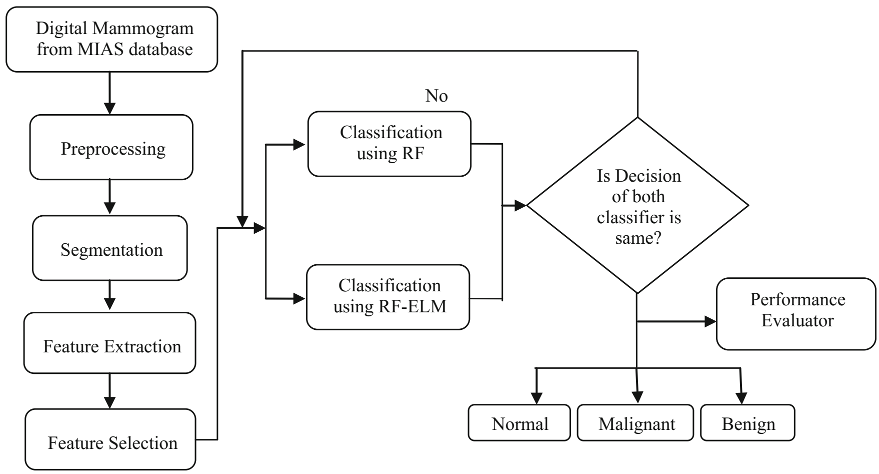

Fig. 1 Structure of the proposed CAD system for the diagnosis of breast cancer

segments. Later extraction of texture features and texture statistics computation is performed. Some relevant features are selected by correlation-based feature selection (CBF) method, and these features are used for classification to determine the masses or non-masses.

3.1 Preprocessing

The principle issue for extracting features of the mammographic images is noise, different resolution, quality, and low contrast of mammograms. This makes location of tumor considerably harder. Preprocessing is required to conquer this issue and makes efficient feature extraction of image possible. Mammographic image is taken from MIAS database for the preprocessing. Firstly, the Gaussian filter is applied for smoothing of images. The Gaussian blur is a type of image-blurring filter that uses a Gaussian function for calculating the transformation to apply to each pixel in the image. It is used to 'blur' image and remove noise. Then adaptive histogram equalization is used to enhance the contrast of grayscale image by transforming the values.

Gaussian kernel coefficients are sampled from the 2D Gaussian functions as shown in Eq. (1).

$$G(x, y) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{x^2 + y^2}{2\sigma^2}} \tag{1}$$

where

x is the distance from the origin in the horizontal axis,
y is the distance from the origin in the vertical axis, and
σ is the standard deviation of the distribution.

3.2 Segmentation

A significant segmentation process is needed that recognize and extract the malignant tumors. Region-based segmentation is used to segment masses from its background. Otsu's strategy is utilized to naturally perform clustering-based image thresholding. The algorithm supposes that the image contains two classes of pixels following bimodal histogram (foreground pixels and background pixels), and it then calculates the optimum threshold separating the two classes so that their intra-class variance is minimal. After image is segmented (binary mask), it is multiplied with the original image as the normalization process. Thresholding is performed using Eq. (2).

$$\begin{aligned} G(x,y) &= 1, \quad \text{for}\, f(x,y) > T \\ &= 0, \quad \text{for}\, f(x,y) \leq T \end{aligned} \tag{2}$$

where T has chosen the value of threshold.

3.3 Feature Extraction

The gray-level co-occurrence matrix (GLCM) is used as a statistical technique to extract the texture features. These features are contrast, correlation coefficient, energy, homogeneity, mean, standard deviation, entropy, variance, smoothness, kurtosis, skewness, and inverse different moment (IDM). On the other hand, shape features such as area, solidity, eccentricity, perimeter, and major axis length are extracted.

3.4 Feature Selection

Feature selection is the way to select a subset of appropriate features. It is used to reduce the feature space to improve the accuracy of classification. This also minimizes the computation time. Correlation-based feature selection (CBF) is used to select the high-dimensional features. Out of seventeen features, only six features are selected for further process. It is a correlation-based feature selection method which is significantly faster than other subset selection methods. The CBF assesses subsets of features on the premise of accompanying theory 'Good feature subset contains features highly correlated with classification, yet uncorrelated to each other.' Following Eq. (3) shows merit of a feature subset '*S*' comprising of '*k*' features:

$$\text{Merit}, S_k = \frac{k\overline{r_{cf}}}{\sqrt{k + k(k-1)\overline{r_{ff}}}} \tag{3}$$

Here,

$\overline{r_{cf}}$ average value of all feature-classification correlations, and
$\overline{r_{ff}}$ average value of all feature–feature correlations.

Selected six features are mean, standard deviation, kurtosis, variance, entropy, and correlation coefficient.

3.5 Classification

Random forest (RF) is used as a classifier. RF is an approach proposed by Breiman for classification tasks. It principally originates from the blend of tree-organized classifiers with the randomness and robustness provided by bagging and random feature selection. The classification is performed by sending a sample down in each tree and assigning it the label of the terminal node. At the end, the normal vote of all trees is accounted for the classification. Bagging process of RF method of classification is well defined using mathematical Eq. (4).

Let $X = x_1, x_2, \ldots, x_n$ be the training set having set of responses $Y = y_1, y_2, \ldots, y_n$ for Z times.

Then for $z = 1$ to Z, predictions for all such unseen samples are denoted by $\widehat{x}$ and can be defined as

$$\hat{f} = \frac{1}{Z}\sum_{z=1}^{Z} f_z(\hat{x}) \tag{4}$$

RF is very efficient with large datasets and high-dimensional data.

The ELM training algorithm learns a model of the form

$$\hat{\mathbf{Y}} = \mathbf{W}_2\sigma(\mathbf{W}_1 x)$$

where $\mathbf{W}_1$ is the matrix of input-to-hidden-layer weights, σ is some activation function, and $\mathbf{W}_2$ is the matrix of hidden-to-output-layer weights.

The algorithm proceeds as follows:

1. Fill $\mathbf{W}_1$ with Gaussian random noise;
2. Estimate $\mathbf{W}_2$ by least-squares fit to a matrix of response variables $\mathbf{Y}$, computed using the pseudo-inverse. +, given a design matrix $\mathbf{X}$:

$$\mathbf{W}_2 = \sigma(\mathbf{W}_1\mathbf{X})^+\mathbf{Y}$$

RF-ELM is a combination of RF and ELM algorithms which improves the accuracy more than other classifiers.

3.6 Performance Evaluation

Confusion matrix, ROC curve with AUC score is the parameters to evaluate the performance of classification algorithm. Confusion matrix helps to get information about both actual and predicted class classifications.

The TPR and FPR are used to plot the ROC curve. The TPR is used to calculate correctly classified malignant ROIs from all available malignant ROIs. The FPR parameter can calculate incorrectly classified benign ROIs among the total number of benign ROIs. At the end, accuracy, precision, sensitivity, and specificity parameters are calculated to assess the system performance.

4 Experiments

To conduct experiments in the proposed method, MIAS database is used. MIAS database is a set of mammogram images. This database was created to contain two experimental datasets on the same images. In the first dataset, the images are split into two classes: normal or abnormal, and in the second dataset, the images are split into three classes: benign, malign, and normal. The abnormal images in this database contain the coordinates and the radius. The first dataset of all extracted features is created, and the process of Gaussian filter and histogram equalization is implemented in this research. The RF classifier is used for classification. The following steps briefly describe the experiment in this research:

Step 1: From mammogram, the region of interest (ROI) is extracted. The ROI was extracted from abnormal images depending on the information contained in the dataset.

Step 2: To remove noise from mammogram images and improve the quality of the ROI, the Gaussian filter and Adaptive histogram equalization are applied.

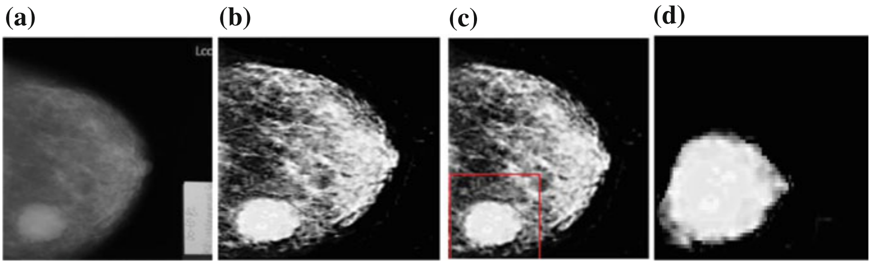

Fig. 2 Results of processes to find abnormalities using RF-ELM approach. **a** Original image, **b** enhanced image, **c** ROI image, and **d** classified abnormalities

Step 3: The features are extracted from the normalized image regions using GLCM. Then from these features, only six features are selected by CBF selection method to improve the accuracy.

Step 4: Mammogram images are classified using RF and RF-ELM classification algorithms. If both algorithm results are same, then it classifies the tumor, else it gets back to the classification stage.

Step 5: Confusion matrix, ROC curve with AUC score are used to evaluate the performance of the classification algorithm.

Figure 2 shows the results of the various processes to find abnormalities using RF_ELM approach.

5 Results and Discussion

True positives (TP), false positives (FP), true negatives (TN), and false negatives (FN) are four different possible outcomes of a single prediction for a two-class case. Accuracy, sensitivity, specificity, and ROC curve with AUC score are statistical parameters that help to evaluate the performance. Sensitivity measures the extent of genuine positives which are appropriately perceived when the mammogram contains malignancies tissues in it. Specificity quantifies the extent of negatives which are legitimately perceived when disease is absent in the mammogram. Evaluated performance of CAD system using RF and RF-ELM classifiers is provided in Table 2.

Table 2 Performance evaluation of CAD system with various statistical parameters

Method	Accuracy (%)		Sensitivity (%)		Specificity (%)		AUC (μ)	
	Best	Av	Best	Av	Best	Av	Best	Av
RF	89	80	90	80	92	81	2	0.9
RF-ELM	98	95	97.9	89	97	91	2.5	1.9

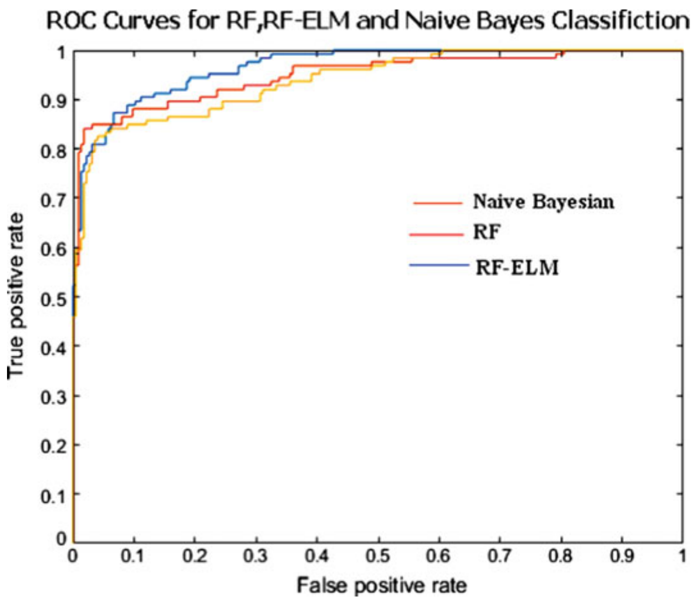

Fig. 3 ROC curve for various classifiers

Comparison of receiver operating characteristics (ROC) curve for RF, RF-ELM, and Naive Bayes classifiers is shown in Fig. 3.

6 Conclusion

This paper proposed a CAD system, which classifies mammograms into normal, benign, and malignant. After preprocessing of the digital mammogram and the selection of ROI, features are extracted and then classified using RF and RF-ELM classifiers. Otsu's method is used for image segmentation to produce the better result. The result shows that RF-ELM classifier provides significantly better classification accuracy by reducing the FPs and FNs, and it also depends upon the optimization of feature selection. This finding is exceptionally valuable for the radiologist in identifying the malignancy from digital mammograms.

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Home Automation Using Internet of Things (IoT) for Smart Cities

Vipra Chudasam, Nikit Somaiya, Dipali Badgujar and Era Johri

Abstract Growing applications of ubiquitous computing have helped life getting better in every way. Pervasive computing has led its way in the advancement of IoT as well as rapid increase in applications. Everyday objects are embedded with microcontrollers to make computer-to-human (C2H) interaction environment to collect information to make it customised for tasks for users (Biradar et al. in Ubiquit Comput Secur Syst (UbiCC J) 4, 2010 [15]). In this paper, we propose smart environment for interaction to automate home security system with the help of ubiquitous computing. System is deployed in modules and as per requirements and can be adjusted. Currently deployed modules include fire detection system, RFID, alarm system, router, emergency contact system, database, motion detection system with the central control unit of android app and storing data at root location and away from direct access over network. The system acts dynamically according to sensors input. System is designed especially for commoners in terms of security issues and affordability making their life comfortable (Jain et al. in Raspberry Pi-based interactive home automation system through e-mail: optimization, reliability and information technology (ICROIT), 2014 [1]).

Keywords Internet of things · Home automation · Smart automation
Smart cities · Motion sensors · Control unit-android app · Fire detection system
Ubiquitous computing · Home security system · Alarm system
Raspberry Pi

V. Chudasam (✉) · N. Somaiya · D. Badgujar · E. Johri
IT Department, K.J Somaiya Collage of Engineering, Vidyavihar, Mumbai, India
e-mail: vipra.c@somaiya.edu

N. Somaiya
e-mail: nikit.s@somaiya.edu

D. Badgujar
e-mail: dipali.badgujar@somaiya.edu

E. Johri
e-mail: erajohri@somaiya.edu

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1 Introduction

With the advancement in technologies, the demand for luxurious lifestyle is increasing constantly. Smart environment eliminates tedious H2H or H2C interaction with the help of IoT which transfer data over a network. Smart mode is connection and communication of world with the help of IoT to draw useful information to develop smarter devices. With upcoming researches and development in nanotechnology, device size is shrinking everyday making it possible for palm-tops compared to computer when inverted. Similarly, big data, cloud computing and pervasive computing made it possible to improve the quality of life and empowering businesses making whole world as one big information system. IoT has evolved from the convergence of microelectromechanical (MEMS) systems, wireless technologies (WT) and Internet. The concept of 'IoT' has a deep relation with the upcoming security system for smart cities. In this paper, various technologies and standalone application modules, an app which is central control unit are converged [1].

2 Literature Review

The various detection systems that have been deployed till now are having different types of data gathering and processing units. The data types of different outputs that are been generated from these detection systems needed to be processed on a common platform using IoT techniques [1].

2.1 The Fire Detection System

This system is a static system located at home and collecting the entire sensors data, processing it and finally sending its processed output to an app for emergency control. This module includes two important hardware components namely—LPG sensor, flame detector which send data to Raspberry Pi bit by bit in '0' and '1'. In a situation in which the router will keep check on incoming data and in absence of incoming traffic, action of notifying can be taken. WSN security protocols like LEAP which provides 2S namely security and support to sensor networks by using micro TESLA which represents timed, efficient, streaming, loss-tolerant, authentication [2, 3].

LPG Sensor (MQ-6). MQ-6 is highly sensitive sensor with adjustability of sensitivity, fast response time and capable of sensing liquefied petroleum gas, iso-butane and propane in concentration anywhere between 200 and 10,000 ppm (parts per million) [4]. The main advantage is its stability, long life, a simple drive circuit and low power up to 5 V only.

Flame Sensor Module. It is a simple circuit for detection of flame and warns with digital interface of a LED. It can sense wavelengths between 760 and 1100 nm infrared with 60° of detection angle. Even the accuracy of this sensor is adjustable according to an area of uses.

2.2 Radio Frequency Identification (RFID)

Another module is RFID used for identifying the persons entering in the house. This is useful to buzzer alarm in case of emergency when someone is present inside the house. RFID used for 802.11 WLAN works on 2450–5800 MHz frequency with a very high speed in the range of 1–2 m [4].

2.3 Alarm

The alarm is used in the approached system to alert the persons in house that there is an emergency. If the input from RFID indicates that someone is present inside the house, then control from Raspberry Pi is sent to alarm and alarm start to buzz to notify the person about the disaster (Figs. 2 and 3).

2.4 Raspberry Pi 3 Module B+

Raspberry Pi is a credit card-sized computer with features which includes an ARM compatible CPU speed range from 700 MHz to 1.2 GHz, an on-chip GPU, 12 GHz 64-bit quad-cores ARMv8 CPU, Bluetooth 4.1, BLE and 802.11 wireless LAN, 1 GB of RAM, 4 USB ports, 40 GPIO pins, CSI, DSI, micro-SD card slot, Ethernet port and full HDMI port [4]. In system, the Raspberry Pi is the main processing unit at home which takes all the sensors data and process on it and takes the appropriate decisions (Fig. 4).

2.5 Router Working

It is a layer 3 device which uses IP address and routing protocol to exchange information. It is the main module in sending information from home to mobile nodes using WT. All the sensor information is processed in Raspberry Pi and forwarded to router to the android application. The data send using routing protocols in encrypted for security using IPsec. The routing protocol used here is Border Gateway protocol which is an exterior routing protocol to exchange route between distinctly separated networks. In case of power outage at a house then no sensor will capture data and all the modules will sit ideal in waiting for the electricity to overcome this there is a backup plan having a high capacity of the battery to provide power to the system. The batteries used are the rechargeable battery so no need to replace them again and again [5]. In case fire starts from router than router gets fail than it will not send data to an android application. If the application is not receiving data for more than 2 min, then there is issue with router. In such case, alarm will buzz indicating router failure and if there is no one inside home, then system will work intelligently by taking a decision to turn OFF power by ceiling mounted tub faucet to slower the circulation of smoke. In case of data collision, it can happen that due to traffic or other issue, data is collapse during transmission [6]. To overcome this issue, CSMA/CA protocol is used to overcome problem of collision.

2.6 Android Application for Emergency Control System

The emergency control unit is nothing but an android application which is the software unit to control the system functionality and notify the system user that there is a disaster at house. An android app has two modules—first is sensor status module, and second is emergency module. Together with this main module, an app can provide many other features like screenshot option to capture the current screen status and store this in a database for evaluation purpose. This system provides normal calling system too. Suppose the emergency contact we saved in the app is not answering the call, then another person can be called with same feature. The next feature is a history system; in this, a log file will be maintained. The log file will contain the sensor status so that user or administrator can get details about each any every sensor data like when sensor senses the fire or exactly when it is turned OFF [3].

The main functional modules of the android application consist of:

Sensor Status Information. The first module shows the working status of all the sensors including LPG sensor, flame sensor, RFID, Raspberry Pi and router too. When data is coming in the app, all this sensors and units will show green signal and if any sensor or hardware unit fails to send the information, then it will be notified by a red signal indicating something is wrong in the system [7].

Emergency Calling System. The emergency calling system also works in two ways. As an automatic system, if the user is getting a notification but he is not responding to them, then the system will switch to automatic mode and will call to the ambulance, fire brigade and favourite number automatically. It consists of three main modules such as ambulance calling system, fire brigade calling system, emergency personal calling system. These modules are designed to make call just by tapping on the button.

2.7 Database

The database used in this system is default android database SQLite [7]. SQLite comes with a security feature that is SQLiteCipher which provides AES encryption with 256-bit transparent key for database file encryption [7, 8]. AES is a specification for the encryption of electronic data [9]. AES has 14 rounds for 256-bit keys, and this is really hard to crack the key as key length is very long [10]. Thus, data store in the database is highly secure. All the data is stored for the analysis purpose. Periodically, analysis is done on this historical data and result is produced with future analysis prediction to analyse how much the home system is secure by using this system.

3 Methodology

The whole system consists of different modules which are interconnected and communicating with each other using wireless communication system. The modules are as shown in the Fig. 1. These modules are performing their relevant tasks and sending all their data to Raspberry Pi where all the processing of the sensor data is done. Then through the router located at home, the information is sent to Android application, which is an emergency control unit for the whole system. Finally, all the historical data is stored in database and analysis is taken out periodically (Fig. 5).

Fig. 1 LPG sensor (MQ-6)

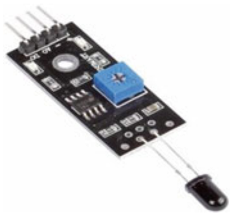

Fig. 2 Flame sensor

Fig. 3 RFID tags, chip

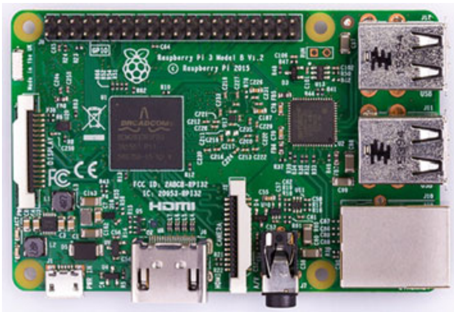

Fig. 4 Raspberry pi

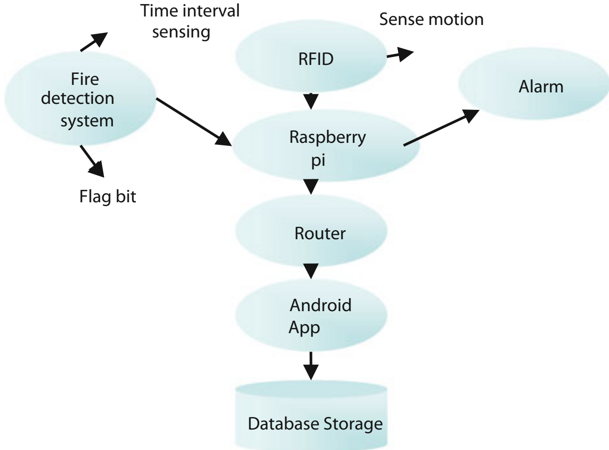

Fig. 5 Interacting modules and their connectivity

All sensing modules are connected to the router using single-hop wireless communication. As modules are connected using star wireless sensor network (WSN) topology, all sensors directly communicate with central point nothing but the router which is in range of 30–100 m [3, 11].

4 Mechanism

App is control unit of the system which helps to control device and perform all necessary task. Sensors data → Raspberry Pi → App which are on the network. Received data is analysed and processed and information. According to information, decision is made and actions are taken keeping each and every log record in the database timely [10]. Similar to airplanes, which have black box to keep a permanent record of received data. The fire system which has a fire detector sensor when sends a positive signal, the database moves the incoming data to a permanent storage so that it can act as a black box with which the user can get to know how the incident occurred. In similar manner, it goes for motion detection system. Once the fire system gives out a positive signal, the motion detectors are notified and they start detection motion in the house and this data is stored in the black box. Since the world is continuously moving to new technology, we have used wireless medium for communication in the house. Consider all the sensors as data collecting nodes; these nodes will be connected to a central chipset. When the nodes collect data, they send it to the central chipset. This chipset is connected to an App via Wi-Fi router configured inside the house. This is one of the features of the system. Another main feature is the security of the house [12]. If ever the user is not present in the house during an accident, the app will automatically do the necessary actions like calling the fire brigade during a fire accident in the house. If someone is inside the house, then it will notify ambulance as well as notify emergency contacts.

5 Security Issues

Security issues must be addressed throughout the lifecycle of the system starting from the designing platform to operational environment of system; therefore, newer versions of software are required minimize the vulnerable functions and loop holes of earlier version [4].

5.1 Secure Booting

To maintain integrity and authenticity of the system and prevent it from intruders, crypto-generated digital signatures are used [13].

5.2 Access Control and Device Authentication

According to their credentials privileges of the device components and applications are granted to minimize intruder activity. The authentication of device based on the set of store credentials in database the devices are provided with network access is the step [14].

5.3 Firewalling And IPS

They are first line of defence which helps in inspection of packets, controlling traffic and preventing 80% of spam and malicious packets.

6 Conclusion

Automating security system for home using Internet of things has had always proven to work at its best by connecting different smart devices to form a complete system. A ubiquitous system can be operated and controlled from anywhere at any time having Internet connection via an app [15]. The proposed system does not only help to monitor the sensor's data like temperature, its intensity, motion sensor, gas leakage but also actuated process according to requirements. Data is stored at home location thus making it available physically only. This part is being planned by keeping security at top and to minimise cyber attacks. The emergency management module helps the user to acknowledge dynamical situation to near and dear ones including helpline numbers of fire brigade, ambulance, police and other customized helpline number. The power unit helps to contact and call on just one click of button making it easy user interaction device. Power unit is important, but system can be operated without it as well. Whole system can be turned off manually; this can risk the security measures; therefore, notification on app will appear displaying message when system loses contact with app or either it turns off manually. Convenience to use due to easy interface, energy management and low power consumption, secure data transfer over network are few advantages of the system.

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Review on Interface Designing and Human–Computer Interaction

Siddharth Kanaskar, Khushboo Satpute and Minal Chalakh

Abstract Humans are social animals, and interaction has been one of the major factors for the development of humans. Invention of computer was a benchmark in technological progress achieved by humans. Proper communication technique between humans and electronic appliances has eased out our lives. But due to improper designing of interfaces of systems, nuclear mishaps like Three Mile Island accident have also taken place. To avoid such huge man-made disasters and to facilitate and equip every common man with technology, proper interfacing of technology such that novice as well as experts can use it to reap the full benefits out of any electronic instrument is a must.

Keywords Interaction · Interface · Marketing

1 Introduction

In today's world, intersection of various fields has led to marvels viz. biochemistry (Biology + Chemistry), nutraceuticals (Nutrition + Pharmaceuticals), and astrophysics (Astronomy + Physics). Medical electronics has given the doctors different ways to analyze and understand different conditions of the subject like if he is critical or normal and deciding the apt treatment for him/her. One such technique is nuclear detection. In almost all the fields, automation has taken over, providing cheaper options for delivering end commodity. While this automation taking place, one important aspect of how normal and non-technical people can use it has always

S. Kanaskar (✉) · K. Satpute · M. Chalakh
MIT College of Engineering, Kothrud, Paud Road, Kothrud,
Pune 411038, Maharashtra, India
e-mail: siddharth.kanaskar@gmail.com

K. Satpute
e-mail: khushboo.satpute@mitcoe.edu.in

M. Chalakh
e-mail: minal.chalakh@mitcoe.edu.in

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been a challenge. In fields where there is no room for errors, professional technicians are installed for using the instruments in the appropriate manner. A very simple example of this is the X-ray technicians.

2 The Crossovers

Human–Computer Interaction is a blend of psychology, sociology, behavioral science, and physiology. Intersection of such a great number of fields has not only attracted the researchers, but due to the consequences and the changes in sales just by minor changes in the aesthetics and the ways of interaction (which also includes ways of displaying) has led to a huge attraction of all the MNCs. Experts from every field are trying to give their contribution to improvise on various techniques for interacting with the computers. Designers, psychologists, and programmers play a critical role in this field.

3 Instance of Changes Made in the History

A good start begins with a good groundwork, and as we all know, a good start is half done. Understanding the needs of the customer is important, as this field deals with the end commodity which directly connects a human to its gizmo, but what is even more important is to understand the changing needs of the customers. Introduction of computer was a revolution practically all possible fields. Automation stepped in, dropping the prices of essential commodities conversely increasing the availability of common man. In the initial states, various projects were carried out to improve the hardware as hardware is the backbone of any system [1].

Once the hardware and its corresponding software were dealt with to a sufficient extent, to run a business, it was important to appropriately not only introduce but to interface a layman to this astoundingly manipulated binary machine. That is actually where interfaces stepped in. Researchers started exploring various techniques of interfacing the computer and its functionalities with the user. After a while, the much-accepted windows, Macintosh and Linux, came into picture [2]. Portability being one of the major constraints, laptops came into picture. Also, communication needed to be done from a non-stationary point to any other non-stationary points due to which mobile phones and palmtops came into picture. All these appliances apart from laptops needed to be properly connected to the user where various platforms came into picture on which operating systems are built. Proper construction of user interface was essential which would not only serve the purpose of a device but also give additional benefits and customization features so the customer would pay a handsome amount for appliances [3].

4 The Interaction

Figure 1 describes the interaction of the user with the computer. The overall flow of information, reception, and interpretation is described in the figure. Over the years, ways of giving the input and receiving the output have changed. In the old DOS computers, input was given with the help of keyboard, whereas now, we can directly click and open the required application or utilize a function of any

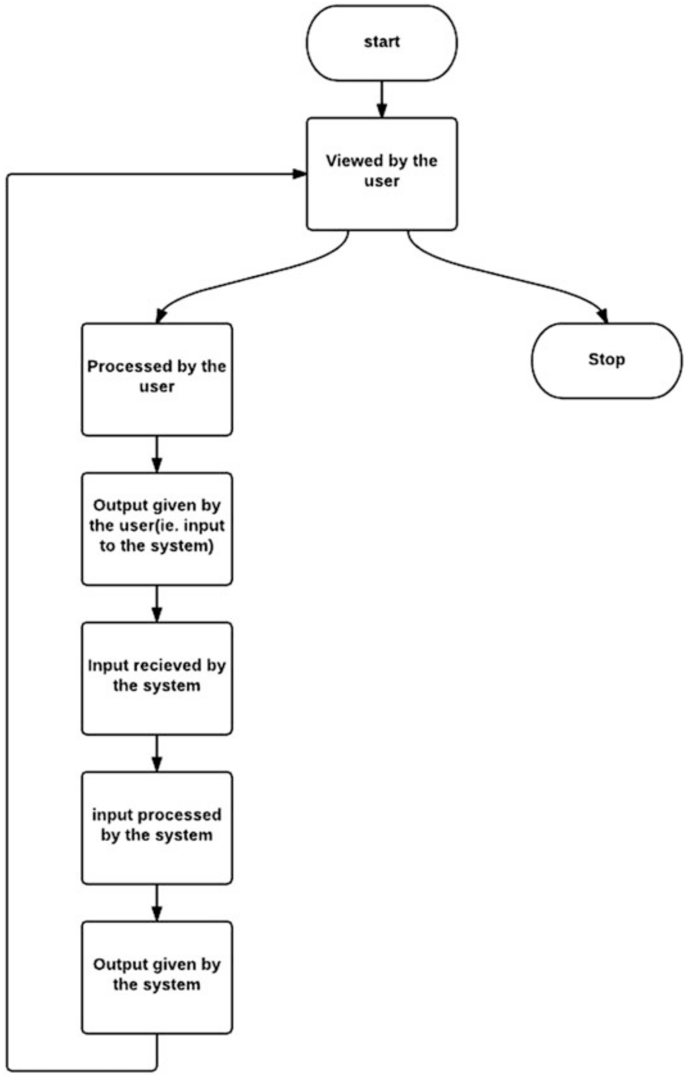

Fig. 1 Flow of information between user and the system

application with the help of a mouse click [4]. Similarly, in case of mobile phones, buttons were used to provide input during the introductory phase, whereas now, finger touch is used to provide the input. In short, the ways of communication with a system has evolved over years. Enormous research is being carried out in the mobile application interfaces as cell phones are most commonly used gadget which has tremendous amount of applications and has now led to the concept of app-fatigue among the users [4]. The flowchart represents the flow of information in a system. It indicates how the communication between human and computer takes place. Initially when we start our computer, a start message along with welcome line is given by the system after which the system asks for password.

- Now, this output of the system is thought about by the user. Although it is not advisable to strain the user by making him/her remember various things, password is must for the security of the user. It helps in maintaining the privacy of the user and his data. This also helps in data security.
- Coming back to the diagram, the output of the system (taking an example of system requesting for password) is thought of by the user. In other words, the user's brain interprets and processes the data. He then remembers the password. The password is then typed by the user, which we can say is the output from the user.
- This output from the user acts as an input to the system. Interpretation of the user's output is done. The user request (here to log-in to his account) is processed by the system. After the request is processed, there is a very important task which is converting the output of the system into a readable output for the user.
- The output of the system is viewed, interpreted and understood, and processed by the user, and corresponding commands are given which again acts as an input. This cycle goes on and on until the user opts for a shutdown option.
- If the users want to shutdown the computer, option is given out by the system asking the user if. This is viewed, interpreted, and responded by the user. If it is a 'yes', the system will take the output of the user as an input, process the request of shutdown, and switch the computer off; or else if the user changes his mind on the request of shutdown, i.e., the user presses a 'no', the system will understand and then process the request. Shutdown shall be aborted by the system and the home screen or desktop shall be visible to the user [5].

4.1 Factors to Be Taken into Consideration

Various factors are taken into consideration while interfacing the application, graphical user interface (GUI), appliances, gizmos, etc., with the user [6].

- The main factor to be taken into consideration is the type of customers which the application or appliance is targeting. Hence, designing a system, or a user interface that shall be understandable even to a layman, is very important aspect for success of that particular appliance [7].

- Nevertheless, aesthetics play a crucial role in the design of interfaces of systems. Small things like placing of buttons at the right place, all buttons of same size, etc. play a deceptive role in the success of any end product. Eye-candy yet not flashy is one of the secrets of good aesthetics.
- Simplicity also is an inevitable component while designing the interfaces. It is advisable that the various functions provided by the system should preferably have an individual button for itself which will in turn reduce the confusion of the available functionalities.
- A critical role is played by the font size, background color, and color schemes used. A well-readable font size should be opted. Due care must be taken that the user need not put any additional efforts for just reading the available options. Bad readability frustrates the users, indirectly affecting verbal publicity of the system or appliance, conversely reducing the sales and profits of the company.
- Due care must be taken that the user should not be strained in any possible way while performing any task or activity. Any small thing like a phone number or email-id can be copied and pasted reducing the strain given to the user's memory. Such small features are appreciated by the users leading to better sales and business of the manufacturers. Such small features give the manufacturers a cutting edge in comparison with its competitors [8].

While designing an HCI, a review of the following three types of user activity should be considered to gauge the degree of user activity.

(i) Cognitive: It involves the actual interaction and understanding of the system by the user.
(ii) Physical: It deals with the extent and practicalities of interaction between the user and the HCI.
(iii) Affective: It involves engaging the user in a way that pleases the user to continue using the system. It may also involve adapting to the needs and requirements of the user to keep him engaged [9].

4.2 Interaction Styles

A machine can understand just two input values, i.e., 0 and 1, as well as term it a binary language. But, the way these 0s and 1s have been so beautifully manipulated and utilized along with the correct hardware has eased out our working by providing us complex systems like computers and mobiles.

We can also say that Human–Computer Interaction is a way in which computer takes an input, interprets it, processes our request, and gives the necessary output. Various ways of interaction with computers are enlisted below:

- Command Line Argument (CLI)
  This includes the very basic type of input technique that is text. Command line arguments have a set of statements that are assigned to perform particular tasks.
- Graphical User Interface (GUI)
  Under this type, a visual format is used to display the various available options. Icons and buttons are assigned various tasks.
- Keyboard and mouse
  They are responsible to take input in the form of alphabets or clicks. Device drivers are must for interpreting the directions and clicks of the mouse or keys pressed on the keyboard.
- Zoom-in interface
  A zoom-in interface is used to improve the readability of the document if the visibility is less.
- Cross-based interface
  Features like mouse-over effects and hierarchical menus improve the user experience.
- Hardware buttons (e.g., power ON/OFF button on every device)
  These are the buttons present on the physical hardware of the appliances. They interact directly with the hardware with any intermediate software [9].

5 Development of HCI

Human–Computer Interaction is a field which involves trial-and-error technique. Understanding the demands of the customers of various types and categories is important to be taken into consideration while designing any interface. For a better understanding, it is important to interact with them. Various surveys need to be conducted, so that the demands' habits and behaviors of varied types of users are better interpreted and appropriate changes can be made in the existing system.

One of the most convenient yet extremely efficient options opted by the manufacturers is allowing the users to customize their own devices. Every user has different individual demands that may not be required by other user. Hence, the manufacturers have facilitated the users allowing them to place various functionalities, buttons, and other components of interface as per their convenience which is a good option too because it not only reduces the efforts of the manufacturers but also gives satisfaction to the users [10].

5.1 Ways of Interaction

Inventions and methods of interactions have been developed for the physically disabled people letting them interact with the system and various devices in the best possible ways.

The development of advanced wheelchairs for victims of features like triple-tap zoom-in has been developed in the android for people with impaired vision.

Physiological Interaction

Physiological interaction is a technique developed that the system can understand and interpret the physical activities of the user and accordingly perform any particular task. Physiological interaction understands the user's activities which include talking, height, and weight. A lot of research work is being carried out on in this field giving out gifts to humankind like automatic speech recognition (ASR), virtual reality, and cave automatic virtual environment (CAVE). Physiological interactions turn out to be extremely useful for the older people. For example, older people having impaired vision can take the help of ASR (automatic speech recognition) for proper interaction with the systems [11].

- Automatic Speech Recognition
  It is a technique that captures the voice of the user and converts it into text that can be read by the user.
- Virtual Reality
  In this technique, an artificial 3-dimensional environment is created, and the user physically takes part in the environment.
  A very good example of this is the simulation exercise provided to the pilots during their training.
  External gears are required to spectate or view things and surroundings to create the necessary effects [12].
- Automatic Virtual Environments
  Virtual reality and automatic virtual environments have a very thin line between them and that is 'external devices need not be used to view the effects.'
  A proper 3-dimensional environment is created where they personally can see and feel the effects as if they are real and existing right in front of them.
- Biometrics
  This technique is used for the identification of the user interpreting the data of the user from various sensors used to interpret human actions and behaviors.
  Many of these techniques are used in our mobile phones too like fingerprint scanner and facial detection.
  Other features that come under this category are the retina scanners and DNA analyzers.
  These features have taken safety and personalization to a whole new level facilitating data security and also giving users a satisfying, reliable provision to keep their personal data safe [5].

Table 1 Sensory organs and their use in computing

Eyes	View the output given by the system
Ears	Listen to audio format of the output (if any) given by the system
Touch	Hands and eyes together are used to provide input to the system
Smell	Although detection of odor is not of any use to computer, lie detection tests are carried out by connecting appropriate sensors to analyze the breathing patterns of the suspect and corresponding to the output determination if the suspect is lying or not is done
Taste	Not applicable for interaction with computers

Table 2 Factors to be taken into consideration while designing any interface

Factor	Description
Simplicity	Reducing the use of submenus. Available options should preferably display in one single frame
Type of customer	Understanding the set and type of targeted customers helps to plot a better marketing strategy
Aesthetics	First impression is the last impression
Font sizing	Adequately spaced and proper use of font size should be done to reduce the strain on users to read any particular thing

From Table 1, human body has five sensory organs namely eyesight, touch, hearing, smell, and taste. A human body interprets the output given by the system by viewing it. The brain interprets what our eyes see and gives corresponding input using hand in the form of touch or key press or mouse click with the help of eyes to understand where the buttons are located. Audio can be heard. If a user wants to listen to a song, then a corresponding request is given to the system and the user can hear it when the system plays the music track in some media player [13].

Table 2 describes the essential factors taken into consideration while designing of any interfaces. It should be simple, easy to read and understand, with good final touch in terms of aesthetics. The customer type should be decided well in advance. This is extremely important to derive the marketing as price structure of the commodity [14].

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Computational Model of Episodic Memory Formation, Recalling, and Forgetting

Rahul Shrivastava and Sudhakar Tripathi

Abstract Our motivation in this paper is to provide a computational model of episodic memory, which is agent and domain independent like human being. Proposed model is smart enough to encode experiences in response to continuous sensory input and able to store in the form of an episode of temporally correlated events based on reward and motivation of agent. In proposed mechanism, event (personal experience) is subdivided into its constituent's coactive activities, where each constituent activity is shared among different events with certain participation strength in different events. Model dynamically allows forgetting of unimportant activities and events based on participation strength which is recalling and reward dependent. This model extracts the key event based on reward which further incorporates in episode formation by clustering of temporal and correlated events with the key event. Recalling is also supported on coming of noisy and erroneous cue or incomplete pattern. To validate the proposed model, an empirical study was conducted, where the proposed episodic memory model is evaluated based on the recall accuracy using partial and erroneous cues and deployed in a car race environment, where agent learns the episode with reward to play by itself. The analysis shows that the proposed model significantly associated with encoding and recalling of events and episodes even with incomplete and noisy cues.

Keywords Episodic memory · Encoding · Recalling · Forgetting
Reward learning

R. Shrivastava (✉) · S. Tripathi
Department of Computer Science & Engineering,
National Institute of Technology, Patna, Bihar, India
e-mail: rahul.vidishaa@gmail.com

S. Tripathi
e-mail: stripathi.cse@nitp.ac.in

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1 Introduction

1.1 Episodic Memory

An episodic memory (EM) is able to encode, store our personal experiences of our daily lives, and support recalling of these experiences on coming of cue [1]. The concept of EM was introduced by Endel Tulving in the early 70s. Episodic system stores experiences with contextual detail of what, where, and when it happened, and it is consciously accessible [2]. Episode formation in EM is dependent on reward, emotions of ongoing experiences [3, 4]. This EM provides the episodic learning, which changes the behavior as a result of events of EM [5]. In this article, we proposed a computational EM model based on some biological findings which are discussed in the paper. Model encodes and stores the events, and then dynamically creates episodes of related temporal events based on reward which supports recalling of previous past experiences (sequence of events) and supports forgetting of unimportant events. Our motivation is to provide a computational model of EM, which is agent and domain independent like human being, and should be smart enough to encode his experiences, and able to store in the form of a episode of temporally related events which would be useful in gaming, robotics, navigation tools, and in predictions [6].

2 Background

Event encoding is the first step for event formation. Shastri and Venkat [7] proposed a new event encoding technique which makes use of binding of subject with its role, such type of binding is used in our model as an activity of an event. It is accepted that hippocampus is the brain region responsible for EM formation and recalling [8], and it is suggested that hippocampus is required to have an autoassociative property for learning, pattern completion and recalling [9, 10], and also it should have competitive network mechanism for pattern separation and sparse memory generation [11, 12]. Edmund [11] proposed a hippocampus model using autoassociative network (for CA3 region) and competitive network (for DG region), but this model does not support Ebinghaus forgetting [13] based on recalling which is supported in our model. Michael and Zachariah [14] proposed competitive trace theory (CTT), which relates EM with semantic memory formation. According to the theory, at the time of encoding (event creation), event is highly contextualize and less semantic, but on further recalling with time event gets less contextualize and more semantic; this theory is very well supported in our model. Budhitama and Ah-Hwee [15] proposed a model for episodic memory, but this model also not supported the Ebbinghaus forgetting mechanism and Recency Primacy effect. These mentioned problems resolved in our proposed model in very well manner.

3 Procedure

3.1 Event Encoding

Here in our model, each experience of life is stored as a sequence of events, where each event is an association of different coactive activities and each activity is a dynamic binding of subject and role played by the subject in the event [7]. For example: Mohan gave Sita a rose. Here <Giver, Mohan>, <Object, Rose>, <Receipt, Sita> are the binding of role ‘giver’ with the subject ‘Mohan’, ‘Object’ with ‘rose’ and ‘Receipt’ with ‘Sita’ are the three different coactive bindings which represent the events. Latter, these events recall on coming of cue (activities). As shown in Fig. 1, event node (diamond) is connected to different activity nodes (circle nodes) through links which are having weights (connection strength). These links weight depends on reward/impact of event; latter these weights decide the event to recall.

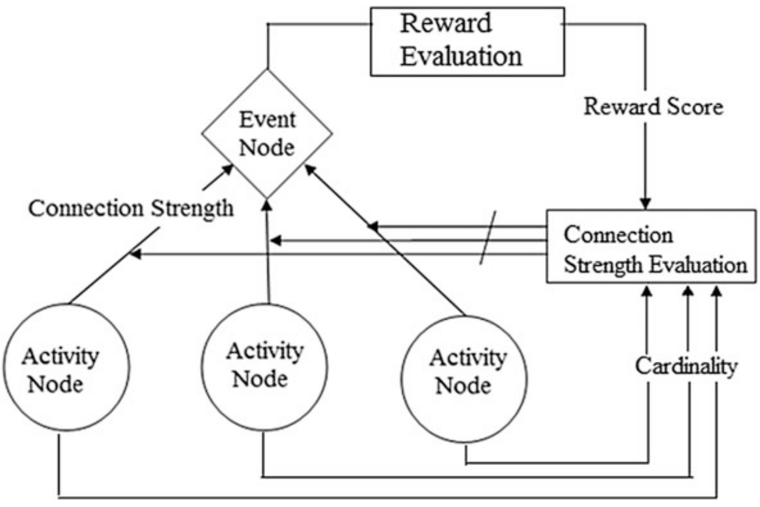

Fig. 1 Here in given figure, circles are representing the activity nodes and events are represented by diamond shape. Different subsets of these activity nodes are the constituents of an event node. These constituent activity nodes are connected with event node by a link which is having some connection strength. After identifying the event, calculate the reward (reward score) of event node. Individual connection strength of activity is evaluated based on reward score and individual cardinality of activity node

Connection Strength (CS): In the process of encoding, not only the binding of role and role player is required but also there is a need to know how much this binding is participating in the event. Here each activity (binding) is connected by link with those events in which it is present. This link weight between event node and activity node represents the participation of activity (binding) in an event.

3.2 Reward Mechanism

Reward represents that the present event is having some impact which makes it more probable to recall in future. Reward can either be positive or negative. For example, in car race environment, accident is having negative reward and refueling of car is having positive reward. These past events reward helps in making decision in environment similar to past environment. At the time of occurrence of an event, a reward score of occurred event is evaluated based on semantics of event and motivation of agent and later these reward score derives the links weight (connection strength). Hypothesize that any event will return high reward score when any one of activity present in the event is important and rare so that connection strength of that crucial activity will be high in event in which it is present. Event recalls on the basis of this CS value of the context (activities) presented to agent as a cue.

Let suppose there is an event node 'e' and $act_{1,}$ $act_{2,}$ $act_{3.........,}$ act_n are the activity nodes present in the event 'e', reward (e) is the reward score of event 'e', and card (act_i) is the cardinality of activity node 'i', then connection strength between event node 'e' and activity node 'i' (CS (e, act_i)) will be derived according to Eq. (1).

$$\mathrm{CS}\ (\mathrm{e}, \mathrm{act_i}) = \frac{\mathrm{Reward}\ (\mathrm{e})}{\mathrm{Card}\ (\mathrm{i})} \tag{1}$$

Reward (e) Derives from the motivation of agent.
Card (i) Cardinality of a set of event in which activity 'i' is present.

In Eq. 1, connection strength of activity in a particular event 'e' will decreases when reward of the event is absent or cardinality of activity is high (activity is so common/ordinary) and increases when impact/reward of event is present and cardinality of activity is low (activity is rare/important).

Algorithm 1: Event Encoding

(1) While (Input from sensor == True).
(2) Input to different sensors activates the activity nodes (binding of role and subject) of different fields.

(3) Make association between activated activity nodes.
(4) Create new event node ‘e’ and connect to all current activated activity nodes S = (act_1, act_2, act_3…… act_n) through links.
(5) Assign weight (connection strength) to each link between event node ‘e’ and activity node ‘i’ where ‘i’ $\in$ S.

$$\mathrm{CS}\ (\mathrm{e},\ \mathrm{act_i}) = \mathrm{Reward(e)/card(i)}$$

(6) End of while.

3.3 Episode Formation

An episode is a sequence of temporally and contextually correlated events. A new episode forms when reward score of occurred event is greater than threshold value, and we call this occurred event as key event, and this key event agglomerates other temporally local and correlated events to formation of episode. To check whether the temporal local events will come in the cluster of key event or not, cluster ratio evaluates for temporal local events. If ratio value is greater than threshold value, then the event joins the episode of key event.

$$\text{Cluster Ratio (j)} = \frac{\forall \mathrm{i} \in \mathrm{K}\ (\sum \mathrm{CS\ (key\ event,\ i)})}{\forall \mathrm{h}\ \in \mathrm{l}\ (\sum \mathrm{CS\ (key\ event,\ h)})} \tag{2}$$

where ‘K’ is the set of activity nodes present in both key event and temporal local event ‘j’ and ‘l’ is the set of activity nodes present in the key event.

Algorithm 2: Episode formation

(1) First step is to check whether the current event is a key event or not by evaluating the impact score of current event
(2) If impact score(current event) > threshold value
   (i) Key event = event occurred at current time step
   (ii) Initialize a set ‘S’ with events which are temporally local to key events
   (iii) Evaluate ratio for each temporal event $\in$ S

$$\text{Cluster Ratio(j)} = \frac{\forall \mathrm{i} \in \mathrm{K}\ (\sum \mathrm{CS\ (key\ event,\ i)})}{\forall \mathrm{h}\ \in \mathrm{l}\ (\sum \mathrm{CS\ (key\ event,\ h)})},$$

   where ‘K’ is the set of activity nodes, which are commonly present in both key event and event ‘j’ and ‘l’ is the set of activity nodes which are present in the key event
   (iv) If cluster ratio (j) > threshold value

Event ‘j’ $\in$ episode (cluster) of key event

(3) Else
(4) No episode formation.

3.4 Recalling

Recalling is the replay of previous episode on coming of cue. Cue activates the set of activity nodes, for example on coming of cue, ‘red car’ activates the activity nodes (bindings) in which red car is playing some role, and then these activated activity nodes recall the event like event of accident with similar red car. To recall any event, a value “recall score” will be evaluated for each event on basis of matched activities of the event with the activities present in cue. The event which is having highest recall score resonates, and the decisions which the episode resonated event possesses will be recall.

$$\text{Recall Score (j)} = \forall \mathrm{i} \in \mathrm{K} \sum \mathrm{CS}\ (\mathrm{j}, \mathrm{i}) \tag{3}$$

where ‘j’ is the event number and K is the set of activated activity nodes and CS (j, i) is the connection strength between event ‘j’ and activity ‘i’

Algorithm 3: Recalling

(1) Input = cue (partial input/incomplete pattern)
(2) Input activates the set of activity nodes K = (act_1, act_2,……, act_k)
(3) Evaluate the recall score of each event ‘j’ using the connection strength with the activated activity nodes
Recall score (j) = $\forall$i $\in$ K $\sum$CS j, i), where K is the set of activated activity node (activated in step2)
CS (j, i) is the connection strength of event ‘j’ with activity node ‘i’.
(4) Max score = max {recall score (i)}
(5) Resonate event = i, where recall score (i) = max score
Resonate event is the event which has maximum recall score, and then episode in which resonate event is present recalls.

3.5 Forgetting

At each iteration, a new event is encoded. So there is a need to remove unimportant events and also need to convert some event into a semantic knowledge which is frequently accessed/recalls.

As we discussed before in this paper, activities have certain participation weights for each event in which they present. These weights are dynamic with respect to time; if agent does not recall an event, then CS value of all activities present in that event will decrease exponentially. But if any reference occurs for the event, then reduction rate will be minimized and after the certain references it will not reduce further.

$$\mathrm{CS}\ (\mathrm{e},\mathrm{j}) = \mathrm{CS}\ (\mathrm{e},\mathrm{j}) * \mathrm{e}^{-\left(\propto \frac{\mathrm{t}}{\mathrm{r}\,(\mathrm{e},\mathrm{j})}\right)} \quad (4)$$

Equation 4 is the formulae for CS where CS (e, j) is the connection strength of activity ‘j’ in event ‘e’ which reduces exponentially [13], ‘∝’ is a reduction rate parameter and r (e, j) is the recalling of activity ‘j’ in event ‘e’ and ‘t’ is the time elapsed from the time of last recalling.

4 Case Study

4.1 Car Race Environment

Proposed model is used in car race environment where the agent (car) uses the episodic memory to accomplish its task of completion of the race in less time. This agent can accelerate the car and can move left and right to avoid accident from the hurdles present on track. This EM-based greedy agent learns the different scenarios and takes decision based on previous similar feature activation of event. On getting input from the environment, agent can recall all the episodes containing event similar to present feature vector and make decision on the basis of previous reward to achieve high score.

5 Result

To evaluate the proposed model, we created two agents, one is random agent and other one is episodic agent. Random agent takes decision randomly based on some static rules to score high, for example if in front of agent, a car is present then move either left or right to avoid accident. On other side, episodic agent takes decision based on recalled episode, where recalling is based on current contextual information. We have performed experiment three times, and agents allowed retaining his previous experiences between experiments. Result is shown in Fig. 2 where

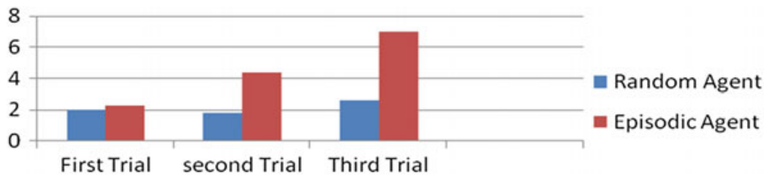

Fig. 2 Showing results of three trials of random agent and episodic agent. Blue bar showing the score of random agent, and red bar showing the result of episodic agent. Vertical axis is representing the score earned by both agents

blue bar represents the performance of random agent and red bar represents the episodic agent. As you can see in first iteration, both random and episodic agent performance is quite similar because initially episodic agent has no episode to take guidance for right move. But in second and third iteration, performance of episodic agent is increased.

6 Conclusion

We presented a new computational model of episodic memory, which is able to take decision based on previous experiences. We performed empirical study on model in car race environment. Various tests are conducted on the model to check its efficiency in memory retrieving during the game. We have done a comparative study between episodic memory-based car agent and a random car agent which uses static rules. Our result shows that our model is able to take decision based on previous episode reward and performed well in comparison to random agent. Its forgetting nature of unimportant events and activities makes it space efficient which removes illusory details so that it is able to recall on giving the noisy cue as input.

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Heart Risk Prediction System Based on Supervised ANN

Ashima Kalra, Richa Tomar and Udit Tomar

Abstract As well said "health is wealth", good health is the key to human happiness. But nowadays due to bad eating habits, stressful life and unawareness among people, the number of cases of death due to heart diseases is increasing day by day. With the help of machine learning techniques, this hazard can be minimized up to some extent by helping healthcare professionals in the quick and efficient prediction of diseases. The motive of this study is to detect the risk of heart disease through a supervised learning network. The paper uses the back propagation approach of neural network. The data set here consists of 180 samples with four attributes adapted from UCI Machine Repository. We have set 70% data for training, 15% data for validation and 15% data for testing. The system gives a better accuracy as compared to the previous researches and with a good figure. It shows an accuracy of 91% for training part which is a good value for any data.

Keywords Neural network · Attributes · Training · Error back propagation

1 Introduction

According to the World Health Organization (WHO) fact sheet on cardiovascular diseases (CVDs), around 17.5 million people die from CVD in 2012 which represent 31% of all global deaths [1]. We have very advanced medical facilities to treat heart diseases, but still the count is increasing day by day. The reason is data gathered by heart-care industry is very big and complex too, and it is not feasible to

A. Kalra (✉) · R. Tomar · U. Tomar
Electronics and Communication Engineering,
Chandigarh Engineering College, Landran, Mohali, India
e-mail: uppal.ashi@gmail.com

R. Tomar
e-mail: richa2486@gmail.com

U. Tomar
e-mail: udittomar24@gmail.com

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handle it manually. Therefore in order to minimize the death rate occurred due to heart diseases, machine learning is required. According to Samuel (1959), "machine learning is the field of study that gives computers the ability to learn without being explicitly programmed" [2]. According to TOM (1998), "well-posed machine learning problem: a computer program is said to learn from experience E with respect to some task T and some performance measure P, if this performance on T, as measured by P, improves with experience E" [3]. Among all machine learning methods, several researchers are using artificial neural network (ANN) that proved to be the best option because of its advantages such as self-learning, associative memory, high parallelism strength, high speed and error tolerance against noises [4]. Feed-forward ANN which is trained by using back propagation learning algorithm is classified into three groups: multilayer perceptron (MLP), radial basis function (RBF) and possible ANN (PANN) [5]. Back propagation learning algorithm is a systematic method for training multilayer artificial neural network. It is a supervised learning method which uses extend gradient descent-based delta learning rule and minimizes the total squared error of the output calculated by the network. The aim of this network is to train the net to achieve a balance between the ability to respond correctly to the input patterns that are used for training and the ability to provide good responses to the input that are similar [6, 7]. K et al. [8] state that the multilayer perceptron model gives the best result in comparison with other models using back propagation learning algorithm. This paper concentrates on training the ANN using back propagation algorithm for the MLP model so that physician can identify the diseases at early stages so as to save one's life.

2 Related Work

Various researchers have presented techniques for the diagnosis of heart diseases. A survey on wearable health monitoring system by Alexandros [9] made it clear that neural network can be used to design such wearable systems for the diagnosis of heart diseases. Jaymin [10] predicts heart diseases using machine learning and data mining techniques with accuracy of 56.76%. Arti [11] analyses the heart risk using ANN with accuracy of 70%. Heart diseases diagnosis by Obaloluwa [12] using back propagation neural network achieve accuracy of 85%. Jasdeep et al. (2012) in [13] approached different method scaled conjugate gradient and Levenberg Marquardt propagation to diagnose the thyroid diseases. The thyroid data set is first trained using LM propagation, and the output is noted. Then, the data set is trained by conjugate gradient back propagation. This has three layers. Hidden layer consists of 20 neurons. This paper consists of 7200 patients' data set. This data set is divided into three categories—normal, hyper- and subnormal functioning. For training, 5040 samples are used, 1030 are used for validation, and 1030 are used for testing. Gokul et al. (2013) [14] presented the application of a fully complex-valued radial basis function network (McFCRBF) and extreme learning machine (ELM) for the diagnosis of Parkinson's disease. It consists of two components: cognitive and metacognitive components. It is a neurological degenerative effect. This disease slows down the movement and also affects speaking and writing abilities. They concluded that MC-FCRBF is more appropriate method as compared to FCRBF and ELM. Ayush et al. (2015) [15] illustrated that the diabetes is worse than all other diseases. Diabetes causes many diseases such as blindness, Alzheimer's and kidney failure. This paper illustrates that human lifestyle such as sleeping habit, physical activities and eating habit plays a major role for any disease. Diabetes is chronic disease which occurs either when pancreas does not produce enough insulin or when the body cannot use properly the insulin produced. The questionnaires set made for interaction with doctor and then these questionnaires asked localities to collect data. It depends on amount of sugar intake, physical activities performed, fried food intake, rice intake and sleeping time. These are the important factors which cause diabetes. Other factors are body mass index (BMI and hereditary diabetes history of chronic disease. Two types of data set were prepared—diabetic person and non-diabetic person. After than data visualization because collected data couldn't be easily interpreted. So they need to correlate some relation between them. *K*-fold cross-validation method is used for result validation. In that, $k = 5$ (means data divide into 5 parts). By this method, the author got the accuracy of 75% correct from the collected data set. Agrawal et al. (2016) in [16] discussed the most effective and friendly model for an expert to help in medical field.

The model was motivated by biological nervous system. ANN can be categorized into many types—single-layer feed-forward network, multilayer feed-forward network. ANN has the ability of learning. ANN has three types of learning process —supervised, unsupervised and reinforcement learning. This study illustrates the usefulness of artificial neural network technique in the diagnosis of cancer. In ANN 2, methods are used for best result—MLP gives 97% accuracy and PNN gives 96% accuracy, and ART shows 92% accuracy. Bharti et al. in [17, 18] also proposed the prediction of diseases (three) with success rate of 84% with varying number of attributes.

3 Structure of Neural Network

A rich vast review on the architectures of neural network and learning techniques is available in the literature [19, 20]. Out of all classical approaches, LM comes out the best approach with minimum mean square error as per the literature survey [21, 22]. The neural network comprises of three specific layers with feed-forward set-up, i.e. input layer, hidden layer and output layer. The input layer of this system is an arrangement which contains all the information and is totally connected to all hidden layers, and these hidden layers are now connected to the output layers. The final response is obtained from the output layer. Figure 1 shows the architecture of neural network.

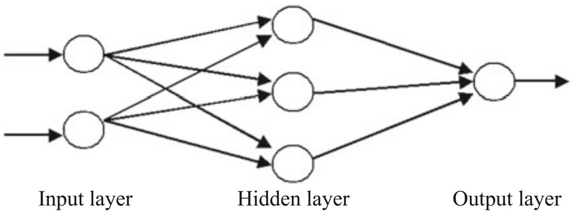

Fig. 1 Architecture of neural network

4 Data Used and Methodology

4.1 Objective

The main aim of our research is to find out the easiest, faster and reliable solution to detect the heart diseases at the early stages. To fulfil this goal, we proposed here machine learning by using ANN. Unhealthy diet, lack of exercise, obesity, stress, smoking habits, high blood pressure and diabetes have increased the risk of heart attacks. Among all these, some factors can be avoided to some extent by spreading awareness among people, but factors such as stress and diabetes problem due to some genetical factors cannot be avoided. Therefore to ensure an accurate medical guidance, machine learning is required because sometimes human perception and visualization is not correct, especially in cases of heart disease prediction which requires a lot of experience.

4.2 Working of Proposed Model

Figure 2 shows the complete methodology, i.e. how our proposed technique will work to detect heart diseases.

4.3 Data Used and Methodology

We have decided to consider certain attributes based on the general information of humans which could be helpful to predict any kind of the risk of heart disease. Table 1 represents the attributes taken for predicting heart attack risk by applying artificial neural network. Here, we have selected four attributes which are of very high significance in predicting heart disease risk. Sample data is taken from UCI Machine Repository. The data set consists of 180 samples.

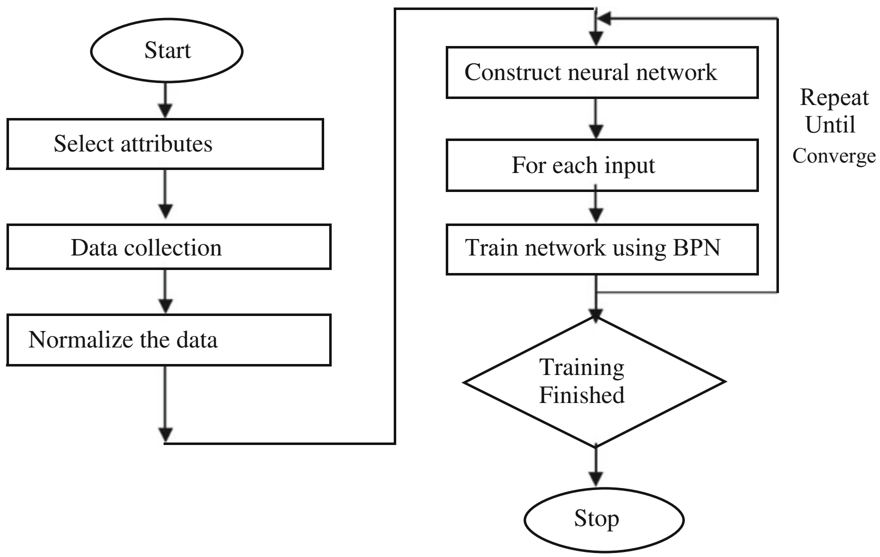

Fig. 2 Methodology

Table 1 Data description

S. No	Attributes	Description	Range	Values
1	Testbps	Resting blood pressure	70–140 mm hg (normal)	0
2	Chol	Serum cholesterol	<240 mg/dl (normal)	0
3	Fbs	Fasting blood sugar	>120 mg/dl	1
4	Restecg	Resting electrocardiographic results	0—normal 1—ST-T wave abnormality 2—probable or left ventricular hypertrophy	

Normalization of data

In order to get better accuracy, here we are normalizing our sample data by finding out the maximum value of each attribute and then dividing each feature with its own attribute.

$$\text{Normalized value} = (\text{Each attribute sample})/(\text{corresponding maximum value}) \tag{1}$$

After normalizing the data, each value lies between 0 and 1.

Table 2 Values of MSE and R for the training, testing and validation samples

	Samples	MSE	R
Training	123	2.8322e-2	9.40535e-1
Validation	27	2.64750e-2	9.30776e-1
Testing	27	1.03467e-1	7.65897e-1

4.4 Experimental Results

The experimental results of this heart disease diagnosis approach are carried out on MATLAB R2012a, and neural network toolbox is used for implementing the algorithm. Here, we are using TRAINLM, i.e. "levenberg-marquardt back propagation" as a training function. Here, we are taking 180 samples with four attributes each; from this, 15% data is used for validation and testing each; the rest 70% is used as training data. The number of neurons in hidden layer is taken as 10. Table 2 represents the value of mean square error (MSE) and regression (R) for the training, testing and validation data.

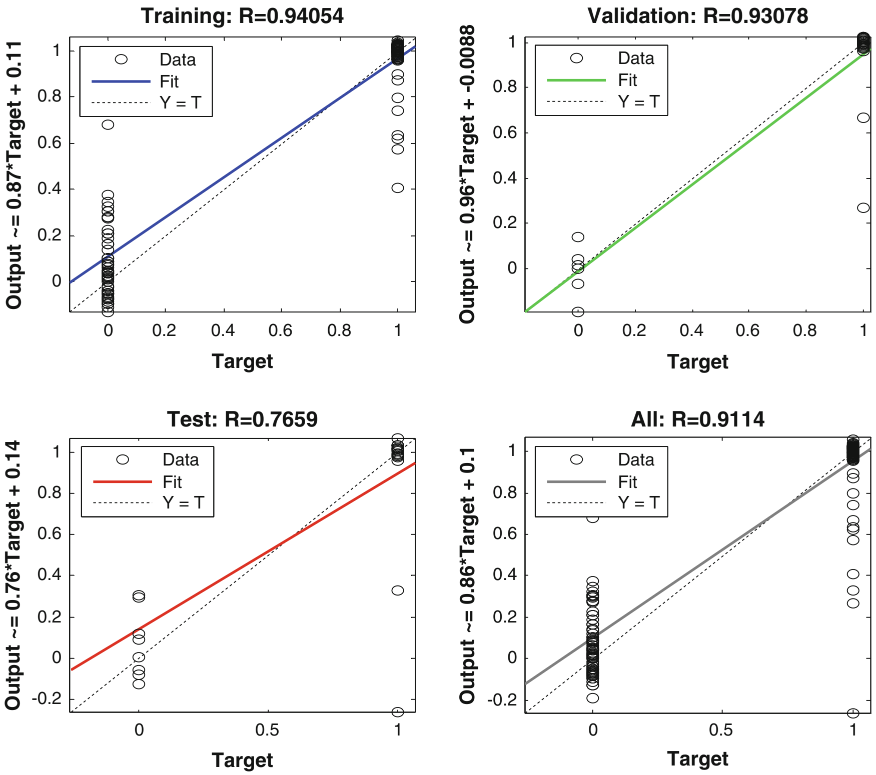

Fig. 3 Regression plot of neural network

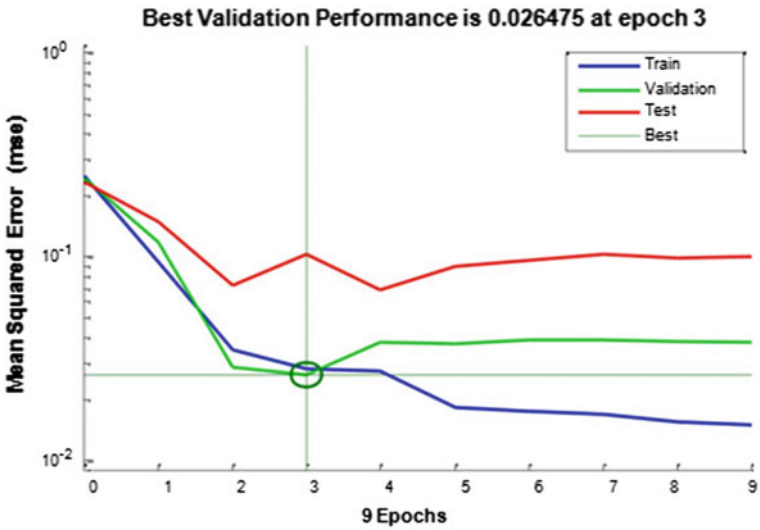

Fig. 4 Performance plot of neural network

Figure 3 shows the regression plot, which indicates training accuracy of 94%, validation accuracy of 93%, testing accuracy of 76.595 and overall accuracy of 91%, and Fig. 4 shows the performance plot.

5 Conclusion

This paper shows the application of ANN to predict the risk of heart disease. The proposed network shows 91% accuracy in training. It is believed that these results will be proved helpful for the specialist in predicting the heart diseases and will also help in reducing the man-made errors. Besides, in this research work, we have discovered that one of the major causes of heart disease is the lack of awareness among people at the initial stages of the diseases. A regular health check-up can help to cure the diseases at the early stage. Finally, the bad habits that are the main cause of heart diseases should also be stopped. To avoid critical case of diseases, unhealthy diet, irregular exercises and smoking should be stopped. We have taken just four attributes, the very basic one which is directly related to the functioning of heart. We can do further possible improvements that could be done to make this prediction system more scalable and accurate by increasing the number of attributes.

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Automated Path Search and Optimization of Robotic Motion Using Hybrid ART-SOM Neural Networks

V. M. Aparanji, Uday V. Wali and R. Aparna

Abstract This paper proposes a new type of unsupervised, path optimizing artificial neural network (ANN) suitable for autonomous motion control of multi-joint robotic mechanisms with arbitrary degrees of freedom (DoF). The ANN can search through the robot's workspace and select an optimal path avoiding obstacles, among several possible paths. This approach does not require computation of nonlinear inverse kinematic expressions generally used for such mechanisms. The proposed ANN combines features of adaptive resonance theory (ART) and self-organizing maps (SOMs). It is a sparse hierarchical multilayer deep learning network with specific features implemented at each layer. Cells in lower levels classify input using a ART/SOM hybrid structure. Higher levels will successively identify and optimize paths that can be used to solve motion problems. The paper describes the cellular automata required to implement the path optimizing network. These ANNs have been implemented using R simulation language. Results for various types of joint systems are presented.

Keywords Adaptive resonance theory (ART) · Artificial neural networks (ANNs) Deep learning · Motion control · Self-organizing maps (SOMs)

V. M. Aparanji (✉)
Department of E&CE, Siddaganga Institute of Technology, Tumakuru, Karnataka, India
e-mail: vma1508@gmail.com

U. V. Wali
Department of E&CE, KLE Dr. MSS CET, Belagavi, Karnataka, India
e-mail: udaywali@gmail.com

R. Aparna
Department of ISE, Siddaganga Institute of Technology, Tumakuru, Karnataka, India
e-mail: raparna27@gmail.com

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1 Introduction

Complexities involved with simulation of robotic systems pose a great challenge especially when such system has to work in real time, autonomously, in human-like environments. Recent effort by DARPA shows that there is a need to review control strategies for such systems [1]. This research indicated use of soft control algorithms instead of analytical or iterative solutions. Some of the machine learning techniques suitable for solving nonlinear problems are back-propagation, multilayer perceptron, recurrent neural networks, support vector machines, etc. [2, 3]. Recently, many new structures like convolution neural networks (CNN), long short-term memory (LSTM), belief systems, adversarial networks, etc., have been suggested. These networks have shown high degree of success in solving complex problems in recognition, estimation, and prediction [4]. Success of an ANN depends on how a real-life problem is mapped to a suitable ANN structure. Capability of an ANN to solve a specific problem at hand depends on the structure used to implement the ANN.

Identification of dynamic equations of robotic systems is complex, and works are still being reported [5]. External environment in which the multi-segmented joint is working can change dynamically, adding to further complexity. Examples of such situations are location of obstacles, effect of gravity at various angles of motion, etc. Robotic control systems using adaptive resonance theory (ART) networks have been discussed in the literature [6]. ART networks start with no or few neurons and grow as inputs are applied. Each node (neuron) records the input pattern. If the input matches the stored value, it produces full output. Node producing the best output will be the winner. The winner will strengthen its weights. If the output of the winner is below a threshold, a new cell is added to the network with the applied input values. Adjustment of weights is controlled by the learning rate. Each node learns independent of the other. ART-2 networks have an elaborate scheme for reorientation and scaling of input to achieve correct classification of input.

Networks based on self-organizing maps (SOM) [7, 8] on the other hand start with a large, fixed number of randomly initiated cells. As the input is applied, the best matching node wins the classification problem and strengthens its weights. Simultaneously, neighbors of the winning cell will adjust their weights toward the weights of the winner. That way, spatially close cells form clusters that identify an input class. Due to this strategy, a new input or input with noise will be recognized correctly. However, in case of large output set, as in case of robotic motion, the size of a SOM network will be very large.

Multilayered neural networks with large number of nodes are now being used for robotic motion. Some of these contemporary works that report neural networks controlling robotic motion include self-organizing maps and particle swarm optimization for path planning [5, 9], adaptive neural networks for biped motion [10, 11], deep learning for robotic motion [4], etc. Several tools for developing neural systems are being developed in recent years [12]. Availability of high-performance parallel computing using GPUs and low-cost memory, implementing large multilayer ANNs, has become feasible. Other reasons for the increased popularity of ANNs are ease with which they can be built, adaptability to various problems, ability to be trained in unsupervised or supervised modes [10], reinforcement learning [11], etc. Such networks have been able to address problems associated with dead zones in workspace and plan motion around obstacles [13].

A biological joint works with pull-relax mechanism while most of the mechanical systems use a constrained rotary motion to drive the joints. Some recent work has been reported in implementation of pull-relax activation for mechanical systems [14]. Initial ideas that contributed to our work were based on the pull-relax model of joint control. From these observations, we can see that development of a generalized neural net to solve kinematic problems can be very useful. We have developed a new type of neural network called auto resonance network (ARN) that can be used in this direction [15, 16]. The new architecture takes clues from ART and SOM networks but is different from both. Overall idea of the network is to store known solutions and their perturbations. This neural network grows and improves its accuracy as more input is applied. Variable resonance of the neurons at the matching input provides cover for noise tolerance as well as recognition of input with no historic record. Perturbation of the network enhances this capability.

In this paper, we have presented a multilayered, hierarchical ANN to solve the path searching problem of robotic mechanisms with multi-segmented joints. The system does not require any inverse kinematic solutions. A scatter function is assumed to describe how the endpoint of the multi-segmented joint moves when it is perturbed from a known stable position. This scatter function can be a first- or second-order function of joint angles and positions. Second method does not assume scatter function but uses forward computation of kinematic equations to compute endpoint location by perturbing the joint angles.

2 Hybrid ANN for Motion Control

A model of mechanisms with multi-segmented joints controlled by a neural network is shown in Fig. 1a. During training, the system will excite the joint angles to random values, which will take the endpoint to a computable point in $\{x,y,z\}$ space covered by the mechanism. The network remembers these input and endpoint location as a pair in a node. On further usage, new nodes are sprouted between and around existing nodes. A scatter function is used to assign initial values to these sprouted nodes. Scatter function can be linear or shape function to fit the endpoint space. Each of these nodes approximates a location and a range of possible input values. Coverage of each of these nodes is a learning parameter. Nodes adapt over period of time and adjust their values to fit the incoming data using statistical information. Error is computed as a difference between the desired location and the location reached by the endpoint. Note that the distribution of sprouted nodes is influenced by the joint system. For example, x-displacement from a known location

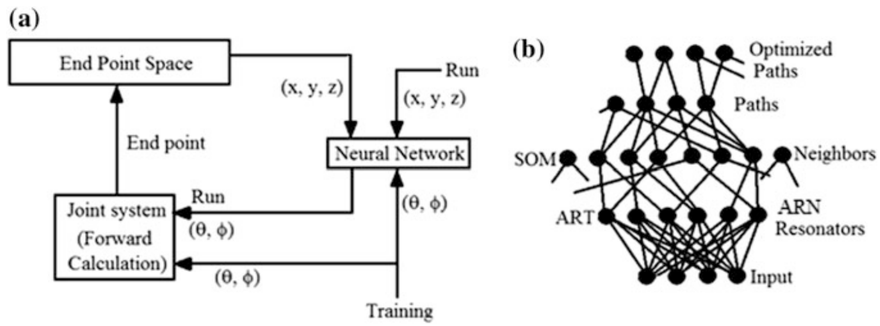


Fig. 1 **a** Model of a joint system, **b** multi-level path search and optimization

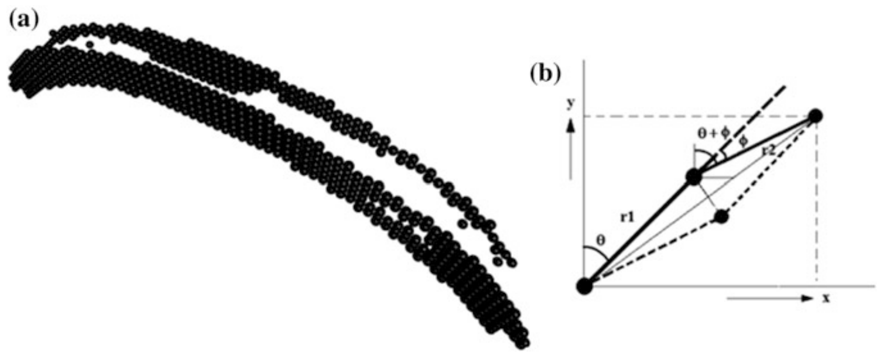


Fig. 2 **a** Two 'Folds' of solutions for the joint system shown in (**b**)

has to increase from left to right. Therefore, the distribution has to account for the direction of endpoint motion.

In a multi-segment joint system, most of the points in the endpoint space can be reached using different sets of joint angles. When a particular location can be reached by more than one possible set of joint angles, each such solution is 'memorized' by a separate cell. When such a cell is added to the network, it generates a neighborhood of cells that are similar to it. This could be construed as folds within the solution space. For example, Fig. 2a shows two folds generated in endpoint space for a two segmented planar joint shown in Fig. 2b. Moving the endpoint within a fold of solution space is less expensive than jumping across folds as it requires large change to at least some of the joint angles. Therefore, shifting between folds is effected by the network only when endpoint cannot reach the desired location within a fold. This is akin to switching in human thought processes.

ARN network uses a single layer of neurons called resonators, with no connection between them. On the other hand, cells in SOM layer impose a spatial relation among nodes and affect the way the network learns. Note that all nodes in traditional ART or SOM are connected to the input and output layers. We have used a separate layer to connect nodes at the output of ARN layer. This layer assigns a spatial orientation on ARN nodes, necessary to decide location in the endpoint space. This is illustrated in Fig. 1b as a second layer of nodes. Similar to SOM networks, these hybrid ANNs can train neighbors of winner node. Unlike the SOM network where nodes are predefined, neighbor nodes in ARN sprout dynamically as the network learns from the input. Two more layers of ARN type are added to recognize optimum path to move from one point to other in endpoint space. These layers are shown in Fig. 1b.

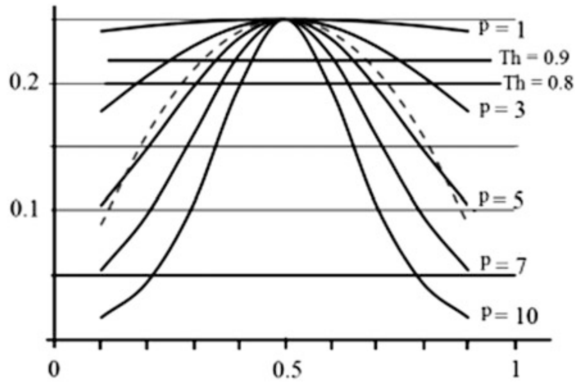
During run time, the desired location of the endpoint is input to the neural network. The network selects one of the possible joint angles based on a cost function. When the endpoint has to traverse a path from current location to the desired location, every cell on the path sequentially triggers the neighboring cells to cause a displacement toward the endpoint. The process is repeated by every cell on path till the endpoint is reached. This sequence of nodes participating in this process represents a path of solution between the current location and desired point. As the process of finding the path is dynamically chosen, it is possible to circumvent any obstructions as and when they arise.

These sets of nodes representing a path are stored in upper layer of cells. Parameters necessary to shift the joint angles are provided by the connections between neighboring cells. A higher layer of the neural network memorizes the paths traversed to reach an end point. Top layer of cells can then select among various available paths and select an optimal path among them. The network represents a set of cellular automata: Each cell in a layer performs identical function but varies only by the weights corresponding to the input. However, cells differ from layer to layer in their functionality. Cells in the higher layers are generic in their function while those at lower levels are highly specialized. In this way, the network can be seen as a complex neural network with specialized layers of cells that can control a given multi-segment joint system. Each of the nodes in the network acts like local memory relating the input to joint angles and end point. Therefore, there is no need for other supervisory confirmation of result. As the same end point can be reached using several sets of joint angles, the network creates folds which can be used to optimize cost of displacement. Sprouted nodes, which are always in a single fold in the network, learn from repeated randomized motion, allowing reinforcement learning. Therefore, the network is suitable for use in fully autonomous motion control.

3 The Control Network

The hierarchical ARN learns by moving the joints arbitrarily and recording the effective end point location and the excitation values applied to each of the joint control inputs. This is similar to a learning process of a child. Suitability of such network for motion control in various types of joint configurations has been

Fig. 3 Space coverage of a node controlled by a single parameter *p*



discussed in [16]. We present details of learning in such networks here. Much like any other ART network, the initial network has no or a very few nodes in the first layer, called the resonator layer (see Fig. 1b). Whenever the output value of the winning node falls below a threshold, a new node is added to the network. The network adds cells as more training data is applied. When a new location is identified, a set of new cells are added to the network. A cell corresponding to the input and effective end point location is added first. Its weights are computed such that the cell resonates (generates maximum output value) when the same input is applied again. Therefore, the cell acts like a long-term memory that will not change over period of time. After the first few resonating cells are added, a set of cells are added in the neighborhood of these cells. Neighbor cells can be added using perturbation of end point or by perturbation of joint angles. Coverage of each of the nodes depends on a single parameter that is adjusted by the cell as shown in Fig. 3. Coverage parameter *p* depends on the precision and resolution required to control end point location. Higher value of *p* gives a sharper control.

4 Automated Path Search and Optimization

The network given in Fig. 1b extends the ART-SOM network described in [15] and section above to include the paths of motion. When a new target is to be reached, a traversal through existing neighbors is attempted. As the search progresses, new cells are added to the path layer. Each path is associated with a cost function. The cost is defined by two parameters:

(a) Total length of the path
(b) Angles subtended between the sections of path.

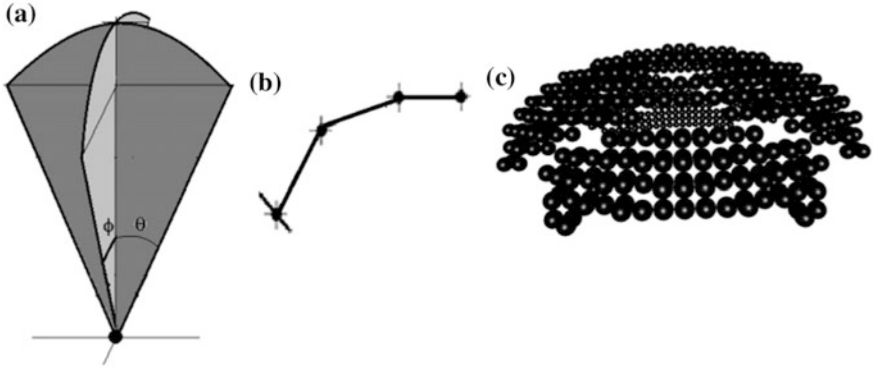


Fig. 4 **a** One segment of joint configuration in *x*, *y*, *z* space, **b** a multi-segment joint using detail shown in (**a**), **c** space coverage of cells in a spherical joint

Acute angles are more expensive in terms of power and hence cost. They are also slow to traverse. For the type of joint given in Fig. 4, the cost function can be written as

$$C = L + s\,\Sigma c(\pi - a) \tag{1}$$

where C is the cost of the path, L is the length of the path in terms of segments, s is a scaling factor, and c is cost of angle a measured in degrees. We use $(\pi{-}a)$ because angle of π radians between sections implies that there is no deflection in the path, and hence the cost is zero. The cells in the path-layer store the path cost. This information is used by cells in the higher layers to select an appropriate path among several possible paths. New paths are created using ARN type of learning when existing paths are obstructed.

For a given source and destination locations, a path is optimized by reducing the path length. This is achieved at a higher layer by exploring the chord edges between alternating cells. Chord edges reduce cost of path. Repeated occurrence of the same source and destination forces alternate paths to be searched. The best path is obtained from the multiple paths based on the cost function.

Notable advantages of the proposed network are its simplicity and scalability. We are not making any assumptions on the number of joints in the mechanism. Only forward calculations are used. In a physical system, these are available automatically during training. The network is self-learning. End point resolution that can be arbitrarily set as learning parameter is node specific and not common to all nodes. Hence, much like in a biological system, the network learns from the environment continuously, growing with experience over period of time.

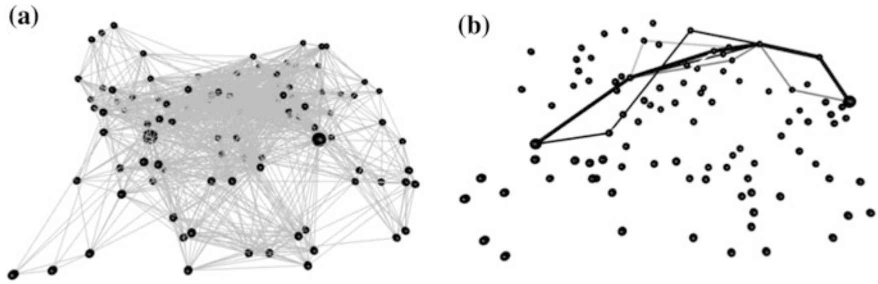


Fig. 5 **a** Formation of edges, **b** best solution among multiple optimized solutions

5 Implementation and Results

Figure 4a shows a spherical joint with a single segment in $\{x,y,z\}$ space, and Fig. 4b shows a joint system using that type of joints. The goal of moving the joints is to reach a particular location in $\{x,y,z\}$, which can be achieved by a specific set of excitation values to be applied to the joint depending on the degrees of freedom (DoF). Each neuron is set-associative: When training input is given, the endpoint location associated with the given input is stored as a set. When target location (or goal) is given, corresponding excitation values to activate motors at each DoF are emitted. Figure 4c shows the space coverage of cells in a spherical joint. Refer [10] for more details on folds of solutions and the computation of forward displacement. The space covered by each of the nodes is specific to the node itself, which in turn depends on training data.

Figure 5a shows the edges created between the cells for a spherical joint with three segments. Only two inputs (cells represented by large black dots at the center) are given to the network. Cells in black color represent the neighbors created for the inputs. Edges are represented by lines (gray) between two cells.

Multiple paths obtained for a set of source and destination are shown in a single plot as shown in Fig. 5b. Different paths are represented by different colors. Each path in the plot represents optimized path. In Fig. 5b, the path with thick line is the best path obtained among the multiple paths. Best path is determined based on cost function which is dependent on path length and cost angle.

6 Conclusion

A new type of unsupervised multilayered artificial neural network is proposed to search through a workspace and select an optimal path by controlling the joint angles. Combination of neuronal resonance, perturbation, and path optimization in a new way is the special feature of this network. It can handle arbitrary spaces covered by set of joints with large number of DoF. Cellular automata required to implement the path optimizing network is described. Results of simulation using R language are presented. Considering that path optimization can be seen as a generic problem solver, the proposed network can be used in many areas of research, e.g., natural language processing (NLP), scene identification, nonlinear control, etc.

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Data Mining Models for Anomaly Detection Using Artificial Immune System

Vaishali Mehare and Ramjeevan Singh Thakur

Abstract In this paper, a new technique is used by implementing artificial immune system (AIS). Artificial immune system is inspired by the human immune system (HIS). It has been applied for solving complex computational problem in classification, pattern recognition, and optimization. Proposed method developed a new model for anomaly detection process by negative selection algorithm (NSA) and classification algorithm. NSA algorithm of AIS is based on the principle of self- and nonself-discrimination in the immune system.

Keywords Artificial immune system · Data mining · Negative selection algorithm Classification · Anomaly detection

1 Introduction

Data mining [1] is the activity of extracting relevant information from a huge amount of data. Data mining is a process to take out information and knowledge from a large number of incomplete, fuzzy, random data, and noisy data. Data mining [2] involves following elements transform, extract, and load transaction data onto the data warehouse system. We used classification technique for detecting the anomaly. An anomaly is an abnormality. Anomaly detection also calls outlier

V. Mehare (✉)
Department of Computer Application, Barkatullah University, Bhopal, Madhya Pradesh, India
e-mail: vaishalimehare18@gmail.com

R. S. Thakur
Department of Computer Applications, Maulana Azad National Institute of Technology, Bhopal, Madhya Pradesh, India
e-mail: ramthakur2000@yahoo.com

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detection. Artificial immune system (AIS) is a new technology of computer science. It is inspired by human immune system. The immune system may use to solve the computer virus problem. Applications of artificial immune system are anomaly detection, fault diagnosis, data mining and retrieval, pattern recognition, computer security, robotics, etc. AIS includes the algorithms for solving the computational problems. In this paper, we used the negative selection algorithm.

2 Data Mining

Data mining is a process of filtering the meaningful information from the large database. Data mining [3] consists of four classes of task; they are association rule learning, clustering, classification, and regression. In this paper, the classification techniques are used for anomaly detection. Classification is the supervised learning. An algorithm that implements classification is known as a classifier. Classifier is a supervised function, where the target attribute is class label. It is used after the learning process to classify new data by giving them the best target attribute. In case of anomaly detection, it will classify the data generally into two categories, namely normal or abnormal (Fig. 1).

3 Anomaly Detection

Anomaly detection [4] is the outcome of patterns in a dataset whose actions are not normal on probable. These unpredicted behaviors called anomalies or outliers. Figure 2 shows the mechanism of anomaly detection technique [5].

The data contains of four types of attacks [6]: denial-of-service (DoS), user to root (U2R), remote-to-local (R2L), and probing (Table 1).

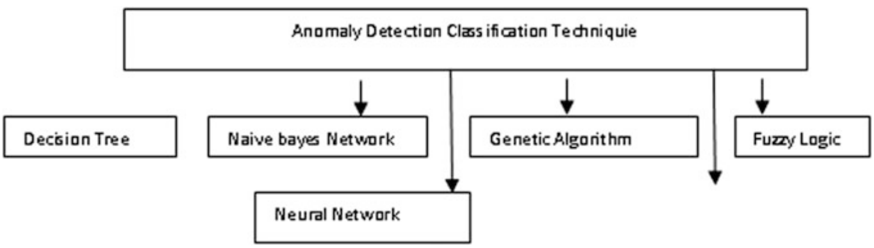

Fig. 1 Classification techniques for anomaly detection

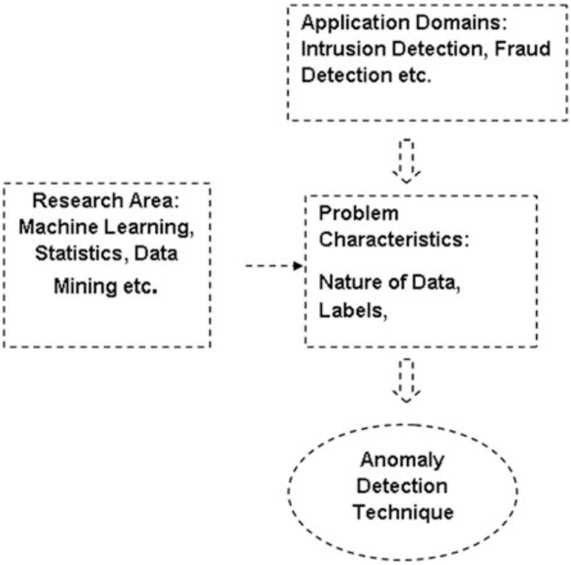

Fig. 2 Mechanism of anomaly detection technique

Table 1 Detection of attack [6] can be calculated by the following terms and their meaning

Detection of attack	Means
False alarm rate or False positive (FP)	Number of detected attacks, but it is normal
True positive (TP)	Number of detected attacks, and it is in actuality attack
False negative (FN)	This type of attacks is the aim of intrusion detection systems (IDSs)
True negative (TN)	Number of detected normal instances, and it is really normal

4 Artificial Immune System (AIS)

Artificial immune system (AIS) which is encouraged by the human immune system (HIS) has been applied for solving difficult computational problem in pattern recognition, classification, and optimization. The main task of a human immune system (HIS) is to protect the body from foreign molecules that called antigens. AIS is computational programming that carries out data manipulation, calculation and uses representation methodologies that are based on mechanism of HIS. Computational algorithm of AIS is:

(1) Clonal selection
(2) Negative selection algorithm
(3) Danger theory
(4) Immune network model.

In this proposed method, negative selection algorithm [5] is used and it is the computational algorithm of self (normal)-/nonself (abnormal)-discrimination. This algorithm generates detector set and monitoring process detector set.

Negative Selection Algorithm [7]

Algorithm
The procedure for negative selection algorithm is as follows:
Input S_{seen} = set of seen known self-elements
Output: D = set of generated detectors

Begin
Repeat

- Randomly generate potential detectors and place them in a set P.
- Determine the affinity of each member of P with each member of the self-set $S_{seen.}$
- If at least one element in S recognizes a detector in P according to a recognition threshold, then the detector is rejected; otherwise, it is added to the set of available detectors D.
- Until stopping criterion has been met.

End

Detector generation process can be understood by the following chart, where detectors (R) are complement of self-strings (S) which show normal state of the system (Figs. 3 and 4).

In monitoring process, detector set (R) generated in the previous phase is matched with the newly produced string. If this string is present in the detector set, then it can be nonself-elements.

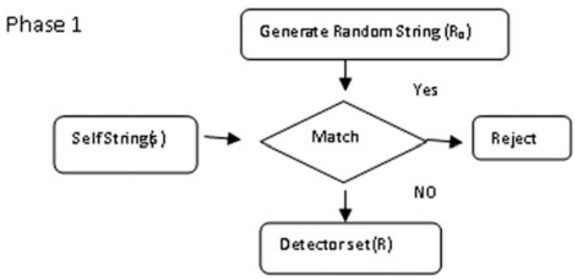

Fig. 3 Generating detector set

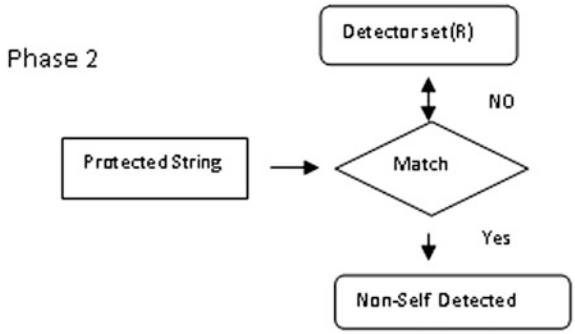

Fig. 4 Monitoring algorithm phase

5 Literature Review

Forrest et al. [8]: This paper describes a technique for change detection which is based the creation of *T* cells in the immune system. This shows how the method applied to the problem of computer viruses. Dasgupta et al. [7]: This presents a technique that is inspired by the negative selection mechanism of the immune system that can detect foreign patterns in the complement (nonself) space. GonZalez and Dasgupta [9]: This paper describes a real-valued representation for the negative selection algorithm and its applications to anomaly detection. Zhengbing et al. [10]: This paper discuss the intrusion detection and comparison of several paper. Tiwari et al. [11]: In this paper, comparison is made in 23 papers for finding out the situation of intrusion detection nowadays.

Lingxi et al. [12]: This paper introduces dynamic anomaly detection algorithm with NSA named as DADAI; it is a generic anomaly detection model. This paper describes the data mining approaches which detect the intrusion in network [13]. Alsharafi and Omar [14]: This paper introduced a detector-generating algorithm to generate effective detectors which lead to improve the standard of NSA, which in turn leads to improve the NSA-based anomaly intrusion detection. Results show that the improved algorithm able to generate more effective detectors and keeping the space and time complexities better than the standard of NSA. Shikha and Jitendra [3]: This is the survey paper. It reviews the various data mining techniques for anomaly detection. Freitas and Timmis [15]: This paper advocates a problem-oriented approach for the design of artificial immune systems (AISs) for data mining.

6 Proposed Methodology

In proposed work, use of negative selection algorithm for discrimination in self (normal)- and nonself (abnormal)- contents and apply the classification model of data mining. Classification is the supervised learning.

Figure 5 shows a new model for anomaly detection process by NSA and classification algorithm by three phases. Phase 1 and Phase 2 are NSA algorithm of AIS, and Phase 3 is classification algorithm of data mining. Phase 1 generates the detector set. In the detector generation process detectors (*R*) are just complement of self-strings (*S*) which shows normal state of the system. In the Phase 2 monitoring process, detector set (*R*) generated in the previous phase is matched with the protected or newly produced string. If this string is present in the detector set, then it can be stated as nonself-elements. In Phase 3, apply the classification algorithm of data mining for anomaly detection in nonself-detected data get by NSA in the

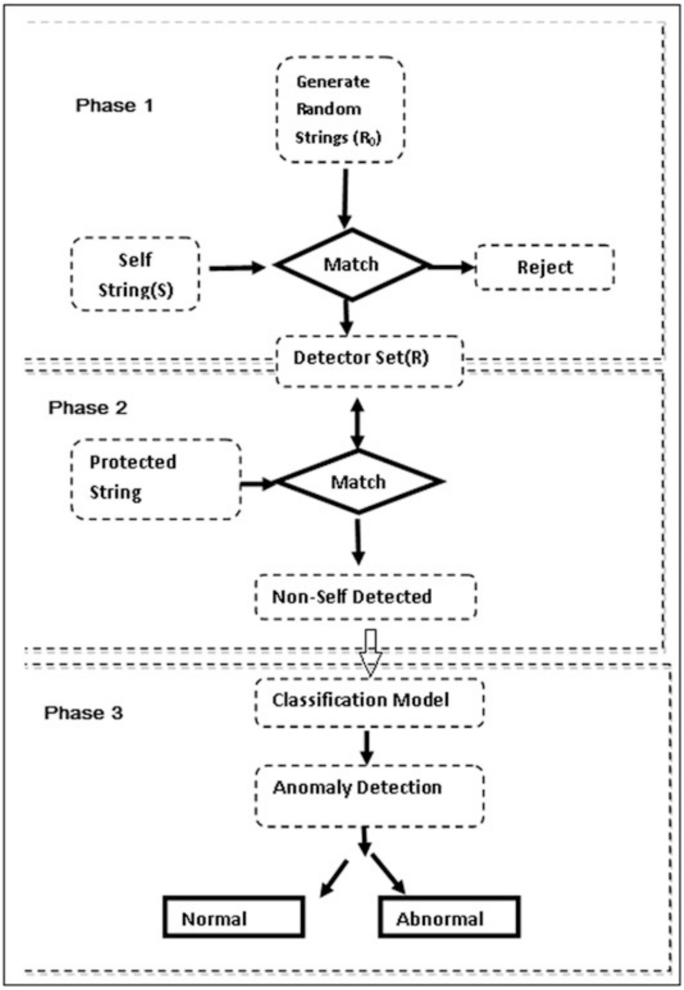

Fig. 5 A new model for anomaly detection process by NSA and classification algorithm

previous two phases. Anomaly detection is classifying the data into two categories normal or abnormal.

The proposed work include the following tasks-The required data will be gathered from the standard data set then artificial immune system and data mining literature will be reviewed after review the training of the data set will be done with method of artificial immune system then apply the classification method of data mining for anomaly detection. Then implementation of the model with random data set will be analysed and result will be evaluated and comparison will be done.

7 Conclusions

Proposed approach developing the model which detects the anomaly using artificial immune system and data mining. In future, this model will also applicable various applications. The expected outcomes of the proposed model will be able to produce a good approximation of the structure of the self-/nonself-space. It will help to improve the anomaly detection accuracy and also improve the NSA's efficiency. Complexity will be observed, and it will be able to achieve high-detection rate and low-false alarm rate, self-learning, and adaption.

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A Framework for Weblog Data Analysis Using HIVE in Hadoop Framework

Pushpendra Kumar and Ramjeevan Singh Thakur

Abstract Web usage mining is the application of web mining, which performs analysis of user click-stream data. As growth of Internet users is increasing rapidly hence to gather information, analyze user behavior from click stream can be helpful to recommendation system and intelligent e-commerce applications. This paper presents the analysis of weblog data using Apache Hive which is Hadoop ecosystem.

Keywords Web mining · Web log analysis · Hadoop · MapReduce Hive

1 Introduction

Nowadays, World Wide Web is the most effective and interactive ways of broadcasting information which leads to unexpected growth of web logs. In today's digital competitive business environment, web service providers are enthusiastic to know whether they provide the best service/product to customers or not. Web service providers should require knowing how to make their web application attractive to buyers and how to enhance advertising strategies to attract them [1]. Answer of such types of question can be found by analysis of log files. Log file is a file that stores all the activities performed by the web user. Web mining is the application of data mining on web data which is used for extraction of exciting and constructive facts and inherent information from actions related to the WWW [2].

P. Kumar (✉) · R. S. Thakur
Department of Computer Applications, Maulana Azad National Institute of Technology, Bhopal, Madhya Pradesh, India
e-mail: pushpendra7589@gmail.com

R. S. Thakur
e-mail: ramthakur2000@yahoo.com

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Web mining can be categorized into web content mining, web structure mining, and web usages mining [3, 4]. Data in the web pages that are designed to convey to the users is called web content. The process of extracting useful information from the web content is called web content mining. Web structure mining uses hyperlinks between websites to gain information. Web usages mining focuses on development of technique that could predict user behavior from web logs. There is a problem in analysis of web log is that a single computer cannot manipulate weblog adequately to meet the demands of the people [5, 6]. A Hadoop-based weblog analysis method uses Hadoop ecosystem to process all the aggregated logs as well as to carry out a different parallelization study that resolves the challenges of traditional setups, such as simultaneous data handling and collection of data, also reduces the congestion efficiency of computing power as well as depository volume, saves the processing time, and increases the effectiveness [5].

2 Related Work

Some author has worked in order to know any existing queries of organization such as no. of hits per hour, top most visitors of web site, server error, and visit stay length.

Neha and Jha [7] have presented the study of web access log data using the automated web analyzer tool called web log expert to know the behavior of users who access an astrology web site.

Brijesh and Ghanshyam [8] have presented the analysis of web usage mining data for which web log analyzer tool "Deep Log Analyzer" is used to find out ideal information from particular server and also developed an ontology which consists the relation among efficient web apart of web usage mining.

Pushkar et al. [9] have proposed a system which is useful for processing of web server logs that can help in examining traffic on the different web site and help developers of the web site to make changes accordingly as per results of analysis using Hadoop ecosystem Flume.

Milind et al. [10] have proposed generic log analyzer using Hadoop MapReduce framework that can analyze different kinds of log files such as e-mail logs, web logs, firewall logs, server logs, call data logs.

Vinod and Ramjeevan [11] have proposed a paper that will help to analyze the set of tools currently available and help to hook the right tool for analyzing logs of a particular organization.

Jaya and Alagarsamy [12] have analyzed web log expert tool which will give you information about your web site visitors: accessed files, paths through the site, activity statistics, information about referring pages, search engines, browsers, operating systems.

3 Hadoop MapReduce

Hadoop is a distributed software framework which is written in Java majorly used for storing and processing of huge amount of data and works on top of commodity hardware [13]. It is an open-source framework which is developed by the Apache Software Foundation [14]. It is designed to work with from a single server with thousands of computational independent computers and petabytes of data. Hadoop is consisting of mainly two parts:

3.1. HDFS
3.2. MapReduce Framework

3.1 *Hadoop Distributed File System (HDFS)*

The Hadoop file system is developed using distributed file system design [5, 15], and it is responsible for storing huge amount of unstructured data. Unlike other distributive systems, HDFS is highly fault-tolerant because HDFS replicates files for a number of times and re-replicates automatically for that data block on nodes that have failed and designed to run on commodity hardware. With the help of HDFS, we can create, copy, and delete, but cannot update a file. The architecture of HDFS is shown in Fig. 1, which consists of three elements.

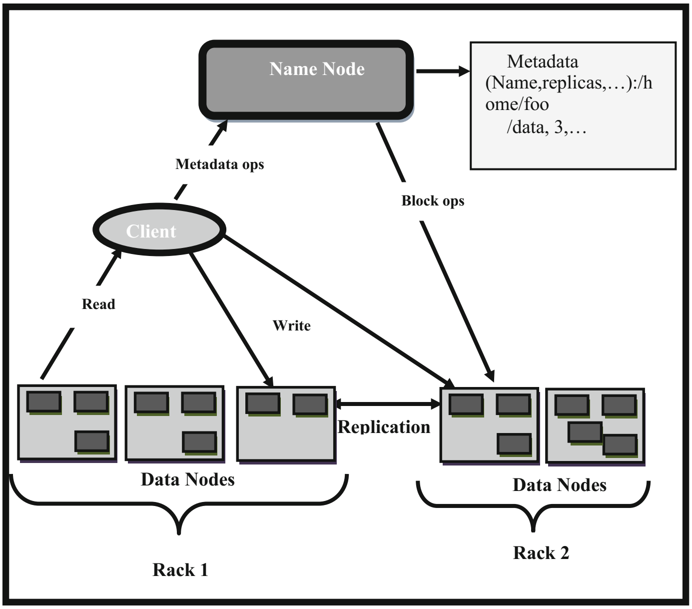

Fig. 1 Architecture of HDFS

Name node: The name node is software that can be run on commodity hardware. There is only one name node in the cluster. The system having the name node performs as the master server, and it stores all the metadata for the file system. This information maintained by the name node is needed for fetching data spread within the Hadoop cluster across many computers.

Data node: The data node is commodity hardware where the actual data resides. A data node is present for each node in a Hadoop cluster. Data nodes execute reading and writing operations upon file setups, as per user request. Data nodes carry out the activities like creating a block, deleting a block, as well as replicating a block as per name node command. All data nodes send a special signal called heartbeat to the name node in every 3 s to say that they are alive. If the name node does not receive this signal from any data node for 10 min, then it considers that data node to be dead and name node initiates replication of blocks which were hosted on that data node.

Block: Hadoop distributed file system stores the data in terms of blocks. A block is the smallest data quantity which is favorable for reading and writing by HDFS. By default, the size of a block is 64 MB. It is possible to extend it if we want to implement a modification while configuring HDFS.

3.2 MapReduce

MapReduce is a core component of the Hadoop framework for easily writing applications which process huge amounts of data in parallel by dividing a job into a set of an independent job in a reliable and fault-tolerant manner. The architecture of MapReduce is shown in Fig. 2.

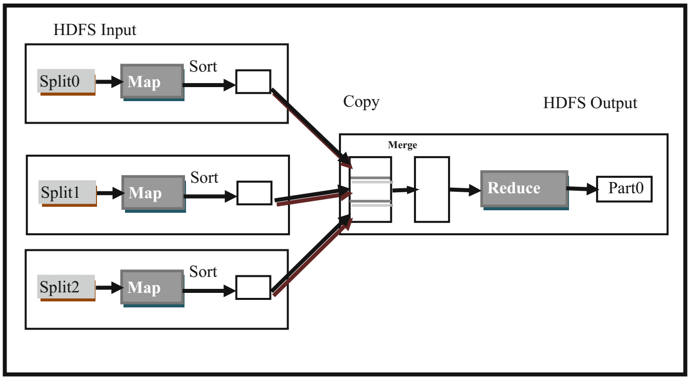

Fig. 2 Architecture of MapReduce

Map stage: The job of mapper function is to process the input data; the map function is written by the user. The input file is passed to the mapper function line by line and produces a set of key/value pairs.

Shuffle and sort phase: The shuffling is the process by which the system performs transferring data from the mappers to the reducer. This phase works after the Map phase and before the beginning of the Reduce phase. In other ways, the shuffle is called the heart of MapReduce.

Reduce phase: The Reduce function is also written by the user. This function receives the various results and merges all intermediate values associated with the same key to answer the larger problem that the master node needs to solve. No reduction can begin until maping is completed.

4 Proposed Approach

In our proposed approach, we are using Apache Hive for log data analysis. Hive is a data warehousing technique which is constructed on top of the Hadoop to manage and process structural data. To work with Hive, there is no need to learn any additional language. It works with SQL-like queries called Hive Query Language (HQL).

In Fig. 3, we have raw data, and this data is in the unstructured format, so we cannot perform any analysis or apply any technique on this data; to overcome this problem, first of all, we have to preprocess this raw data and convert it into our desired format. Here, we are using some preprocessing technique for converting raw data into a structured format. After preprocessing the raw data, we are using Apache Hive for analysis of the structured weblog data and obtaining results as a user and number of times visited by that user to the web site. We are also determining the top *K* visitor count of the web site.

5 Conclusion

This paper presents a detailed look about the weblog analysis using the Apache Hive, a Hadoop ecosystem. Apache Hive works for heavy structured datasets giving efficient results in less time than other weblog analysis tool. This result helps a business organization to recommend a new product to the top *K* visitor of the web site. In the future, we can analyze different parameters of weblog such as time spent by a user on a particular page, username, and referrer. Our proposed approach is beneficial for advertisement or recommendation for the particular user.

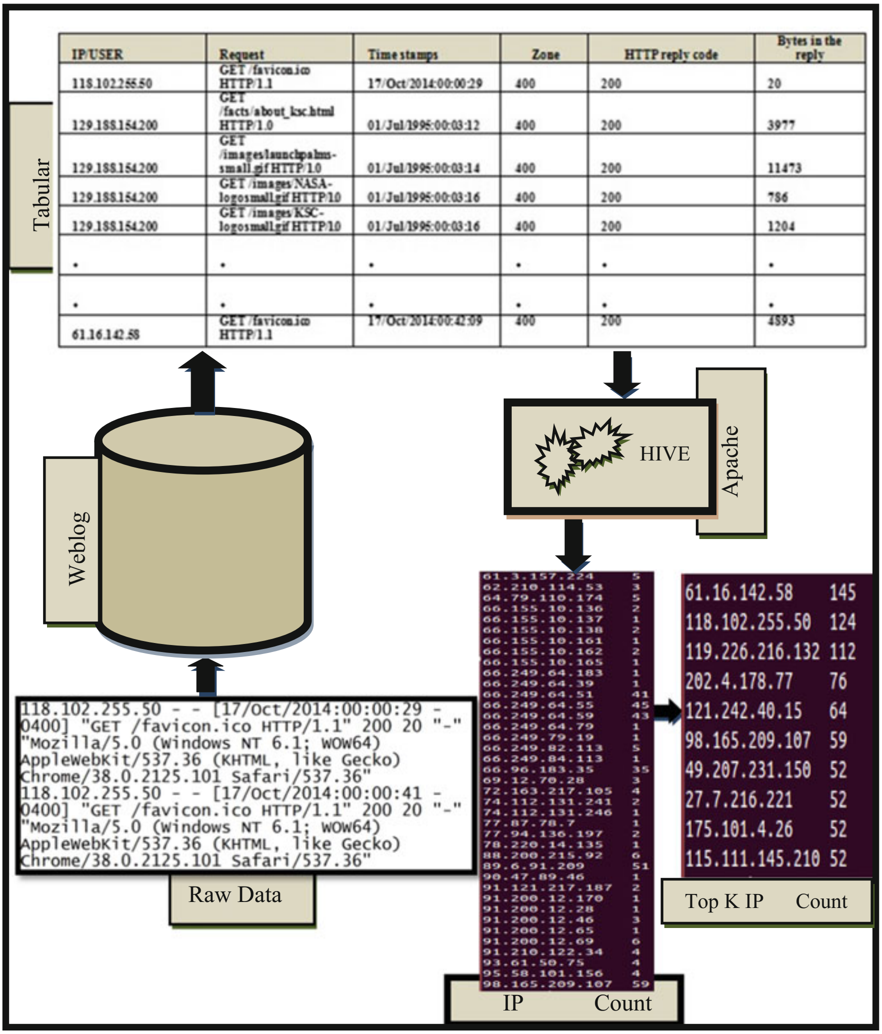

Fig. 3 Framework for weblog analysis

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Sentiment Analysis Using Lexicon and Machine Learning-Based Approaches: A Survey

Binita Verma and Ramjeevan Singh Thakur

Abstract Sentiment analysis is the process of automatic identification of people's orientation toward individuals, products, services, issues, and events. Task of sentiment analysis requires mining of textual data through natural language processing (NLP). Text method of communication like tweets blog is necessary to examine the emotion of user by studying the input text. Sentiment analysis of social networking sites is a way to identify the user's opinion. Determination of opinion and strength of the sentiment of user toward entity is growing need of current times. In this paper, a survey on sentiment analysis is done. Text reviews, techniques, lexicon, and machine learning approaches are discussed.

Keywords Sentiment analysis · Machine learning technique · Lexicon-based technique · Hybrid technique

1 Introduction

Social media has turned into another correspondence channel between consumers and organizations. From social networking sites like Twitter, Facebook, Tumblr users are provided with a platform to publish and express their emotions, views, and likings about various topics, people, product, and services. Traditionally, text and reviews are collected through questions are prepared by researcher. This method of data collection was time consuming and difficult to manage. With the advancement of technology and Internet, consumer is using social media to provide feedback and comments in form of unstructured text. Opinions expressed in social media can be

B. Verma (✉)
BU, Bhopal, India
e-mail: vinu_v05@rediffmail.com

R. S. Thakur
Department of Computer Application and Mathematics,
Maulana Azad National Intitute of Technology, Bhopal, Madhya Pradesh, India
e-mail: ramthakur2000@yahoo.com

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classified to determine the orientation (negative, positive, neutral) of the posted text. Sentiment strength and intensity of the post is determined with the aim to identify opinion and emotion of the user about a specific product or service. To analyze the text and reviews, sentiment analysis is used.

Social networking sites are required to keep customers happy to overcome the competition and retain them. One way to achieve customer satisfaction is to be able to present and display the products of customer's interests, inform them about upcoming sale on products of customer's interests, suggest them with new products similar to user's preference studied on social sites. The contents of the social Web are dynamic and quickly changing to reflect the social and emotional ups and downs of users [1].

Recently, one of the most popular sources of personal opinion about any topic people or product is blog. As the demand of internet increases, the blog pages are also growing at a great rate. For sentiment analysis, blogs are used as a source of opinion available in social Webs. For a consumer review sites are helpful to speculate about the product or services which is available on the internet [2].

Nowadays, users spend their time on social media sites like Twitter, Orkut, Tumblr, MySpace to create short messages to be posted that can be used as data source for sentiment classification.

2 Related Work

Process flow of sentiment analysis is shown in Fig. 1. Information obtained from various papers that are related to sentiment analysis.

Hanen and Salma [3] suggested linguistic approach of sentiment classification by using lexicon words. Large data corpus was collected from using Facebook API. They demonstrated automatic technique for compiling and collecting words in

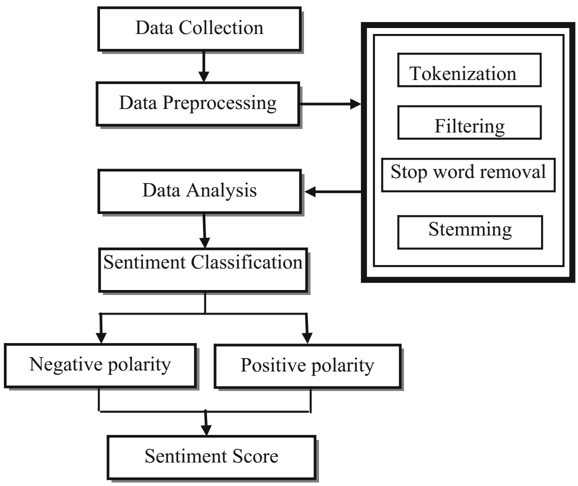

Fig. 1 Process flow of sentiment analysis

corpus into positive and negative dictionaries. They updated the dictionary by exploiting emotion symbols like emoticons, acronyms, and exclamation words.

Augustniak et al. [4] presented fast and efficient approach for extracting lexicon using bag of words (Bow) for sentiment determination. They combined the word frequency measure approach to build lexicon with ensemble method, exploiting the efficiency provided by machine learning, and performance provided by lexicon-based methods.

Dang et al. [5] proposed a framework with combination of machine learning and lexicon-based approach for sentiment classification to improve the performance of sentiment classification.

Goodarzi et al. [6] proposed lexicon-based framework for sentiment analysis of citation on research contents. They determined sentiment orientation, polarity, and strength. They also compared the performance of SentiWordNet, Bing Liu, and AFINN lexica for PubMed schema-based research contents.

Liu et al. [7] presented scalable implementation of Naive Bayes algorithm to analyze sentiment sentences of millions of movie reviews. They build big data analyzing system using simple mapreduce analyzing jobs and workflow controller (WFC), user terminal, result collector, and data parser.

3 Sentiment Analysis

Sentiment analysis is a way to determining whether the given sentence or document is positive negative or neutral. It derives the opinion or attitude of a speaker. Sentiment analysis aims to determine the polarity of users opinion on a certain topic or a whole document.

Sentiment text available on social networking sites is composed of 3 Os [8]

- Opinion Holder: User who provides his view/opinion.
- Object: Entity about which view is presented.
- Opinion: Actual view present in form of text.

3.1 Techniques of Sentiment Classification

Sentiment classification [9] also known as the polarity classification of identifying and designating of certain opinion based on the polarity such as positive or negative opinion. A sentiment analysis is a technique of analyzing and studying the subjective information from large texts.

Technically, following are ways to perform sentiment analysis [10–12].

3.1.1 Machine Learning (ML) Approach

These learning approaches are based on building classifiers from labeled instances of textual posts. They perform well for the domain on which they are trained.

Machine learning can be divided into two approaches [12].

a. **Supervised learning**

The supervised learning approaches use labeled training documents. Supervised learning is based on automatic text classification. A labeled training set with pre-defined category is used. A classification model builds to predict the class of document based on pre-defined category [12, 13].

Supervised learning algorithms are [13].

1. Probabilistic classifiers like Naïve Bayes, Bayesian network maximum entropy.
2. Linear classifiers determine good separators with can best separate the space into different classes. Most famous linear classifiers are support vector machine (SVM) and neutral network.
3. Rule-based classifiers divide the data into set of rule. Rule in the form of "IF condition THEN conclusion" is generated during the training phase. Decision rules classification method classifies documents to annotated categories.
4. Decision tree classifiers build a hierarchical tree-like structure with true/false queries based on categorization of training document.

b. **Unsupervised Learning**

Unlike supervised learning approaches, unsupervised learning approaches do not depend on the domain and topic of training data. Unsupervised learning approaches overcome the difficulty of collecting and creating labeled training data.

3.1.2 Lexicon-Based Approach

Lexicon-based sentiment analysis of text is a data analysis task performed by employing opinion words and phrases with no prior knowledge Opinion bearing words are compiled and collected. Positive and negative words along with opinion phrases are collectively called opinion lexicon. Lexicon-based approach used lexicon and unlabeled data [14]. Words in the text are evaluated based on opinion lexicon to determine their orientation and henceforth the sentiment of the text. Opinion lexicon generation is crucial to lexicon-based sentiment analysis process. Generation of opinion lexicon is generally performed using one of the three approaches [12, 13].

a. **Manual Approach**—Opinion words are collected manually based on individuals domain knowledge and language understanding. This is a time-consuming process. This approach is mostly combined with automated approaches to improve on mistakes done by automated approaches.

b. **Dictionary-Based Approach**—Opinion words with known orientation are collected from lexicographical resources like online dictionary. It uses synonyms, antonyms, and hierarchies in opinion lexicons to determine word sentiments. Since there is no knowledge of domain, dictionary-based approaches have limitations on identifying context-specific sentiment. The dictionary used may be WordNet, SentiWordNet, secticNet, sentifull, and others [15].
c. **Corpus-Based Approach**—Corpus-based approach exploits the syntactic pattern of co-occurrence words along with opinion words to identify and compile opinion words in large corpus. Corpus-based approach eliminates limitation of context-specific classification of opinion words in dictionary-based approach. However, dictionary-based techniques are more efficient. Corpus-based approach used labeled data [16].

3.1.3 Hybrid Approach

Hybrid technique is the combination of both lexicon and machine learning approaches. Researchers proved that the combination of both the approaches gives improved performance of classification [17]. The advantage of hybrid approach is it makes the detection and measurement of sentiment at the concept level, and high accuracy from a powerful supervised learning algorithm [18] (Table 1).

Table 1 Sentiment analysis techniques and their approaches

Name of the technique	Sub-technique	Approaches	Type of data	Pros & cons
Machine learning technique	Supervised technique	Naive Bayes	All data is labeled and the algorithm learn to predict the output from the input data	Easily create trained model for given purpose
		SVM		
		Maximum entropy		
		Bayesian network		Labeled data could be costly due to this applicability of new data low
	Unsupervised technique	Neural network	All data is unlabeled and the algorithm learn to inherent structure from the input data	
		Semantic orientation		

(continued)

Table 1 (continued)

Name of the technique	Sub-technique	Approaches	Type of data	Pros & cons
Lexicon-based technique		Manual approaches	Lexicon and optionally on unlabeled data	Covered wide range of terms
		Dictionary based	Lexicon and optionally on unlabeled data	Lot of words in a lexicon and assign sentiment scores to each word
		Corpus based	Labeled data	
Hybrid technique		Combination of machine learning and lexicon-based approaches	Labeled data and lexicon, optionally with unlabeled data	Concept-level measurement of sentiment and lesser sensitivity to change in topic domain
				Noisy data

4 Conclusion

This survey paper presented an overview on the various classification techniques, and their methods of sentiment analysis. Every kind of classification techniques has its own advantages and disadvantages. Machine learning techniques like supervised learning methods are better than unsupervised learning methods. In future, we have analyzed various machine learning algorithms can be applied in datasets which can analyze the sentiments.

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A Survey on Hyperspectral Image Segmentation Approaches with the Integration of Numerical Techniques

Satish Kumar Soni, Ramjeevan Singh Thakur and Anil Kumar Gupta

Abstract Technological advancements in various sectors of science and IT-enabled services have broadened the spectrum and quantum of data in very large scale. The picture is even more furious than assumptions, and a huge volume of static and dynamic data is being produced every second by various means such as air traffic control systems, remote sensing and GPS satellites, social media, imaging techniques used in medical radiology and so many other datasets in the form of texts, images, audios, videos, etc. Same way, a very rich dataset is generated by ultra-sensitive electronic sensors which are used in modern imaging systems, known as hyperspectral images. This data may give variety of information, useful for solving the problems of real world, but gathering or extracting meaningful information from that much data are as difficult as 'getting the needle from a haystack.' Machine learning approaches have been proven to be useful for analyzing large datasets of various types and formats. This paper is an honest effort of presenting a comprehensive survey of various machine learning approaches like clustering along with numerical methods used by researchers worldwide for analyzing hyperspectral image data.

Keywords Machine learning · Datasets · Hyperspectral images
Numerical techniques

S. K. Soni (✉) · A. K. Gupta
Department of Computer Science and Applications, Barkatullaha University, Bhopal, India
e-mail: satishkumarsoni15@gmail.com

A. K. Gupta
e-mail: akgupta_bu@yahoo.co.in

R. S. Thakur
Department of Mathematics and Computer Applications, Maulana Azad National Intitute of Technology, Bhopal, Madhya Pradesh, India
e-mail: ramthakur2000@yahoo.com

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1 Introduction

The pace of revolution in information technology has changed the way of communications among persons, devices, human-machine and cloud computing and also drastically changed the way of using IT resources. Now, the world is full of bulk data of homogenous and heterogeneous nature. Since, storage of huge datasets is not an issue because of easy availability of economical storage devices and various free cloud storages available in the market like Google drive, Wuala, Zoolz, OneDrive, and Rackspace. However, analyzing these huge datasets is a big issue nowadays.

Hyperspectral images are the resources of a very rich dataset which is generated by ultra-sensitive electronic sensors that are used in modern imaging systems, known as hyperspectral images. Hyperspectral imaging gathers and processes knowledge from almost all of the electromagnetic spectrum. The main purpose of hyperspectral imaging is to obtain the band for each pixel in the image of a scene, with the purpose of finding things, identifying materials or detecting processes [1, 2]. It is figured that hyperspectral sensors gather information as a set of 'images.' Every part of image characterizes a fine wavelength range of the electromagnetic spectrum, also identified as a spectral band. These 'images' are combined to form a three-dimensional (a, b, λ) hyperspectral data cube for processing and exploration, where a and b represent two spatial dimensions of the scene of an image, and λ represents the spectral dimension [3]. This type of data may give variety of information, useful for solving the problems of farming, eye care, food processing, mineralogy, surveillance, astronomy, biological imaging, environmental science, and other real world, but gathering or extracting meaningful information from that much data are as difficult. A very important task in hyperspectral data processing is the segmentation of spectral images without any loss of generic information. Various researchers have discussed about the use of clustering techniques for segmentation of hyperspectral images [4–6].

Clustering approaches can be used in two ways: Supervised learning which is based on number of clusters to be generated from the datasets is predefined; in unsupervised learning or probabilistic learning, the number of clusters to be generated is not decided in advance, and author in [7] has discussed about the use of unsupervised clustering with an application to hyperspectral images. In [8], author has presented a brief analysis of various area in which clustering algorithms can be used to draw useful information. Whereas in [9], authors have presented an approach using weighted features for cluster space analysis using HyMap data. In [10], authors have tried to investigate data mining-based techniques for processing and analyzing the data for useful information extractions, and for better results and accuracy, least squares method has been proposed for clustering approach as least square which is applicable on most of the datasets available today. This paper will try to explore various spectral image segmentation approaches with the integration of numerical methods in analysis of hyperspectral images for efficient classification and extraction of knowledge.

2 Hyperspectral Image Processing

Hyperspectral images produced by various sources are very useful in research areas like pattern matching, computer vision, information retrieval, and image processing (Remote Sensing). High spectral images are usually images of high wavelength which is recorded from visible wavelength to infrared wavelength capturing all together hundreds of spectral bands (channels) [6, 9]. These images are different from usual images captured from mobile camera or other camera devices, whereas the processing of normal images is simple task, high spectral image processing is bit complicated. The process of normal image processing depicted in Fig. 1 and the process of hyperspectral image processing as a framework of IT-based hyperspectral image processing are depicted in Fig. 2.

For capturing hyperspectral images, sensor-based network is used, and image datasets collected by the sensor are represented as vector of specific wavelength [6]. Presently, hyperspectral images are used in various areas like military application, geological sciences, and hydrological sciences. Figure 2 depicts the framework of IT-based hyperspectral image processing [6, 10, 11].

Steps in Processing the Hyperspectral Images

1. Input from various sources captured by sensors placed at different locations.
2. Image datasets obtained from sensor are placed in different bands.
3. Dimensionality reduction approaches are applied to these bands for reducing band size.
4. Reduced band sizes are merged or fused, and a single image is obtained.

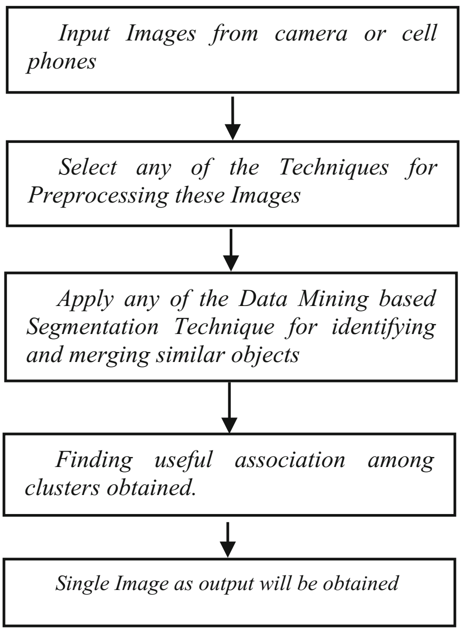

Fig. 1 Process of normal image processing

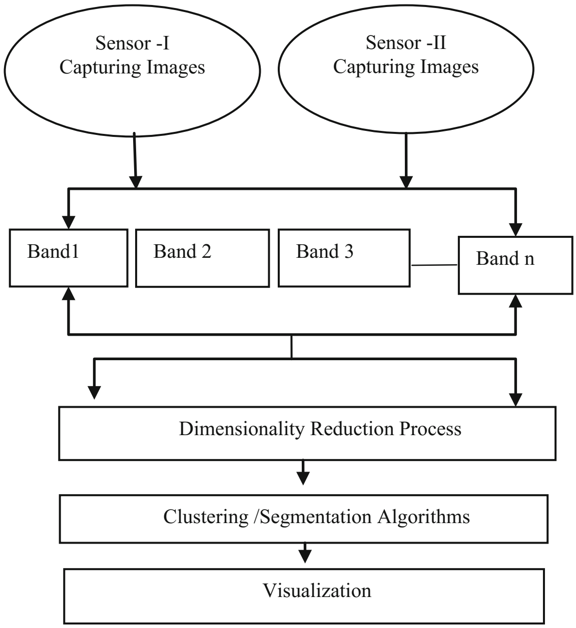

Fig. 2 Process of hyperspectral image processing as a framework of IT-based hyperspectral image processing

5. Partitioning the pixels of image so obtained into multiple regions based on their similarity in features.

Analysis of hyperspectral images is very useful in many aspects like early detection of stages of complicated diseases, accurate weather forecasting, mineral detections, and target detection in defense sectors [6].

Dimensionality Reduction Approaches

In fact, hyperspectral datasets contain thousands of bands consisting of fine spectral resolution and spatial information and in this large volume of all of the bands are not usually useful and also sometimes, it is difficult to store these bulk datasets.

Here, dimensionality reduction techniques are used to reduce the dimension of such datasets by removing redundant band using supervised and unsupervised approaches. Various metrics are used for selecting useful bands among these huge datasets [6].

Euclidean Distance

Since data collected by sensor are represented in the form of vector, Euclidean distance can be applied for finding related Bands for selection.

Say A and B be two vectors then Euclidean distance between is given as

$$E_{\text{Euclidean}} = \sqrt{\sum_{k=1} (A_i - B_i)^2}$$

where A_i and B_i denote various points, and lesser the distance among vectors indicates closeness of bands for merging as single band.

Spectral Angle Mapper and Spectral correlation Mapper

It is an approach in which an angle is measured between two vectors *A* and *B,* and spectral correlation mapper is a correlation measure which measures the strength of the linear relationships between two vectors.

3 Clustering Approaches for Segmentation

Clustering techniques partition the data into certain number of clusters by taking into account internal homogeneity and external separation, which means that the pattern in same cluster should be similar to each other while pattern in different cluster should be dissimilar [8]. For measurement of similarity and dissimilarity measures among the clusters, various measures have been used which include Minkowski distance, Euclidean distance, Pearson's correlation, cosine similarity, Mahalanobis distance, and point symmetry distance [4, 5, 8] etc.

Various clustering approaches have been used on high- and small-dimensional datasets. For high-dimensional datasets, various algorithms like CURE, DENCLUE, FC, CLIQUE, OptiGrid, and ORCLUS are usually used, and K-means clustering, hierarchal clustering, BIRCH, DBSCAN, and CLARANS are used for small-dimensional datasets [8]. Among numerical techniques, Runge–Kutta technique has been used to reduce the gap between two clusters so that Euclidean distance metrics give better results. Similarly, bisection methods have been used in integration with clustering algorithms to find clusters falling in same intervals. Brief details of data mining techniques in integration with numerical techniques are depicted in Table 1.

From the table, we analyze that most numerical techniques have been used in classification of various datasets.

In Table 2, brief description about the data mining techniques in hyperspectral images used is given.

Table 1 Data mining techniques in integration with numerical techniques [12, 13]

Techniques	Datasets	Efficiency
Multivariable linear regression	Numerical and nominal data	Reducing a high-dimensional feature space to a smaller dimension still retains significant characteristic knowledge
Transformation approach for Boolean attributes	Boolean datasets	Boolean attributes do not disclose any private information
Classification by using fuzzy rules	Students datasets of various universities	More efficient than others in terms of performance
Human behavior modeling and data mining to predict human errors	Numerical datasets	Outperformed benchmarking scenarios

Table 2 Data mining techniques in hyperspectral images [14–16]

Techniques	Datasets	Efficiency
2-D extension to singular spectrum analysis	Hyperspectral imaging datasets	Effective spatial-spectral feature extraction and dimension reduction in HS
Compressive sampling of multichannel signal datasets	Acquisition of the hyperspectral images	An accurate, low cost, and fast recovery
Probabilistic graphical model	Hyperspectral image (HIS)	Significant improvements over existing approaches in classification

The table depicts that in analysis of hyperspectral images, numerical techniques have played very crucial role by improving the result. The comparison is made on the basis of efficiency of different techniques and applicable datasets. There are different parameters which can be obtained from different hyperspectral images for identifying numerous components and the objects in images.

4 Conclusion

In this paper, we have presented an approach to deal with hyperspectral datasets using clustering algorithms and the process of analysis is divided into two stages, which includes dimensionality reduction and segmentation. In fact, image fusion techniques, which is not mentioned, also come as a part of the process. It has been seen that integration of numerical techniques has improved the cluster analysis process. We have seen that in classification of various types of datasets, numerical techniques have improved the result obtained. We propose to integrate numerical techniques in hyperspectral images as correct and efficient prediction of hyperspectral datasets that can result in useful decision making in various segments depending upon types of hyperspectral images.

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An Efficient Image Enhancement Method for Dark Images

P. V. V. S. Srinivas, Lakshmana Phaneendra Maguluri and Maganti Syamala

Abstract Image enhancement is a technique to give a better quality of an image in terms of its clarity, brightness, and to give the human eye comfortable to look at. There are different types of techniques to give good quality to an image. Global image contrast enhancement is one of the most commonly used techniques to enhance the quality of an image, but it has some disadvantages with the fact that it does not consider the local details of an image, that is the detailed texture of an image. In local contrast enhancement, it addresses the local details of an image and preserves the local details of the image. Local details of an image are very important while analyzing an image, which is that of the scientific study of an image like the image taken from planetary bodies, satellite image, and also in medical images. Local details of an image are very important for diagnosing a particular ailment. When we used either local contrast enhancement or global contrast enhancement alone, we faced the loss of brightness of the image. In order to address and reduce this discrepancy of individual enhancement methods, a new proposal that uses both these methods on the same image. First, the image is locally enhanced and the output is again processed by the global enhancement method, thereby giving a properly enhanced image without losing the brightness of the image. This enhancement method is simulated in MATLAB, and results are verified on the parameters of image.

Keywords Image enhancement · Image sharpening · Unsharp masking Global contrast stretching · Local contrast stretching

P. V. V. S. Srinivas · L. P. Maguluri (✉) · M. Syamala
Department of Computer Science and Engineering, K L University, Green Fields, Vaddeswaram, Guntur 522502, Andhra Pradesh, India
e-mail: phanendra51@gmail.com

P. V. V. S. Srinivas · L. P. Maguluri · M. Syamala
Dhanekula Institute of Engineering and Technology, Ganguru, Vijayawada 521139, India

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1 Introduction

The human visual perception of an image can be greatly affected by the contrast of an image. Contrast has defined as the difference in the pixel intensity value of a particular pixel to its neighboring pixels. If the difference in the intensity is more, then we can say that the contrast is more of that image. The more contrast gives us better clarity of an image in terms of local details. The more details in the local information of an image are very important if the image is of medical or astronomical for analyzing it and extracting information of that image and proper diagnosing of the ailments based upon the image of a cell. So with the advancement of science and technology, especially in the field of signal processing, the quality of an image can be enhanced so that it gives clear and detailed information about the image [1]. There are various techniques for enhancing the image quality, and many techniques have been proposed to address various aspects of an image over the years.

Since long back, many scholars have developed techniques for enhancing an image. The equalization of the histogram of an image for enhancement of the image is very common and effective. One single technique cannot be used as a universal technique that can be applied to all types of images [2]. One technique may give a very good result to a specific type of image but may not give a satisfactory result to another image.

Various contrast stretching methods have been proposed to enhance the image of leukemia, a medical image in [3]. When a dark stretch is performed, the bright portions of the image or the bright pixels are more brighten. A better way to address such problem is to enhance the dark regions by keeping the bright regions untouched [4]. They have shown the effects of various contrast stretching techniques like global stretching, local contrast stretching, and partial contrast stretching [5], and which one is best suitable for which type of image is studied. The problems of a blurred image, which is caused by the motion of the object while taking the image, and how to avoid, are presented in [6]. It also used local edge detection to de-blur the original image. In [7], the effect of application of both global and local contrast enhancements is studied on grayscale image, and only the brightness [8] parameter of the image has been studied. This method is being used on this paper on the dark color image, image enhancement parameters like mean and measure of enhancement [9] factor are calculated, and the output image is compared with the existing image enhancement techniques.

This paper is organized as follows: In Sect. 2, the image enhancement techniques are presented. Section 3 describes the methodology of the algorithm. In Sect. 4, the implementation of methodology and results is explained, and Sect. 5 concludes the paper.

2 Image Enhancement Techniques

Image enhancement techniques have been widely used to get a good quality of an image for the human interpretation. Image [10] enhancement techniques may be broadly classified as local image enhancement and global image enhancement.

2.1 Local Enhancement of the Image

The local enhancement is employed to get the minute details of an image. It enhances the local details in terms of the gradient of the image which gives useful information to the analyzer of the image. It addresses those pixels which would be ignored by the global method. The local enhancement method employed here is the unsharp masking. In this method [11], the image is sharpened by subtracting an unsharp that is a blurred or smoothed image from the original image, so the name unsharp masking is derived. In this method, the following steps are involved:

1. Blurring of the image
2. Subtracting the blurred image from the original image to make the mask
3. Adding the mask to the original image

If the blurred image is denoted as $b(i, j)$ and the image as $p(i, j)$, then the mask $m(i, j)$ is given according to Eq. (1)

$$m(i,j) = p(i,j) - b(i,j) \tag{1}$$

Then, a weighted portion of the mask is added to the original image to get the sharpened image $s(i, j)$ as given by equation

$$s(i,j) = p(i,j) + w * m(i,j) \tag{2}$$

where "w" is the weight, generally greater than zero. When the weight is equal to 1, it is the unsharp masking and when greater than 1, then it is called high-boost filtering.

2.2 Global Enhancement of the Image

The global enhancement of the image is used to increase the contrast of the image. In this process, each pixel of the image is adjusted so that it gives a better visualization of the image [5]. In spatial contrast enhancement, the operation is done on the pixel directly. Different methods can be used to improve the image quality. In HE, for the discrete image, the probabilities of the pixel value are taken. To take the probabilities, first the corresponding number of pixels should have a pixel intensity value; it is calculated and divided by the total number of the pixels present in the image. The probability of occurrence of pixel intensity level "k" in the digital image is given by Eq. (3)

$$p(r_k) = \frac{n_k}{N * M} \tag{3}$$

where $N * M$ is the total number of pixels in the image, and n_k is the total number of pixels having intensity level "k." The pixels are transformed per the following transformation equation in discrete form [8].

$$t_k = L(r_k) = (G - 1)\sum_{i=0}^{k} p(r_1) = \frac{G - 1}{N * M}\sum_{i=0}^{k} \tag{4}$$

where G is the highest intensity level or value, $L(.)$ is the transform function and k = 0, 1, 2, 3, …, $G - 1$. So the output image pixel is obtained by mapping each input pixel r_i to the new transformed value t_k. The processed output value may have fractional value so a rounding function to the nearest integer value is needed. While doing so, some of the image pixels may go to the new value and some of the intensity pixel values may not be present in the transformed image.

3 Methodology

Figure 1 shows the methodology to be incorporated in the paper to get a good quality image and algorithm of combining both local enhancement and global enhancement of a color image. It mainly consists of the following four steps:

Step 1 Get the color image and convert it into Hue Saturation and Value (HSV) color space and take the luminance of that image.
Step 2 Apply the local enhancement method to enhance the local details of image.
Step 3 The local output is again given as global input and perform global image enhancement.
Step 4 Recombine the components and reconvert it back to color image.

Here in order to enhance the local gradients or the local details, an existing local enhancement method has been used. Here, the unsharp masking is used as local details of enhancement method. As the name suggests, it uses the blurred image to make the mask and enhances the local details in the form of edge sharpening. The sharpened image is used as the input to the global enhancement method. The global enhancement method uses one of the global contrast stretching methods.

At first, a color image to be enhanced is taken, and it is converted to the HSV color space. From that color space the luminance portion is taken. The enhancement in the hue and saturation is not done. The enhancement of image [12] is performed

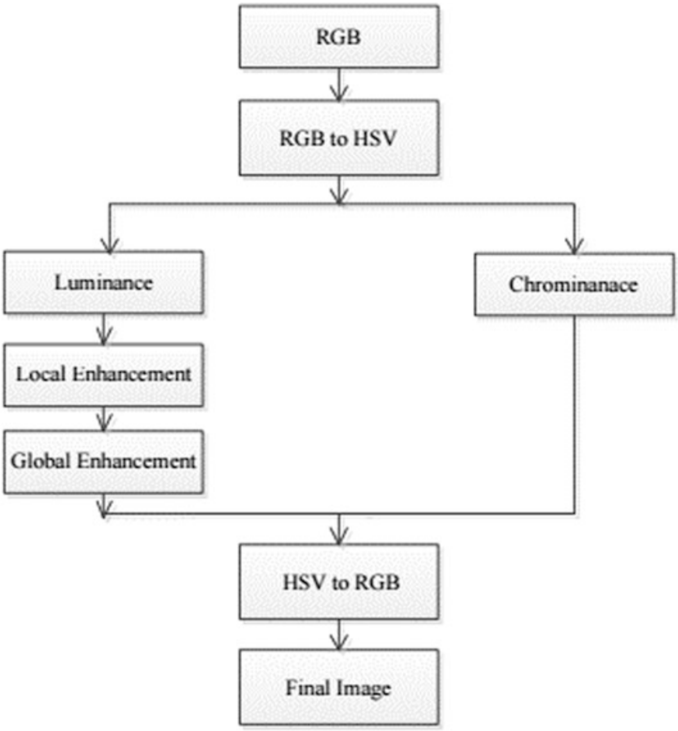


Fig. 1 Flow graph of the algorithm

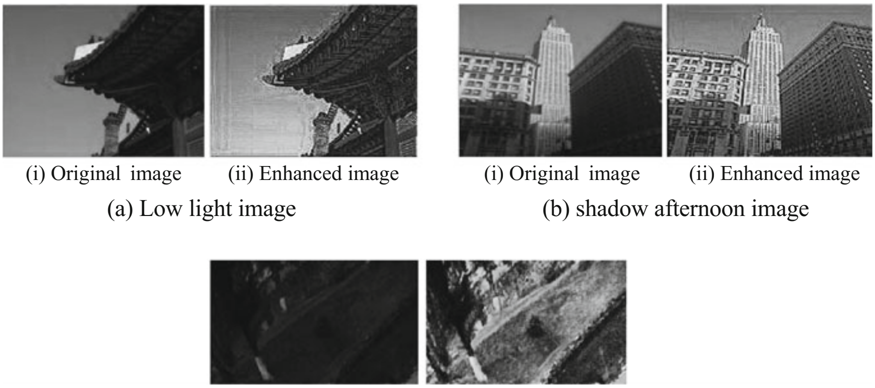
only in the luminance plane of the image. The local details of an image can be accessed or addressed through the luminance only.

4 Implementation and Results

To see the effect of the combination of local and global enhancement methods to a given image, the above-mentioned algorithm is applied to the image. The color image or digital color image to be enhanced is taken and converted to the HSV color space to apply the algorithm. The image plane slicing is performed, and the image is divided into three different planes each of hue, saturation, and value. To enhance the edges which is consider as the local features of an image, the local contrast stretching process, that is unsharp [13] masking, is applied. This is the first step of the enhancement method. At the end of this step, a locally enhanced image

Table 1 Comparison of input and output images

S. No.	Image name	Input mean value	Output mean value	MEF
1	Low-light image	0.37	0.42	1.75
2	Shadow afternoon image	0.38	0.4	3.05
3	Evening image	0.37	0.38	2.95



(i) Original image (ii) Enhanced image
(a) Low light image
(i) Original image (ii) Enhanced image
(b) shadow afternoon image
(i) Original image (ii) Enhanced image
(c) Evening image

Fig. 2 Input and output images of three different images

is obtained. It gives a clear picture of the local information of the image but deficient in the overall brightness of the image. The working of the algorithm can be verified with the help of image quality parameters. One of the very common parameters is the Measure of enhancement and Measure [14] of enhancement factor (MEF). In order to find the MEF, the measures of enhancement of the input and output have been calculated individually. MEF is the ratio of the measure of enhancement of output image to the measure of enhancement of the input image. A better value of MEF implies that the visual quality of the enhanced image is good. The mean of the input original image and enhanced output image is also calculated. The comparisons of the input and output image are done, and the comparison is shown in Table 1. The original images and its enhanced images by performing [15] proposed algorithm are shown in Fig. 2. It is also compared with some of the existing methods like histogram equalization (HE), discrete shearlet transform (DST) as shown in Fig. 3.

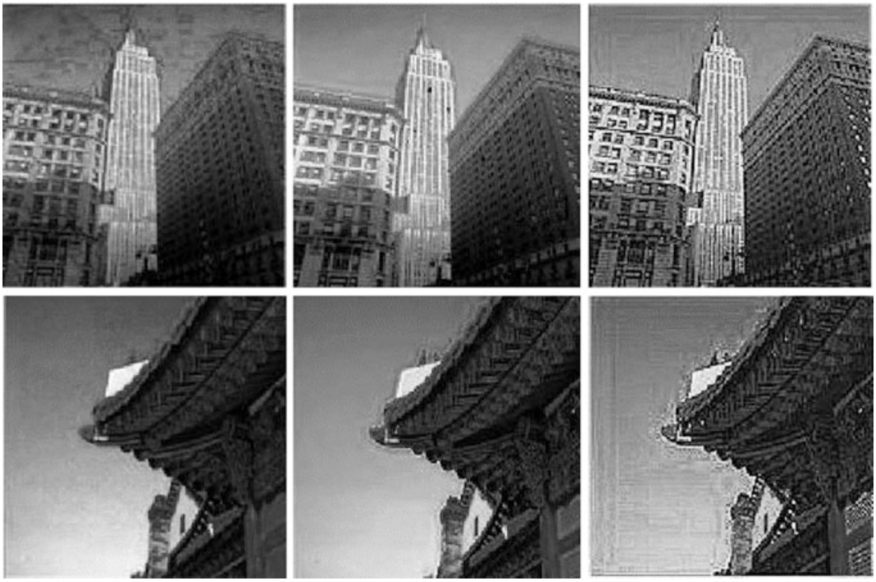


Fig. 3 Comparison between different methods

5 Conclusion

The results are successfully carried out in MATLAB R2014a. A combination of both local and global contrast enhancement techniques, where a local enhancement method is applied first to enhance the local details of the image, which is not taken care and usually neglected in the global contrast enhancement. The locally enhanced image is given to the input of global enhancement for better visual perceptions and increases the brightness to a level which gives pleasant sensation to the human eye. This method works fine in most of the dark images. It has more significance to those images where we need local minute gradient information such as the image of planetary and heavenly bodies, satellite images, and medical images. The comparison is done with a couple of the existing methods. The different local and global methods have been used and tested their effectiveness of the different combinations of the local and global methods.

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Finding Adulteration of Food Grains with Novel Digital Weighing Scale

K. D. Gaikwad and P. B. Dahikar

Abstract The digital weighing scales highly required in industrial application, consumer application to the research area, from weighing the big objects in food industries to weighing a small sample of the chemical in a research lab. As far as the general use of weighing scale is used to measure the weight of food items in ration shop. So in day-to-day life, the food item mixes with some adulterant, now digital weighing scale measure the weight of food item with adulterant. The customer paying for that adulterant food item not for a pure food item. In this paper, they proposed a digital weighing scale model that measures the weight of food items and also finds the adulteration from the food item. In the proposed system, the digital weighing scale interfaces with bulk density finder apparatus. The bulk density finder apparatus works on the principle of variation in density of food grains. The density of pure food grains and adulterant are different then this variation easily identified by the density finder. This proposed system makes very effective change in the consumer and nation point of view. With the perks of utilities for every class of the person, this research work will really bring a great change in traditional weighing scheme with the assurance of new retailer–consumer management.

Keywords Food grains · Density · Bulk density finder apparatus
Microcontroller · Weighing scale

K. D. Gaikwad (✉)
Department of Electronics, ASC College, Chopda, Jalgaon, India
e-mail: akunal2@yahoo.co.in

P. B. Dahikar
Department of Electronics, Kamla Nehru College, Nagpur, India
e-mail: pbdahikarns@rediffmail.com

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1 Introduction

A measurement is a series of manipulations of physical objects, or systems according to a defined protocol, which results in a number [1]. The number represents the range defined by the specification limits compliant to customer requirements by using process control. Measuring weight is a dynamic and essential part of many industrial, commercial, and research purposes. It is very difficult to measure weight with proper accuracy because of errors, so that it causes many losses like customers revenue. Load cell is used for accurate and errorless weight measurements. Load cells are transducers used to measure force or weight. Load cells that are used in the weighing industry are based on strain gauges [2]. The small change in resistance in strain gauge bridge detected and converted into digital form with 24 bit ADC [3]. This can be interfaced with the microcontroller through the digitizer at 5 V. This output can be used to display or for analysis. After measuring the weight of food grains with accuracy and precision, the issue of purity of food grains is still not solve. A part of ongoing research in the field of digital weighing scale is more focused on precision and accuracy. Besides this, research vision is focused on the contamination of food. The contamination of food is big issue in customers' point of view. The contamination is the addition of unwanted substance in due to intention [4]. The biggest physical contamination is called adulteration; it should be try to minimize with this proposed system. In the previous method, adulteration of food grains is finding with the help of color variation of food grains. The color variation of pure food sample and adulterated food sample detected by image processing mechanism. This mechanism is made by very high speed IC hardware description language (VHDL). FPGA Vertex4 has been used for the hardware implementation [5]. In our research paper, the mechanism used for finding the adulteration is with the help of density parameter of food grains. Density is a physical characteristic of substances related to several other physical, chemical, and mechanical properties [6]. The density of pure food grains and adulterated food grains having variation; it should be detected by bulk density finder [7]. This bulk density finder has lockable funnel of fixed dimension; the known size and dimension of food grains are gives out from the outlet. This pure food grains should be measured with the help of digital weighing scale attached in the proposed system. This system makes it very easier for the customer taking pure form of food grains with proper weight. The focus of this paper weighing the load with zero error in the weighing system. This proposed system not only measures the weight of a food grains, it also finds the adulteration.

2 Literature Review

The purpose of this literature review is to provide the knowledge of the work done about measuring systems, load cell, adulteration, and purity. We first focused on the previous work of researcher on measuring systems, the measuring system is basically developed to study of variation of fundamental sources which affects the system [8]. The measurement system can also be defined as the system which can compute the accuracy, precision, and repeatability. Weight measurement is a basic requirement of industries and marketable areas, but measuring weight without error with accuracy is a tough job. This causes the loss of revenue of consumers. So to overcome this problem, load cell is used for error-free measurement.

The load cell is a transducer which can convert pressure into electrical signals. Load cell which is used in many industries consists of strains gauges [2]. Strains gauges consist of resistors bridges; it is used for sensing minor variation in resistance. The sensing signal is very small so that it can be amplified by the instrumentation amplifier. The measurement of bridges is importantly done by analog to digital convertors (ADCs). This type of ADCs has very vital features such as differential inputs, internal amplifiers, automatic zero calibration, high common-mode rejection, and digital noise filtering [9]. The precision 24 bit ADC used with a programmable gain amplifier; it communicates with serial peripheral mode (SPI) [10, 11]. This SPI mode ADCs send signal further for processing serially to the digitizer block. The output from digitizer directly interfaces to a microcontroller or the PC through the RS232 with MAX232 to get final readings of the measurement [11]. This system can measure various load successfully with accuracy. This type of measurement system can be implemented easily in any environment like industries or in research area. It can measure load sophisticatedly, still there is some possibility for further improvement of the system [12]. The food grains is measured precisely with the measuring system still the issue adulteration and purity of weighted food grains. So I focused on adulteration issue of food grains and its measurement. Adulterant is a substance that found with other substance that is not allowed for legal or other reasons. The mixing of adulterant is called adulteration. The term contamination is usually used for the inclusion of unwanted substances due to accident or negligence rather than intent [4]. Adulteration is one of the major physical contaminations. Adulteration is the mixing of poorer quality material or superior substance to the superior product, which reduces the nature, quality, and originality in taste, color, odor, and nutritional value causing ill effects to the health of the consumers. For detection of adulteration, previous researcher makes comparison of images of impure sample with pure sample with help of image processing techniques. But digital color imaging technique is exchange other technique as it is low cost, reliable methods. In this digital color imaging technique, food sample images are acquired as reference images. This reference images compared with the images of tested sample whether it is adulterated or not. The comparison is based on the color variation parameter. In the very-large-scale integration (VLSI) implementation, field-programmable gate array (FPGA) is used to store the images for high-speed comparison [5]. In this proposed system, I take density as comparison parameter for finding adulteration of food grains. Density is physical property of material associated with chemical, mechanical, & physical properties [6]. This property is basically focused on shape and size of the food grains. If the adulterant food grains have different size and shape as compared to pure food grains then the density change. This affects the bulk density; it is detected by bulk density finder apparatus [7]. This bulk density finder apparatus is attached to the weighing scale, and it gives out the weight of food grains without adulterant.

3 Weight Measurement

In many areas like commercial, industrial, defence, medical weighing process a vital process. Weighing gives you information that information use for other purposes in the system. But many customers face the problem of accuracy in weighing process; it is a loss of customer directly. So to provide a solution to this problem, the proposed weighing scale system made up of the load cell. The load cell is nothing but the transducer which gives out an electrical signal, its magnitude is proportional to force applied to load cell. There are many types of load cell-like strain gauge, hydraulic, a pneumatic load cell. In the prototype system, strain gauge type load cell is used which is work on the principle of change in resistance. The architecture of weighing a load with the digital weighing system is as shown in Fig. 1. In this diagram, strain gauge load cell senses the change in resistance and sends this signal to the instrumentation amplifier. The signal coming from the load cell is very weak, so it has to be amplified that's why we needed instrumentation amplifier. The instrumentation amplifier has very high gain; it amplifies the weak signal coming from the load cell send it to the next block for further process [11]. The next block is analog to digital converter (ADC) of 24 bit which is used to convert the amplified analog input into the digital output [17]. This digital output is fed to the digitizer block.

This digitizer block directly interfaces to the PC or to the microcontroller with its serial output feature. The baud rate of serial data transfer is about 9600 bps. This gives the result in kg on the PC terminal, when it directly connects to the PC port [13].

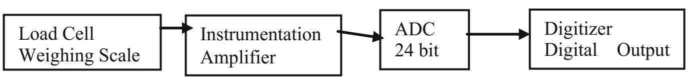

Fig. 1 Architecture of weighing scale

4 Adulteration

Adulterated food is impure, unsafe, or unwholesome food. Incidents of food contamination have occurred because of poor harvesting or storage of grain, use of banned veterinary products, industrial discharges, human error, and deliberate adulteration and fraud. Adulteration is one of the major physical contaminations. Adulteration is the mixing of inferior quality material or superior substance to the superior product, which reduces the nature, quality, and originality in taste, color, odor, and nutritional value causing ill effects to the health of the consumers. Adulterants when used in illicit drugs are called cutting agents, while the deliberate addition of toxic adulterants to food or other products for human consumption is known as poisoning. Some of the following examples of adulterant are as follows:

(i) The cow/buffalo milk can be adulterated with starch, milk powder, and urea; it causes cancer or acute renal failure. (ii) Metanil yellow, a non-permitted color, is a common adulterant in food items like laddu, tur dal, and turmeric; it causes tumor and cancer. (iii) Ghee essence is used in vanaspati or cheaper oils and passed off as pure ghee. This type of ghee will not solidify like normal ghee. It may also not have that grainy texture of pure ghee; it causes cancer or acute renal failure. So at the time of purchasing the food items from shop then there should be system that should indicate that this food item contains adulterant. This gives the solution of adulteration problem at the time of purchase the product. So in the proposed system try to find adulteration and measuring the weight of food grains.

5 Density of Food Grains

The density means mass per unit volume. It is denoted by ρ. There are following types of densities like apparent density, bulk density, envelop density, true density, and skeletal density. Apparent density means the mass of a particle divided by its apparent volume. Bulk density is defined as it is the ratio of mass to the given volume of grain sample. The bulk density is basically depending on the mass of food grains, the composition of grains, shape, and size of the particles. Figure 2 shows apparatus used in determining apparent density is used in the prototype system.

This bulk density is a very vital parameter for deciding the quality of the food grains [7]. So I used this parameter for deciding the quality and adulteration from pure food sample. This apparatus is interfaced with the prototype system. If the adulterant mixes in the pure food then its bulk density of the food grains changes, it can be detected by this apparatus.

Fig. 2 Apparatus determining bulk density [7]

6 Prototype Development

I would use microcontroller PIC18F252; it is 18F252 and has 28 pin and 10 bit A/D converter inbuilt with five input channels. It is operated at 40 MHz, it has 32 kb program memory, and data memory is of 1536 bytes. All the ports are used for interfacing of different peripheral devices [10]. One of the ports is used for bulk density finder apparatus interfacing, that detects the falling of food grains from the topmost position. The changes in density of adulterant that is different from density of pure food. It can be detected by bulk density finder apparatus placing in front of falling tray of food grains as shown in Fig. 3, and it shows the basic block diagram of a prototype of the system. The bulk density finder apparatus used for detection of adulterant is interfaced with the microcontroller, bulk density finder apparatus sense change in density of adulterant. The bulk density finder apparatus sends the signal of density change of adulterant to the microcontroller and controller process the

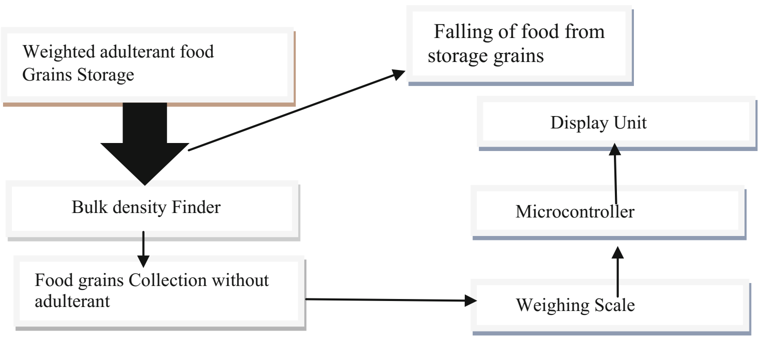

Fig. 3 Block diagram of prototype development of a system

signal. The microcontroller after processing the signal sends the commands according to the programming. As per the programming, the microcontroller shows the result of percentage of adulteration on the display unit. The display unit shows the total weight of a pure food without adulterant.

7 System Software Development

The microcontroller used for the system development is PIC18F series, so the programmer for the programming used is MPLAB IDE [14]. This is integrated development environment for the development system tools. The MPLAB IDE consists of MPLAB IDE project manager, MPLAB editor, and MPLAB SIM simulator, as well as general editing and debugging features [14]. It is a flash-based, power-managed, PIC microcontroller family; it can be suitable for low power design requirements including driving the LCD display in sleep mode. PIC microcontroller can also equip with all other desired features. With the ability to select from an array of available LCD PIC microcontrollers, a designer can provide additional value by creating scalable designs and products. This gives the designer flexibility to offer different solutions based on the demand of varying market segments all from a single design. When the system assembles all the units as shown in block diagram, the system worked as per the schedule. The system workflow is explained in detail in the following flowchart Fig. 4. When the system starts, it weighs food grains with adulteration and then food grains falls into the bulk density finder. It detects the change in bulk density of food grains. Bulk density finder gives the signal to the microcontroller, and it takes action according to the programming.

Figure 4 explains the system working flow using system flow chart, as per the system flow chart the system takes a decision and displays the adulterant result.

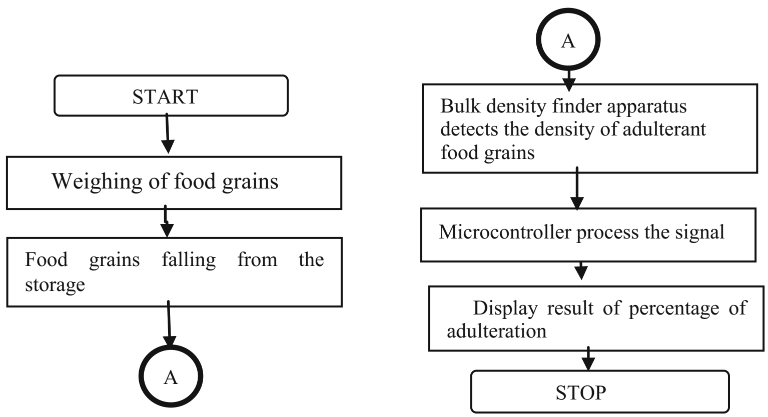

Fig. 4 Flow chart of prototype system

Table 1 Testing with load cell for digital weigh scale system

S.No.	Calibration point (gm)	Value on standard (gm)	Value on UCC (kg)
1	100	100.0101	0.1
2	200	199.958	0.2
3	400	399.8525	0.3
4	500	499.9623	0.5
5	1000	1000.2901	1
6	2000	1999.8856	2
7	3000	2998.9765	3
8	5000	4999.9385	5
9	10,000	9994.9990	10
10	15,000	14,994.4998	14.99
11	19,000	18,994.8456	18.99

8 Result

8.1 Weighing the Load

This system has been principally manufactured for forecasting the weight of food grains without error less result. The system test includes load cell carrier pan interfaced with the amplifier and digitizer. It sends serial signals to the PC via a RS232 port connector. These readings compared with the standard reading are almost the same. Table 1 shows the readings of load cell testing for accuracy.

The readings should be accurate if slight calibrations have to be done to accelerate the performance of the weighing system. The platform on which the system is placed should be perfectly flat. So the error the percentage is reduced.

8.2 Adulteration

The density parameter of food grains is very vital as far as adulteration is concerned. So for finding adulteration from pure food, this density parameter is used in this proposed system. This parameter is beneficial for a researcher who works in the field of adulteration. This paper trying to propose a system that should find the proper weight of pure food grains without adulterant.

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Review of Clustering Methods: Toward Phylogenetic Tree Constructions

Akansha Sharma, Shailesh Jaloree and Ramjeevan Singh Thakur

Abstract In modern context, integrated approach of science and technology has given new subjects such as bioinformatics. This discipline of informatics gave a pathway to understand the larger data of various biological systems in much simplified manner. The various attributes studied in the form of computational patterns result in phylogenetic tree construction. These phylogenetic trees establish both similarities and dissimilarities among organisms. Different algorithms of clustering were studied and compared on various parameters to establish the best among them and utilities of others methods as well. The current text makes us informative about clustering methods used to generate phylogenetic trees by both distance- and character-based analyses.

Keywords Species · Phylogenetic tree · Neighbor joining · UPGMA Maximum parsimony · Maximum likelihood Felsenstein

1 Introduction

The branch of bioinformatics is mainly based on analysis of various biological data such as physiological, biochemical, and genetic information with the help of modern software and data already existing as result of numerous observation made by contributors. The large number of data present helps to generate information about living world [1, 2]. Phylogenetic tree is a pictorial representation of

A. Sharma (✉)
Anand Vihar College for Women, Bhopal, M.P., India
e-mail: akansha_dolly@yahoo.co.in

S. Jaloree
SATI, Vidisha, M.P., India

R. S. Thakur
Department of Computer Applications, Maulana Azad National Institute of Technology, Bhopal, Madhya Pradesh, India
e-mail: ramthakur2000@yahoo.com

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progressive relationship among organism. Their branching shows that how much species is evolved with common ancestor. The distance of one group from the other groups indicates the degree of relationship; i.e., closely related groups are located on branches close to one another and vice versa [3]. To identify these close groups, clusters emerge as more robust method.

Cluster analysis commonly represented as clustering is a method in which we can group a set of objects or characters of similar factors more close to each other. Each cluster formed is viewed as class of objects. The objects thus clustered are based on the phenomenon of intra-class maximization in similarity and minimizing the inter-class similarity. Their grouping based on similarities and dissimilarities in their physical and genetic characteristic. The construction of graphical phylogenetic tree reveals similarity as well as dissimilarity among organisms [4]. To make a cluster or group of similar organism in the tree, various clustering methods are applied. Such observations also make the appearance of organism in relation to time. Phylogenetic tree represents branches and nodes. Basically, phylogenetic tree is categorized as follows [5].

(1) Rooted Tree: Rooted trees are single node consist of a common sector and a uncommon path emerging from it across evolutionary time to any other node.
(2) Un-rooted Tree: Un-rooted trees help in specifying the relationship among nodes and depict nothing about the direction in which evolution happens.

Phylogenetic trees based on sequence data give the more accurate encryption of patterns of relatedness. It also gives the Linnaean classification of new species. Phylogenetical technique is now commonly used to assess DNA evidence presented under law to inform situations. Molecular sequencing techniques with assistance of phylogenetic approaches are now in use to learn more about a new pathogen outbreak. This includes finding out about which species the pathogen is related to and subsequently the likely source of transmission. This gave the direction to new approaches recommended for public health policy. Besides this, phylogenetical recommendations help us by informing conservation policy for various uniquely identified extinct species [6].

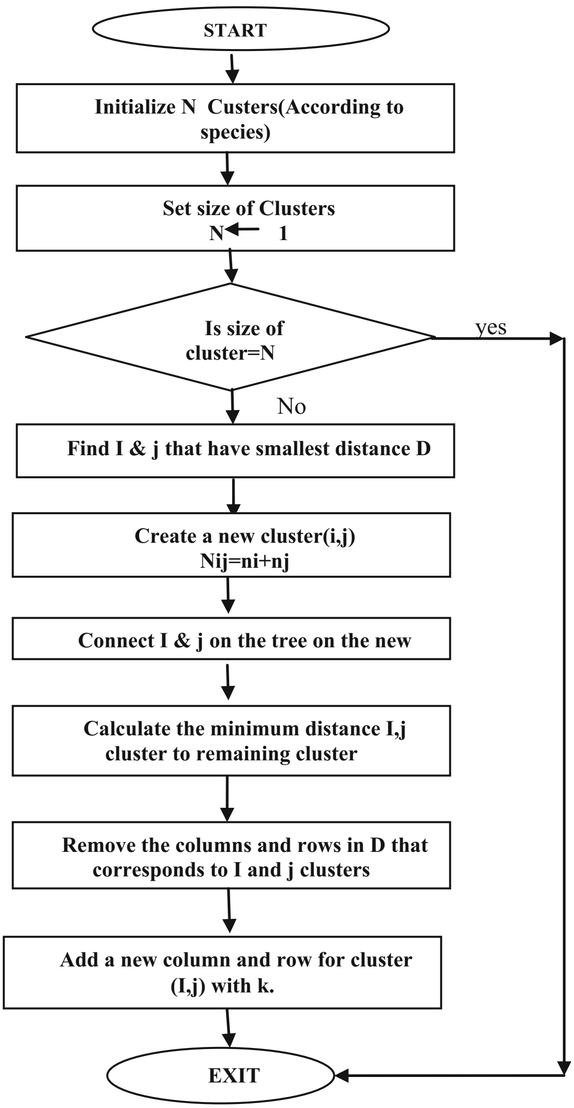
2 Methodology

2.1 Distance-Based Method

2.1.1 UPGMA

The phonograms are result of agglomerative or hierarchical clustering applied in bioinformatics. Pair-wise distance matrix (similarity index) is major tool which is to study applying algorithm, which results in the structure and construct of a rooted tree, i.e., genogram [7] (Fig. 1).

Fig. 1 Flowchart showing steps of UPGMA method



2.1.2 Neighbor Joining Method

The DNA or protein sequence data obtained after wet laboratory analysis is used for production of trees based on algorithm which generates a pair-wise distances of taxa resulting into construct. Neighbor joining is an application of distance matrix explaining the distance between each pair of taxa. Presently, neighbor joining also known as bottom clustering is frequently used technology to generate phenograms [8, 9] (Fig. 2).

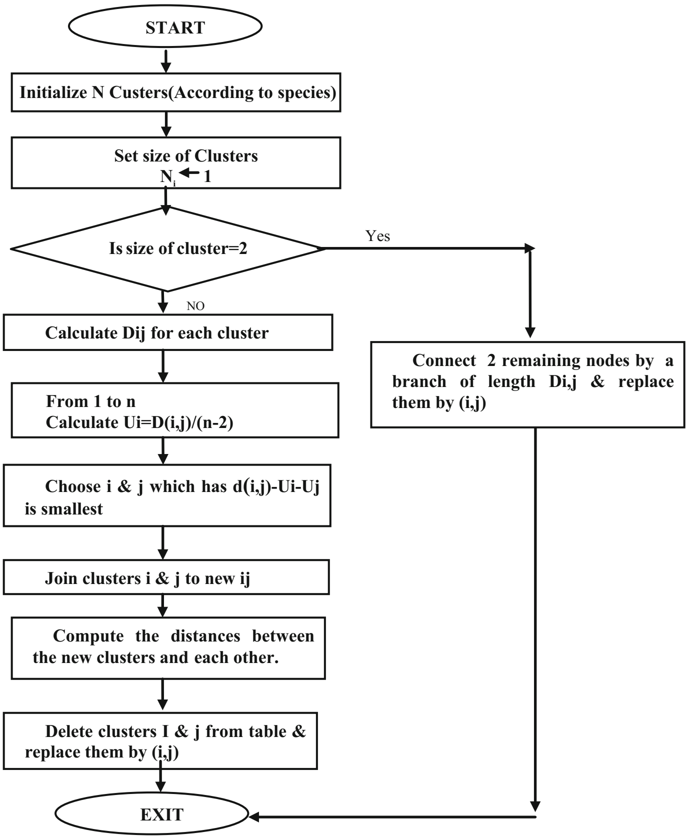


Fig. 2 Flowchart showing steps of neighbor joining method

2.2 *Character-Based Method*

2.2.1 Maximum Parsimony

This technique is the widely accepted and is based on the assumption that the most preferable tree generated depends upon the requirement of minimum number of alteration to depict the data used in alignment [10, 11]. The minimum length of the branches indicates most parsimonious tree and is considered as best representative of the evolutionary pattern. The minimum alterations within the tree construct have always been the basic approach of MP. The minimum number of changes within the tree is generated using post-order traversal activity initiating from the leaf of the tree leading toward the root [12, 13] (Fig. 3).

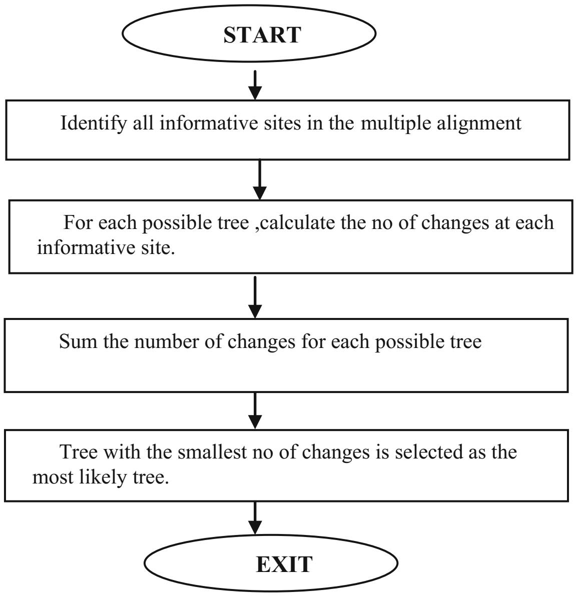


Fig. 3 Flowchat showing steps of maximum parsimony method

2.2.2 Maximum Likelihood Felsenstein

It is one of the most computationally intensive approaches. The model of nucleotide evolution and tree topology is optimal requirement of this methodology. ML is used to specify model of evolution using data available. The process also defines the greatest probability of observed data. Since ML depends upon purely probability or likelihood, it makes no similarity with other existing methods. The probability or likelihood is obtained where $L = P$ (data/tree), indicating probability of observing data. The ML provides advantage of statistical comparisons between topologies. It is one of the robust methods used by the scientists. On the other hand the disadvantage of the process that one can observe multiple maximum likelihood for a given phylogenetic tree, which demands more detailed computational exercise [14, 15].

Table 1 Comparison of methods

S. No.	Method	Advantage	Disadvantage
1	UPGMA	Fast	More assumptions
2	Neighbor joining	Fast	Unreliable due to loss of information
3	Maximum parsimony	Fast, robust	Performance is not satisfactory
4	Maximum likelihood	Phylogeny is clear	Slow

3 Conclusion

In all exercise, generation of construct using given sequence or data requires high degree of accuracy, thus achieving an optimal alignment along with reduction in complexity of sequences. Such results are obtained with the use of distance-based and character-based techniques. The large number of models can be constructed using distance-based method; on the other hand, phenotypic and genotypic attributes are generated using character-based method (Table 1).

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A New Method to Preserve Privacy of Utility Item Sets Using Differential Privacy

Lavi Bandil, Rishi Soni and Sugandha Rathi

Abstract Utility mining being a new branch of data mining is focused upon the profit earned from the item sets. Though it is a great technique to the world, the privacy issues are rising higher with the increasing usage. Previously, various techniques proposed are discussed here with brief idea about them. Due to lack of effective preservation technique, a new concept has been proposed in this research for preserving the HUI using differential privacy. A proficient method that provides privacy of HUI using Laplace mechanism has been described in detail with help of flowchart. No such work has ever done before in this field. So, it is an attempt to preserve HUI using the differential privacy concept.

Keywords Differential privacy · Frequent pattern mining · Utility mining
Privacy preservation

1 Introduction

In recent years, there have been some major concerns about the privacy issues in data mining. While a lot of valuable information can be uncovered by data mining techniques, this is a controversial issue for customers that their privacy may be compromised. Privacy-preserving data mining is an area of research that is concerned about privacy determined from personally individual information considered with data mining [1]. Several organizations are precautious about their data and are averse to join in the exploration of possible profit from data mining. Typically, the

L. Bandil (✉) · R. Soni
Department of Computer Science Engineering, ITM, Gwalior, India
e-mail: lavibandil@gmail.com

R. Soni
e-mail: rishisoni17@gmail.com

S. Rathi
Department of Computer Science Engineering, RJIT, Tekanpur, India
e-mail: sugandharathi@gmail.com

B. Tiwari et al. (eds.), *Proceedings of International Conference on Recent Advancement on Computer and Communication*, Lecture Notes in Networks and Systems 34, https://doi.org/10.1007/978-981-10-8198-9_51

mining result is numerical and refers to a large set of cases as a summary and therefore does not pose any threat to the confidentiality of individuals.

However, in the method of data mining, each individual processing unit may select data from different sources and it is there that the privacy issue may be significant.

Privacy is a charged term meaning different things to different people and even different things to the same person, according to the context. In the digital information area, the flow of information is generally associated with loss of privacy, or to manage the purposes for which information is employed. To achieve privacy, a new technique emerged known as *Differential Privacy* [2].

1.1 Frequent Pattern Mining

Frequent pattern can become valuable for financial and research purposes [3]. The pattern observed through the user-searched data is termed as frequent pattern [4]. The mining of frequent pattern is a fundamental concept in data mining. There are some algorithms that came into existence to find frequent pattern from the transactional database, i.e., FP growth, Apriori algorithm, etc. Here, the key concern about the releasing of frequent item set in public can breach privacy.

1.2 Utility Mining

Utility mining emerged through the frequent pattern mining. The major intent of Utility mining is to recognize the item sets with maximum utilities, by taking into consideration profit, quantity, cost, or other customer preferences [5]. User-specified threshold is used to mine high-utility items from the database. In numerous real-life applications, rare items are found from high-utility item set. For example, in a mall, customers buy television or cooker rarely as compared to soap, toothpaste. But the previous transactions give more profit to the mall. The utility is used to quantify that how valuable or profitable an item set Y is. The utility of an item set Y, i.e., it is the addition of the utilities of item set Y in all the transactions that have Y, is denoted by $u(Y)$. If $u(Y) \geq$ min_utility then only item set Y is called a high-utility item set, where min_utility is a predefined lowest utility threshold. The core goal of high-utility data mining is to find all those item sets that have utility greater or equal to user-defined minimum utility threshold.

1.3 Differential Privacy

A statistic is an output of many sample queries; when result of a sample query is exposed to the population, it should focus only on the information without breaking one's private data. The question arises in this area that how to retrieve valuable data from the underlying population while preserving the privacy of individuals. We therefore take care of the problem of privacy-preserving study of data. Cynthia Dwork proposed a novel method for this problem termed as differential privacy [2].

ε-differential privacy can be calculated with the help of special function K, if two data sets D and D' differing on at most one row, and all $S \subseteq \text{Range}(K)$,

$$\Pr[K(D) \in S] \leq \exp(\in) \times \Pr[K(D') \in S]$$

It means that the risk to one's privacy should not significantly (as bounded by ε) raised as a consequence of participating in a S database. Thus, an invader should only be able to learn any information about any participant. If the participant does not involve in the database, they could not learn anything. It clearly means that participating in the database may lead to the risk of individual privacy. The function $K()$ is our method that is used for adding this noise and D for database [6]. Different mechanism can be used to achieve differential privacy such as Laplace mechanism, exponential mechanism etc. Here, the question arises that how much noise should be added to achieve differential privacy? For this problem, we have a mathematical solution known as sensitivity of the query.

$$\Delta f = {}^{\max}_{D,D'} \|f(D) - F(D')\| \tag{1}$$

In simple words, it is the highest dissimilarity in the values that the ***f*** query may take on a pair of database that differ only in one row. There is a clear proof which shows that a result of adding up a random Laplace $(\Delta f/\varepsilon)$ variable to a query gives guaranteed ε-differential.

In differentially private analysis, the chief concern is about minimizing privacy loss and maximizing utility.

2 Literature Review

To conserve the privacy of frequent item set in two-dimensional sites, a semi-join concept was proposed by Ke Wang. The concept is used to return only those tuples of one relation which is the outcome of 'join' operation with another relation that gratify some additional condition. It may also use with star schema in distributed database [7]. Luca Bonomi proposed methods for exact frequent pattern. For exact pattern, prefix tree and two-phase algorithm were introduced and to capture noisy pattern, two definitions were proposed (i.e., Θ-approximate occurrences and gapped pattern occurrences) [4]. Mined frequent pattern can be encrypted with noise to assure privacy [8]. This work is done by a novel two-phase algorithm having preprocessing and mining phase. Transaction splitting-based differential private FIM is proposed. The technique divides long transaction into sub-transactions whose length is within a particular limit. This technique results in high data utility and high level of privacy.

Expansion of frequent pattern mining is utility mining [5]. Items having high utilities come under utility mining. Another mining strategy named rare item set mining is also defined. Rare item set is those which are least frequent in a record but having high profit rate. Mengchi Liu and Junfeng Qu proposed an algorithm named HIU-Miner to mine high-utility item set. High Item set Utility Miner (HIU-Miner) uses utility list rather than candidate generation to work efficiently with low run time and less memory consumption [9]. Utility list contains utility information regarding an item set as well as heuristic information whether the item set should be pruned or not. They also compared the result of this algorithm with state-of-the-art algorithm. The result shows HIU-Miner work efficiently than state-of-the-art algorithm.

Costly join operation for each pattern is performed in HIU-Miner. This is the limitation of HIU-Miner. To reduce join operation on the basis of item co-occurrence, a new algorithm is introduced called Fast High-Utility Miner (FHM) [10]. In FHM, a novel structure Estimated Utility Co-occurrence Structure (EUCS) is built. EUCS performs only one database scan and implements in the form of triangular matrix. It is more efficient in terms of execution time, pruning effectiveness, and memory overhead. Occurrence of mined item set from database changes over time. In traditional ARM, utility values are static over a particular period of time. This type of uncertainty can be handled with a temporal-weighted item set utility mining approach [11]. This approach allowed utility values to be dynamic over a specified time. Fuzzy values and continuous values can also be used with this approach.

To preserve privacy in utility mining is a new challenge in data mining. Two algorithms were proposed to hide the sensitive data, namely Hiding High-Utility Item First (HHUIF) algorithm and Maximum Sensitive Item set Conflict First (MSICF) algorithm [12]. The main goal of the HHUIF algorithm is to diminish the utility value of each item set by modifying the values of items contained in the sensitive item set. MSICF is a method that selects a suitable item which has the highest conflict count among items in the sensitive item sets to reduce the number of modified items from the original database. Two-phase algorithm consists of two phases; in first phase, high transaction-weighed utilization item sets are identified, and in second phase, database is scanned only once to sort out the high transaction-weighted utilization item sets that are definitely low-utility item sets [13]. An approach is introduced to avoid the selection of top K item set from large candidate set. These define the notion of basis set with small width. Θ-basis set $B = \{B1, B2\ldots Bw\}$, where each Bi is a set of items which have the property that any item set with frequency higher than Θ is a subset of some basis B [3]. From these basis set, the most frequent item set can be selected. This technique also preserves differential privacy and gives definition of frequency threshold. Cynthia

Dwork proposed a mathematical method called differential privacy to preserve individual security by adding noise to the item set [6]. Addition of noise can be done with various methods like Gaussian approach, exponential method, Laplace mechanism.

Differential privacy can be applied to many fields like location pattern mining, health data mining, social network [14]. Laplace noise addition mechanism is used to satisfy differential privacy that may be vulnerable to a tracker attack [15]. The mechanism is applied on the numeric data, and Laplace distribution is used here.

3 Proposed Work

In this work, we are applying differential privacy on high-utility item sets to preserve privacy. For this we proposed a hybrid algorithm that uses the concept of two-phase strategy with Laplace distribution.

Firstly, the flowchart of algorithm is shown. It has many phases and each phase defines how the whole process is working to secure high-utility item set with the proposed algorithm. Later, we develop an algorithm with all the given measurements (Fig. 1).

The phases involved in algorithm are as follows:

1. Data is collected and preprocessed from database.
2. High-utility item sets are mined out from the collecting data using high-utility mining algorithm.
3. Condition to check whether the mined item sets are high-utility item sets or not. For this predefined threshold is used; items whose utility is greater than threshold will be preserved and rest are discarded.
4. Laplace distribution is used to append noise to the high-utility item set to preserve differential privacy. The mathematical formula used in it is as follows

$$\begin{aligned} f(x|\mu, u) &= \frac{1}{2b}\left(-\frac{x-\mu}{b}\right) \\ &= \frac{1}{2b}\left\{\exp\left(-\frac{\mu-x}{b}\right), \quad \text{if } \; x<\mu\right\} \\ &= \frac{1}{2b}\left\{\exp\left(-\frac{x-\mu}{b}\right), \quad \text{if } \; x\geq\mu\right\} \end{aligned}$$

   Here, μ is the threshold value, x is the high-utility item, and b is scale parameter.
5. These noisy item sets are then considered, and items with frequency less than threshold will be deleted from the database before a final reply is formed.
6. The item set greater than threshold is saved in a new database, and privacy is preserved using proposed algorithm.

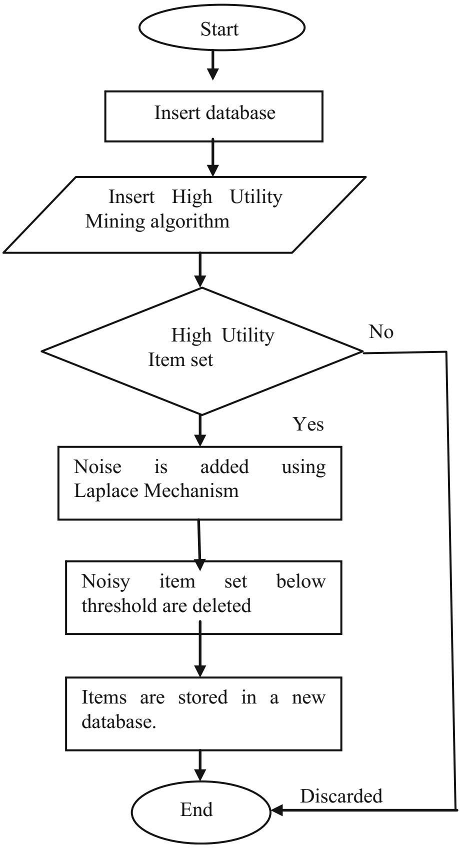

Fig. 1 Flowchart of proposed algorithm

4 Conclusion

Differential privacy being a new area of research has very less work done. The area selected in the research shows that it can also be used in utility mining. As the proposed work suggests that to preserve privacy of high utility item set through Differential privacy will be a crucial task to implement. The results will be better than any previous algorithm designed, and a comparative study will be shown later. Few measures will be taken as the benchmark to prove the work's clarity and usefulness.

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Face Detection in Hybrid Color Space Using HBF-KNN

Vinay Singh and Deepa Aswani

Abstract Biometrics cannot be lost or forgotten. They are difficult for attackers to forge. Face is a peculiar characteristic that falls in the category of biometrics. Thus, face detection plays a trivial role in identification of person system. There are various challenges of illumination, occlusion, and others. Detection of face from the large similar set of image database becomes very essential. In this paper, we propose a method which uses KNN and high boost filter. The KNN classifier is used to select skin and non-skin pixel and then high boost filter approach is applied which can eliminate the noise and blur from the image. We also use Gaussian probability density function to model the skin color in HSV and YCbCr color space sand and also use canny edge detection technique to sharp the edge of images. The experimental analysis of the proposed system is done using performance-measuring parameters such as accuracy.

Keywords Face detection · KNN · High boost filter · Histogram equalization

1 Introduction

In recent years, face recognition attracted attention of researchers and neuroscientists in the area of application of computer vision communication and automatic access control system. Automatic face recognition is the first step of face detection. Face detection is as simple approach but it has many challenges of image appearance, such as pose variation, occlusion, image orientation, lighting condition, and facial expression. The first [1, 9] important step is to identify the presence of human face and position of the face which includes posture and scale, face

V. Singh (✉) · D. Aswani
Department of Computer Science & Engineering, SISTec,
Gandhi Nagar, Bhopal, India
e-mail: vinay.cse5@gmail.com

D. Aswani
e-mail: deepa.aswani3@gmail.com

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Fig. 1 **a** Input image, **b** segmented region using HIS color model, **c** segmented region using YCbCr model

orientation, facial expression, ethnicity, and skin color. External background's inconsistent illumination condition and quality of image may also contribute significantly to the overall problem. Skin-based face detection has been proposed by many researches. Some popular techniques are RGB, normalized RGB, YCbCr, and HSI (Hue, Saturation, and Intensity). HSV and YCbCr color [7, 8] spaces help to identify and locate the face based on intensity variations in color space. There is distribution of skin color in humans. When source light changes, the appearance of face image changes significantly. The transformation simplicity and explicit separation of luminance and chrominance components make YCbCr color model very popular. Thresholds should be chosen carefully, [Cr1; Cr2] and [Cb1; Cb2], a pixel is classified to skin tone if the chromaticity values (Cr; Cb) fall within the ranges, i.e., Cr1 $\leq$ Cr $\leq$ Cr2 and Cb1 $\leq$ Cb $\leq$ Cb2 (Fig. 1).

2 Background Theory

Face detection methods are broadly classified in four areas: template matching methods, feature invariant methods, knowledge-based methods, and appearance-based methods.

(1) **Template matching methods**: In template matching [2] method, it stores standard pattern to identify the face. It is a way to detect the face up to certain level of correlation with basic feature of face. When an image is given, certain value of counter is calculated such as distance of eyes, nose, lips, and eyebrow. Then with the help of these counter values, face is detected. Template matching is used for face localization and detection. It also has some difficulties to represent standard templates fit for different poses, orientations, facial expression, illumination conditions, etc.

(2) **Feature invariant methods**: This algorithm [5] aim is to find out structural feature such as face even lightning conditions, pose, and viewpoint variations etc. It uses facial features such as eyes, nose, ear, lip, and skin color for face detection.

(3) **Knowledge-based methods**: These methods [4, 5] are based on rules. In this method, the relationship between facial features is captured. But accuracy of this method is greatly affected by rules designed for face detection. Strong rules in algorithm can increase the face detection rate while weak rule can decrease the face detection rate.

(4) **Appearance-based methods**: Appearance-based [6, 11] method is trained through some set of images. After training, the trained model is prepared and then test images are applied for face detection. Neural network-based face detection technique is related to appearance-based methods.

3 Related Work

Thakur et al. [1] introduced face detection using skin tone segmentation. In this paper, an improved segmentation algorithm for face detection in color images with multiple faces and skin tone region is proposed. Algorithm uses skin color model and RGB-HS-Cb-Cr for identification of faces. Many techniques are based on pixel, which classifies the skin and “non-skin” region of pixel with its neighbor. This algorithm uses the hue and chrominance effect with RGB properties, which is used to improve the discriminality between skin and “non-skin” pixel.

Morphological Operation: Morphological operation [7] is used to refine the skin regions which are extracted from above operation. First step is hole- and gap-filling operation. Then removal based on width-to-height ratio [2]. By applying trial and error on training set, we have found that the good range of values lies between 1.1 and 0.4. Ratio values which are greater than 1.1 would not be a face since human face’s vertical height is greater than width.

In Fig. 2a, the skin color is detected and connected region is eliminated, and then in Fig. 2b, face is detected using morphological operation. Kang et al. [2] suggested a method to improve the speed of face detection with the help of sliding window and skin color modeling. This method controls the size of window and detection areas which help in reducing the processing time. In this paper, color image is taken

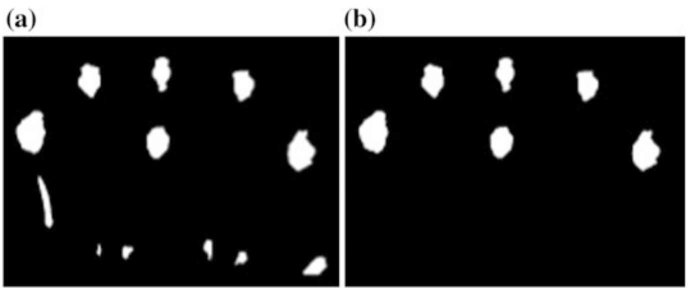

Fig. 2 **a** Connected region eliminated in training image, **b** face-detected training image

and then skin modeling is done. Skin segmentation operation is performed. Skin color modeling [3, 12] requires the process of selecting one color model. Color model includes RGB, normalized RGB, HIS (hue, saturation, and intensity), HSL (hue, saturation, and lightness), TSL (tint, saturation, and luminance), and YCbCr. After performing color modeling, the non-skin area is rejected. Removal of area smaller than 24×24 is done, which is minimum size of a face according to the face-learning data collected by the face detector. The sliding window over the skin region helps to improve the speed of face detection by reducing the area to be scanned.

4 Proposed Work

Face detection identifies the presence of any face and locate where it is. It does the modeling of face and segments it. Image is selected from the database, and portion is selected where the operation is performed. The portion is selected from image which is identified on the basis of [15] color hybrid color space. Then Gaussian probability density function is applied to model the skin and non-skin pixel. For classification purpose of skin and non-skin pixel, KNN classifier is used. High boost filter technique is applied for removing the blur edges from image. Eventually to remove the noise from image, canny edge detection is used.

Gaussian Probability Density Function

Gaussian or normal PDF is called the Gaussian probability density function. It is the vertically normalized PDF. Function of Gaussian probability density is produced from a signal that has purely random errors. The normal probability density function is:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \mathrm{e}^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

K-Nearest Neighbor Classifier

The *K*-nearest neighbor (*K*NN) classifier [14] is an extended version of the simple nearest neighbor (NN) classifier system. The nearest neighbor classifier works on an easy nonparametric decision. Every query is answered on the basis of its distance of feature. The nearest neighbor is found from image which has the minimum distance from the query image in the feature space. The distance between two features can be found with the help of distance functions such as city block distance d_1, and Euclidean distance d_2 or cosine distance $d_{\cos}$.

$$d_1(x, y) = \sum_{i=1}^{N} |x_i - y_i|$$

$$d_2(x, y) = \sqrt{\sum_{i=1}^{N} |x_i - y_i|}$$

$$d_{\cos}(x, y) = 1 - \frac{\vec{x} \cdot \vec{y}}{|x||y|}$$

High Boost Filter (HBF)

A high boost filter [10] belongs to a category of spatial filtering. A high boost filter is used to retain some of the low-frequency components. In this filter, the input image $f(m, n)$ is multiplied with an amplification factor "*Af*" before subtracting. The low-pass images are discussed as follows. $\mathrm{HBF} = Af \times f(m, n) - \mathrm{LP}$, adding and subtracting 1 with the gain factor,

$$\mathrm{HB} = Af - 1 \times f(m, n) + f(m, n) - \mathrm{LP}$$

where $f(m, n)$—LP − HP

$$\mathrm{HBF} = Af - 1 \times f(m, n) + \mathrm{HP},$$

where,

HBF	High boost filter
LP	Low pass
Hp	High pass
Af	Amplification factor

Proposed Step:

The multistep process is shown in Fig. 3 and explained as follows:

Step 1. Select an image randomly either from a database or from own galleries which consist of single and multiple faces.

Step 2. First skin detection is done. Color space combinations, such as luma and chroma component, are explicitly separated. Convert the RGB color pixels into YCbCr and HSV color pixel. The skin color pixel should satisfy the following condition in HSV color space $0 \leq \mathrm{H} \leq 0.26$; $0.16 \leq \mathrm{S}$; ≥ 0.1, and for YCbCr, it should satisfy $141 \leq \mathrm{Cr} \leq 164$; $141 \leq \mathrm{Cb} \leq 194$.

Step 3. Gaussian probability density function is used to successfully model for skin color. This can be obtained via maximum likelihood criteria mean vector and covariance matrix that maximizes the likelihood function. Segmentation is done on the basis of them.

Step 4. After the low-level process of skin and non-skin pixel detection, K-nearest neighbor classifier is used for classification and segmentation process is also run which is used for removal of the unwanted skin regions like neck and shoulder part.

Step 5. We use contrast enhancement technique along with high boost filter so that probability of object gets enhanced and the difference between face and background should be clear, and this is done using contrast stretch.

Step 6. Binary mask has been created by removing noises (gaps and holes) from morphological phase.

Step 7. Now in the noise removal process, we use high boost filter and Gaussian filter.

Step 8. To identify and locate sharp discontinuities of an image, we use edge detection method which is [13] canny edge detection method. The edges identified still contain noise so the noise removal process starts in a loop with canny edge and the desired output detected faces.

5 Experimental Result

To verify the effectiveness of the proposed scheme, MATLAB simulated experiments are performed. Most frequently used databases for face detection are PIE, CMU, MIT databases which consist of single frontal gray color images. Therefore, images from own photo gallery and from Internet are taken into consideration which consist of both single and multiple group images with various poses and illumination conditions. The test is performed on 10 group images containing 121 different faces. The examples of part experimental result are shown in Figs. 4, 5, 6, 7, 8, 9, 10.

The performance of the proposed scheme is evaluated in terms of true detection rate and defined as:

$$\text{Detection rate } (\%) = (\text{True detected faces} \times 100)/(\text{Total no. of faces}).$$

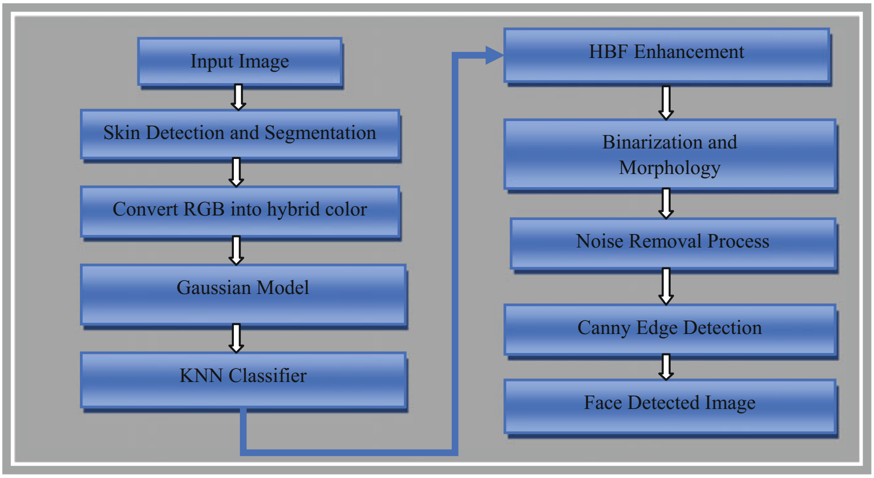

Fig. 3 Block diagram of the proposed method

Fig. 4 Input test image and its skin-detected image

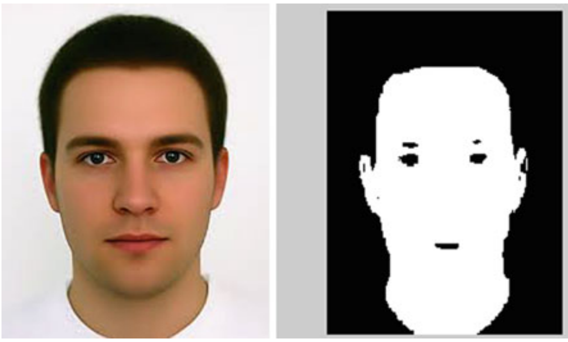

Fig. 5 HBF-enhanced image and successfully detected face

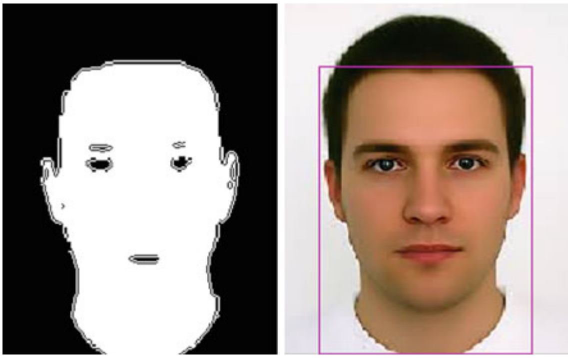

Fig. 6 Input group image

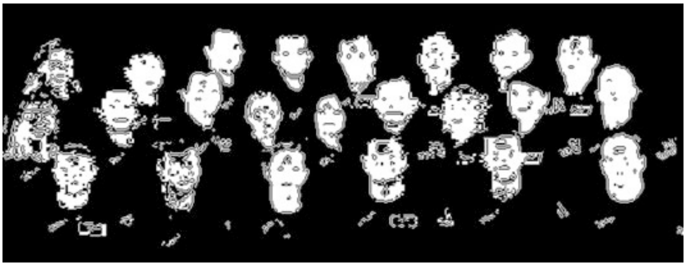

Fig. 7 HBF-enhanced image

Fig. 8 Noise removal process

Fig. 9 Edges detected using canny edge

Fig. 10 Successfully detected faces in group image

Table 1 Result analysis of existing method

Database image	Total faces	Detection		Misses	Detection rate (%)
		True	False		
nasa1	17	16	3	1	94.1
nasa2	23	13	0	10	56.5
group1	11	7	6	4	63.6
group2	4	4	6	0	100.0
group3	20	20	0	0	100.0
group4	13	11	3	2	84.6
group5	12	8	1	4	66.7
group6	8	1	2	7	12.5
Spicycity	13	0	4	13	0.0

Table 2 Result analysis of proposed method

Database images	Total faces	Detection		Misses	Detection rate (%)
		True	False		
nasa1	17	17	0	0	100
nasa2	23	23	1	0	100
group1	11	11	0	0	100
group2	4	4	0	0	100
group3	20	16	0	4	80
group4	13	13	1	0	100
group5	12	9	0	3	75
group6	8	8	0	0	100
Spicycity	13	13	0	0	100

Experimental results show that the proposed scheme achieves 95% true detection rate for colored group images. Proposed method claims high detection rate because geometric features are being used. The statistical data is shown in Tables 1 and 2.

6 Conclusion

We have presented a novel model for face detection. First skin color segmentation is performed and then *K*-nearest neighbor (*K*NN) classifier is used. Canny edge detection is used for edge detection. The experimental result showed that our approach achieves good detection and success rate. Experimental results show that the proposed scheme achieves 95% true detection rate for colored group images. When nasa1 image is tested in existing method, there are 17 faces in the image; the true detection is 16 and detection rate is 94.1%. When the same image is tested in the proposed method, the detection rate is 100%. The false detection rate is almost zero in the proposed method.

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Multi-channel-Based Neighbor Discovery in Cognitive Radio Ad Hoc Networks

Rajiv Kumar Berwer and Santosh Kumar

Abstract Cognitive radio ad hoc networks (CRANs) provide the better utilization of already assigned channels. Cognitive radio networks enable an unlicensed or secondary user (SU) to use the frequency owned by licensed or primary users (PUs) when the PUs not using the frequency. It is difficult to share information of neighbor and available channel in CRANs environment. Neighbor discovery algorithm for better communication of neighbor discovery is most important in cognitive radio ad hoc network (CRAN) for better communication between nodes because in CRANs, nodes have the different channel. There are very less algorithms on multi-channel environment, and our goal is to find out the common channel for communication among nodes and to reduce the total number of message for neighbor discovery. For termination, threshold time t is defined for every node, where if reply comes within time t, then accept and increment the neighbor list. Our simulation result indicates that time complexity is linear and message complexity is $O(n^2)$ (reduce the number of message for neighbor discovery).

Keywords Cognitive radio network · Multi-channel · Neighbor discovery Broadcasting

1 Introduction

Cognitive radio ad hoc networks (CRANs) empower the utilization of idle channel in an opportunistic way. In CRANs, secondary user (SU) allows using free or idle portion of the spectrum without making any obstruction to primary user (PU). Channel is owned by the authorized user, i.e., PU and remaining users are SU.

R. K. Berwer (✉) · S. Kumar
Department of Computer Engineering, National Institute of Technology, Kurukshetra, Haryana, India
e-mail: rkberwer@gmail.com

S. Kumar
e-mail: santosh.iet06@gmail.com

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When the authorized user renter the channel, secondary user leaves the channel and switches to another accessible channel [1]. The channel is considerably available when the messages can be sent or received by the secondary user on that channel when authorized user is not using the channel. In cognitive radio ad hoc networks (CRANs), when two nodes lying inside each other's transmission scope with one common channel at minimum, then these two nodes are considered to be neighbors [2]. Every node is prepared to do time-to-time checking and recognizing the accessible channel for that node. Since the usage of channel from one region to another changes widely, dynamic channel assignment scheme is used for communication between clients. With a specific end goal to arrange a cognitive radio network, nodes are required to find their neighboring nodes and available channels for communication between them. Initially, nodes do not have any prior information about the topology of the framework and neighboring nodes [3]. Due to the geological partition between nodes, distinct cognitive radio nodes might have sets of distinct accessible channel. After sometime, accessible set of channel changes because of entry and exit of authorized users. Additionally, new cognitive radio nodes may join the system at any instant of time. Given features of cognitive radio network need new calculations to configure and form cognitive radio systems [4]. All calculations, which address the above issues, require none of the accompanying inquiries.

1. Neighbors of each node?
2. Channel that may be utilized communication between neighbors?

The goal is to develop an efficient algorithm to answer above inquiries.

2 Related Work

Despite the fact that neighbor discovery algorithm in cognitive radio ad hoc networks (CRANs), very little work has been done addressing the multiple channel systems.

Chanaka et al. [5] have developed an asynchronous neighbor discovery algorithm that searches single-hop neighbor and channel in CRN. But there is no algorithm for multiple channels in CRANs.

Chao and Hsu [6] develop a fast neighbor discovery algorithm that uses Chinese remainder theorem to find neighbor node to quickly discover the nodes.

Krishnamurthy et al. [7, 8] have developed some neighbor discovery algorithms for CR networks with single- and multi-transceiver CR nodes. But these algorithms have problem with node synchronization.

Mittal et al. [9] have on neighbor discovery algorithms in cognitive radio networks operate over multiple channels. Due to the geological partition between nodes, distinct cognitive radio nodes might have sets of distinct accessible channel. After sometime, accessible set of channel changes because of entry and exit of authorized users.

Wang et al. [10] have a neighbor discovery algorithm, which uses two modes for communication—master mode and slave mode.

Islam et al. [8] have a neighbor discovery algorithm, which uses channel hopping sequence method using Tower of Hanoi (ToH) algorithm for multi-channel system. But it cannot provide complete medium access solution for cognitive radio network.

Jia [11] proposed a message passing protocols for cognitive radio networks which manage and exchange user information. However, algorithm has limitation such as it only share the information of node, and it does not tell about channels and its neighboring node.

Htike et al. [12] proposed a message broadcasting mechanism over multi-channel cognitive radio ad hoc networks. It is a message broadcasting protocol for multi-channel in CRANs.

3 System Model

1. Set of node (V): The symbol V represents the number of node in the cognitive radio ad hoc networks.
2. Channel for node i (C_i): The symbol C_i represents the number of channel with node i, in the cognitive radio ad hoc networks each node may have different channels for communication.
3. Channel list for node i (C_{li}): The symbol C_{li} represents the total number of channel in the cognitive radio ad hoc networks environment.
4. Broadcast$_i$ (hello, C_i): The symbol represents node i broadcast the hello message for channel C_i so that the node which having same channel can get hello message.
5. N_{li}: The symbol represents the neighbor list for each node i in the CRANs environment, such that each node has information about its neighboring nodes.
6. N_c: The symbol represents the number of neighbor node with each node in CRANs environment.

3.1 Proposed Work

The cognitive radio ad hoc networks (CRANs) require specific algorithm to form and configure cognitive radio (CR) systems. We have proposed an algorithm, which will address the issues of finding neighbors of each node and the common channel among them for communication. The existing neighbor discovery algorithm is based on single channel. We improvised the existing neighbor discovery algorithm which is working on single channel environment [3, 13]. The node which having common channels (multiple channels with each node) among its neighbors can communicate easily over that channel and able to make a list of neighbors of each node.

3.2 Proposed Algorithm

1. Initialization

```
begin              ∃ i : i ϵ V
         for       ∀ Cᵢ : Cᵢ ϵ Cₗᵢ
                   broadcastᵢ (hello, Cᵢ);
         endfor ;
          waits for a time threshold t

 end.
```

First of all, select a node i randomly from a set of nodes, i.e., V (set of nodes) and select channel over which send hello message to its neighbor which is having common channels among them [14, 15], i.e., *broadcast*$_i$ (*hello*, C_i). Wait for sometime (threshold time t) so that the node does not wait for long time for Ack().

2. Action was taken on reception of hello message by node j

```
 Begin
        for     j : j ϵ V
             if ( Ack()ᵢ != Send )  then  Ack()ᵢ to i     // node j sends ack to node i only if it has not sent
ack           already
             ∀ Cⱼ  : Cⱼ ϵ Cₗⱼ
            broadcastⱼ (hello, Cⱼ)
        endfor ;
       waits for a time threshold

end.
```

Node j sends Ack() message to node i only if it has not send Ack() message, and after sending Ack() message, node j selects channel (C_j) over which sends hello message to its neighbor which is having common channels (C_j) among them, i.e., *broadcast*$_j$ (*hello*, C_j). Wait for sometime (threshold time t) so that the node does not wait for long time for Ack() message.

3. Action was taken by node i after broadcasting hello message

```
begin
        on expiry of time threshold t
         for all node j, from which node i  has received acknowledgement
          for     j : j  ϵ V (Recv()==Ack())
            Nli=Nli U j

            Nc=Nc+1;
        endfor ;
end.
```

After expiring of t (threshold time), all nodes were getting the Ack() message from its neighbor node. They make list of N_{li} (Neighbor list of node i) and N_c (count number of neighbor).

Let us discuss neighbor discovery in multi-channel algorithm by example as shown in Fig. 1. Assume that, there are six nodes in network and each node has set of available channels. At starting of algorithm, first, Fig. 1a, select an initiator node, i.e., 0 and node having set of available channels ($c1$, $c2$). According to the algorithm, node 0 broadcasts the hello message() for each of its available channels, i.e., $broadcast_1$ ($hello$, C_1) to its neighboring node which have common channel with node 0. So, node 0 sends hello message to node 1 and 4 over common channel among the channel $c1$, and similarly, $broadcast_2$ ($hello$, C_2) common channel for node 2 and node 3 is channel $c2$ and wait for threshold time t for Ack() from nodes.

Now other node are active i.e. node 1 can Fig. 1b broadcast the hello message() for each of its available channels $broadcast_1$ ($hello$, C_1) to its neighboring node which have common channel with node 1. So, node 1 send hello message to node 6 common channel $c1$ and similarly $broadcast_3$ ($hello$, C_3) common channel for node 5 is channel $c3$, and wait for threshold time t for ACK() from nodes. Meanwhile node 4 and node 3 Ack() to node 0 as shown in Fig. 1c.

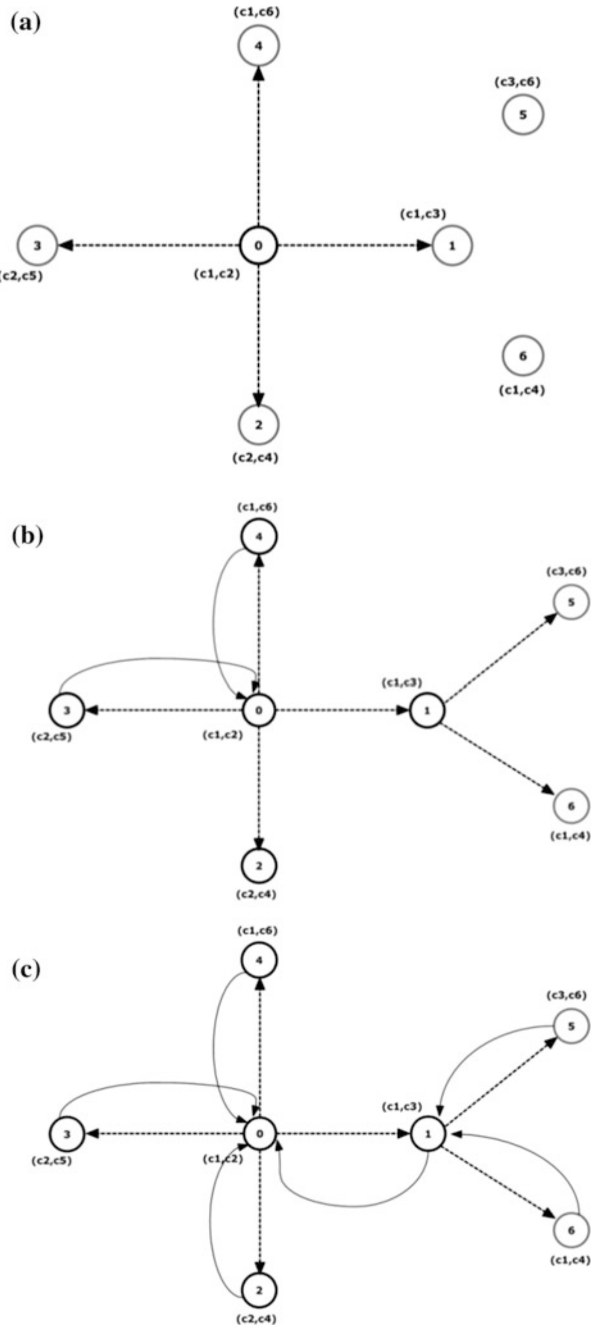


Fig. 1 Example of neighbor discovery in multi-channel

4 Complexity

We simulated the neighbor discovery algorithm in multi-channel cognitive radio ad hoc networks (CRANs) environment. In this complexity section, we analyze the message complexity and time complexity of our neighbor discovery algorithm.

To analysis the time complexity, we have two important sections; reception of hello message and action taken by node after broadcast of hello message. We get the time complexity of neighbor discovery is $O(n^2)$ where n is number of nodes. Analyzing the message complexity of neighbor discovery algorithm includes total number of message from initialization of node to receiving message to node. During initialization process, each node transmits broadcast (hello message) to its neighboring nodes and neighboring node first replies for that hello message, after which they repeat initialization step and ensures that not to broadcast (hello message) to previously initiator node (because it is already discovered its neighbor in starting). Therefore, the number of duplicate message in neighbor discovery is reduced. Therefore, the total message complexity of algorithm is $O(n^2)$.

Proof: Let us take worst case
M is the number of channel with each node
n is number of nodes
node sends one hello message and receives one Ack message (two message for each node)

$$\begin{aligned}
&\text{1st node} \; -----------2M(n-1)\\
&\text{2nd node} \; -----------2M(n-2)\\
&\text{3rd node} \; -----------2M(n-3)\\
&\text{4th node} \; -----------2M(n-4)
\end{aligned}$$

So, like that up to n node……….

$$\begin{aligned}
&(n-1)\text{st node} \; ------------2\\
&n\text{th node} \; ------------1
\end{aligned}$$

Sum of node is:

$$2M(1) + 2M(2) + 2M(3) + 2M(4) + \cdots + 2M(n-3) + 2M(n-2) + 2M(n-1)$$

take $2M$ common from series:

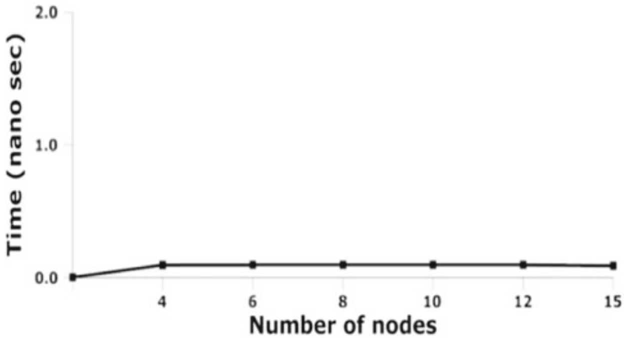
$$\begin{aligned}
&2M(1 + 2 + 3 + 4 + \cdots + (n-3) + (n-2) + (n-1)) \\
&\frac{2M(n-1)n}{2} \\
&O\left(M n^2\right) \\
&\text{But } M \lll n \\
&O\left(n^2\right)
\end{aligned}$$

where M (number of channel) is much smaller as compare to (n) number of nodes. Therefore, we neglect M.

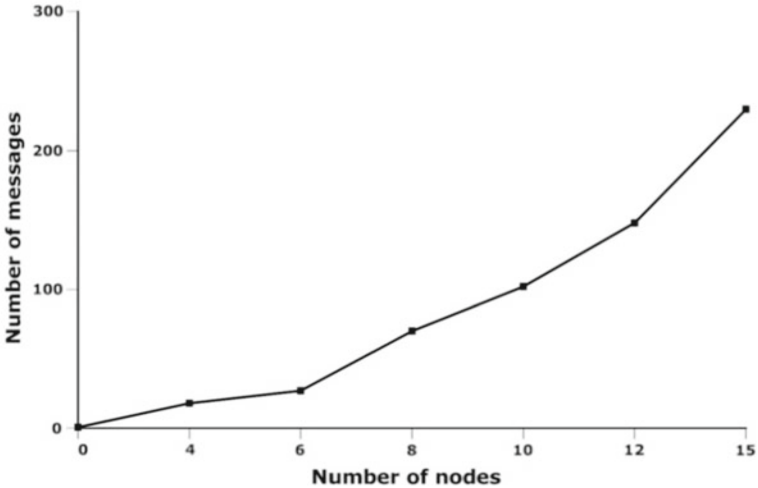
5 Results

At first round, the number of message may be more but as the next round starts, the overall number of message is reduced. We maintain two arrays; first is neighboring list (*NL)* and second is number of neighbors (*In)* with each node so that the list of neighbor not having duplicate values.

The results of algorithm are shown in Fig. 2. Figure 2b shows that the message complexity for neighbor discovery algorithm with multi-channel is $O(n^2)$, and we are able to cut down the number of duplicate messages. Figure 2a shows that termination is done using threshold time t for every node.



(a) Termination Detection



(b) Message complexity

Fig. 2 Simulation evaluation

6 Conclusion

We have addressed the multi-channel environment for neighbor discovery in cognitive radio network. There were very less amount of work that has been done in this regard. With our algorithm, we have achieved time complexity of $O(n^2)$ with message complexity of $O(n^2)$. Further, the duplicity of messages is completely removed from the neighbor discovery process in our algorithm. We have also considered the possible chance of infinite waiting stage for a reply message and avoided it with the help of threshold time t defined for each node. As an extension of this work, we are working on reducing the message complexity of the algorithm.

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New Approach for Animal Migration Optimization Algorithm

Riya Rai and Virendra Singh Kushwah

Abstract Animal migration optimization has few limitations such as movement probability, limitations of certain factors for reproduction and limited growth of individuals. In this paper, we aim to propose an innovative approach for animal migration optimization which is being proposed for a better animal migration optimization that can work on multiple factors and will lead to a new algorithm that can work on multiple scenarios. An overview using a flow chart is given to explain the overview of the new proposed algorithm. The results have been calculated on four benchmark functions which show the enactment of the animal migration algorithm and its working. Mean standard deviation and global minima are factors which are calculated.

Keywords Animal migration optimization · Cuckoo search · Firefly algorithm Ant bee colony · Bat algorithm · Particle swarm optimization

1 Introduction

Data mining is a procedure to mining excerpt striking, inherent, beforehand unknown and hypothetically valuable information or patterns from facts in huge databases. The ultimate objective of this data assembly is to be capable to utilize this knowledge to expand a viable frame by founding beforehand unidentified patterns in the data which is used for the process of decision making [1]. An input junction of operation research and data mining is in the use of optimization algorithms, either unswervingly practical as data mining algorithms or used parameters of other algorithms [2]. These methods are started from a primary collection of variables, finding the global optimal solution by repeating the procedure [3].

R. Rai (✉) · V. S. Kushwah
Department of Computer Science Engineering, ITM, Gwalior, India
e-mail: rai.riya1811@gmail.com

V. S. Kushwah
e-mail: kushwah.virendra248@gmail.com

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The first popular algorithm might be genetic algorithm. In animal deeds ecosystem, migration is a general existence in the animal kingdom which has been studied deeply. The migration is unrelenting and straightens out association pretentious by the animal's own locomotors exertions transport them to novel habitats. The long distance society of animals' movement is referred as animal migration, usually on a seasonal basis [4] optimization algorithm.

2 Literature Review

Li et al. [5] proposed BAMO that is binary animal migration optimization. With the help of BAMO, we can select optimal subset of instructive features. BAMO is most pertinent for classification. With the jackknife cross-validation, a classifier *K*-nearest approach is used. Dataset including 317 proteins is tested by BAMO with *K*-nearest neighbour approach (BAMOKNN). A total of 92.43% accuracy is achieved in this approach. This model also tests dataset including 98 apoptosis, obtains 94.90% accuracy. For identification of apoptosis protein location, BAMO is a successful approach.

Huynh Thi Thanh Binh et al. [6] proposed a new method for solving a travelling salesman problem through biography-based optimization algorithm by using a new migration operator. There are several optimization problems solved by BBO. In BBO, the good information among solution is efficiently shared with the help of migration operator. The result shows that the new operator is more effective and provides good solutions for data instances.

Ezgi Deniz Ulker et al. proposed a method used for solving optimization problem based on complex array design. The remarkable results are produced by the swarm intelligence algorithm when it is used for complex optimizing problems. Animal migration optimization algorithm is one of the swarm intelligence algorithms. When AMO is used for solving complex array optimization problem, high-quality results are produced and by using its attributes, it is able to defeat local optima points. When high excellence solution is desired in complex array design, then animal migration optimization (AMO) problem is an influential algorithm.

Li et al. [7] proposed animal migration optimization algorithm which is a new type of heuristic optimization search method. In all groups of animal, we generally saw migration behaviour. To prove the presentation of AMO employs 23 benchmark functions. The author compares other optimization algorithms with AMO. Li and Yin [8] proposed an opposition-based differential evolution algorithm (ODDE). This algorithm is used for variation flow shop scheduling founded on diversity degree. The proposed ODDE algorithm performs better than other algorithms. The author compares the ODDE algorithm with several states of PSPF algorithm and with several benchmark function problems of PSPF.

Tang et al. [9] proposed a wolf search algorithm. The idea behind this algorithm comes from the wolf's hunting behaviour in which they shift as a bunch. Every individual probing practice of agent hunts. It is understandable that wolves unite by rousing their present locations to their respective peers' locations. When the performance of the novel terrains is far better than the previous ones, it is significant that every wolf has possessed visual range and only be in action in tariff trip. This is the whole process of penetrating food.

Boussaïd et al. [10] describe some main meta-heuristics. They proposed a method to verify the similarities and differences among all the meta-heuristics. They describe various meta-heuristic ethos, some are single solution based and other are population based.

Voges et al. [11] explain a new method to describe rough cluster through template and data structures. It also clarifies the impression of evolutionary algorithm. These evolutionary algorithms are used to develop viable cluster, providing the description of cluster that contains the number of templates.

Ramos and Vale [12] proposed an electricity medium voltage (MV) consumers uniqueness and categorization. By comparing three algorithms beguiling the numeral of clusters, it adjoins the novel tariff structures to increase each customer class.

Richardson [13] in 2008 author explains the techniques worn by fellow's reactions and feedback from the students by integrated data mining and software engineering. Engineering principle-based project is STEP and is pertinent to student's life. To rush the certainty and learning aptitudes of students using STEM subject's jumbo miming mart is planned to understand correlations in a familiar situation and periodic table.

de Castro and Timmis [14] proposed opt-aiNet. On the basis of similarities, aiNET shows the communiqué of network cell and by a self-control procedure that get rid of those cells whose affinities are fewer than a stick threshold.

Alonso et al. [15] make a variation of aiNet to typical an agent that productions the Iterated Prisoner's Dilemma (IPD) that try to discover a strategy (most stimulated B-cell) in the resistant memory. In the memory mechanism of aiNET, the main alteration is made. If a B-cell is supplementary to memory, it will certainly not be detached. In this paper, we focus on immune network algorithms as a focal branch of artificial immune systems for irregularity discovery to replicate adaptive resistant scheme of optional technique.

3 Proposed Work

In proposed work, we tried to modify the AMO algorithm to perform efficiently with respect to the time. We made some changes in current algorithm from previous one. Here we used four benchmark functions to calculate the performance of AMO. So the new proposed algorithm steps are as follows:

- Generate the population through genetic algorithm.
- Mutate the population.
- Apply AMO algorithm.

- Compute the rate of fitness function $(Xi)^2$.
- For calculating the fitness function here we take ten situations. Two situations are belonging to climate and five conditions as of food.
- When we select situation, multiply the rate of fitness function with "score".
- On the origin of fitness function, animal will travel.

The AMO has few limitations like:

1. Movement probability.
2. Limitations of certain factors for reproduction.
3. Limited growth of individuals.

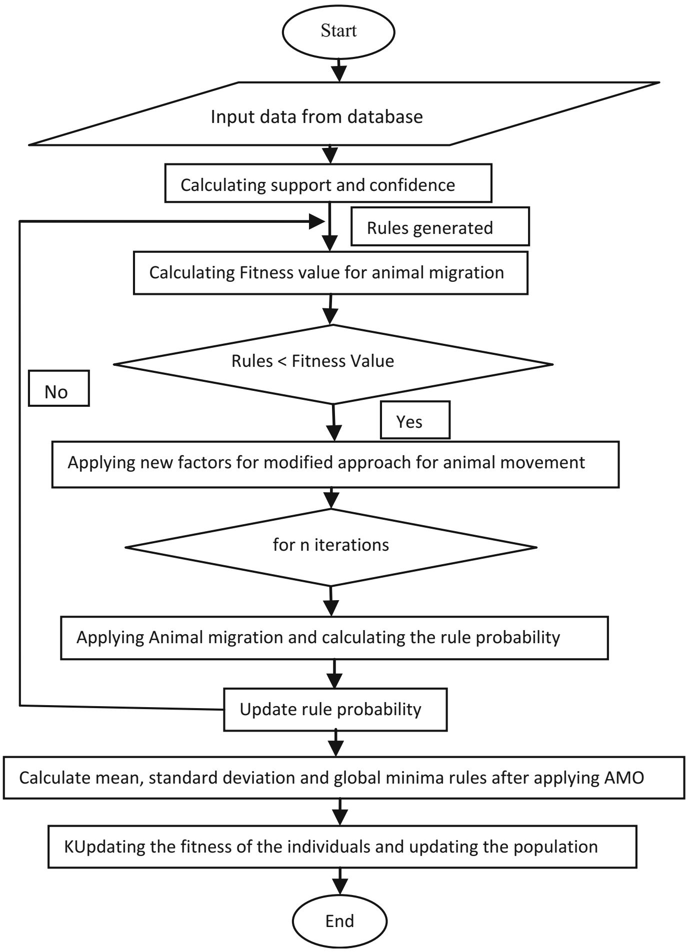


Fig. 1 Flow chart of animal migration optimization algorithm

Thus, a new approach for AMO is being proposed for a better AMO that can work on multiple factors and will lead to a new algorithm that can work on multiple scenarios.

An overview using a flow chart is given to explain the overview of the new proposed algorithm (Fig. 1).

4 Result Analysis

Here we use MATLAB 2016a for the coding of algorithm, and the experiments were performed on HP workstation with 3.0 GHz processor with 1.0 GB memory. The code is run on 64-bit operating system of Windows 10. The results have been intended on four benchmark functions. The factors which are considered in AMO are mean, standard deviation and global minima. The benchmark functions taken are Sum, Ackley, Beale and Rosenbrock. These results show the results on various benchmark functions which are considered as standard functions in order to show the results on multiple factors and functions. Mean value is represented by this result, standard deviation and global minimum. The results are represented in form of graphs (Table 1).

The results are represented in form of graphs, and a comparison has been shown for the values (Figs. 2, 3, 4 and 5).

Table 1 Global minimum, standard deviation and mean values of benchmark functions

S. No.	Functions	Algorithm	AMO
1.	Sum	*Glob_min*	2.5768e+04
		std	42.4393
		mean	−0.8524
2.	Ackley	*Glob_min*	518.4355
		std	55.4974
		mean	3.6531
3.	Beale	*Glob_min*	426.0937
		std	50.7612
		mean	9.6272
4.	Rosenbrock	*Glob_min*	2.7610e+10
		std	63.3607
		mean	−1.3503

Fig. 2 Global minimum of benchmark functions

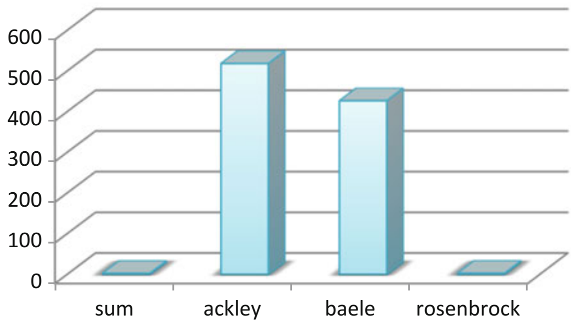


Fig. 3 Standard deviation of benchmark functions

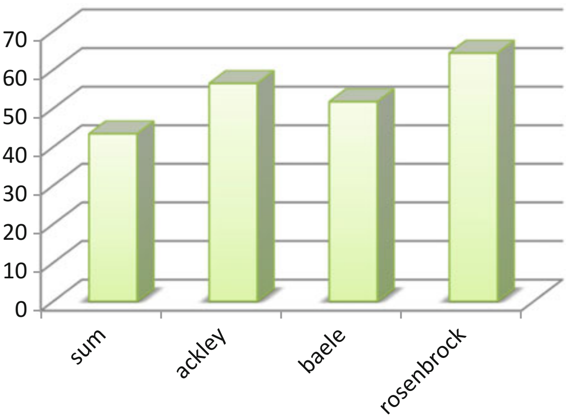
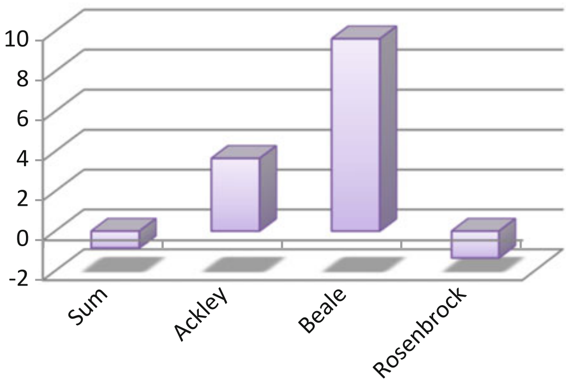


Fig. 4 Mean of benchmark function



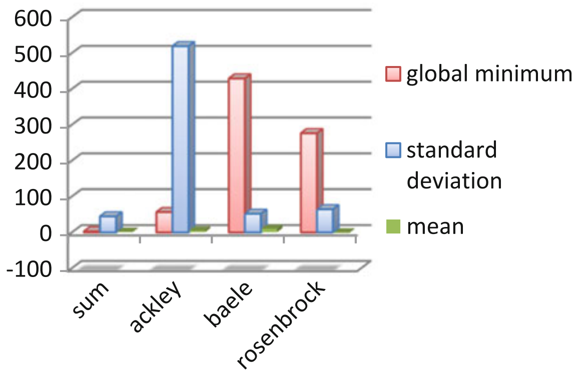


Fig. 5 Global minimum, standard deviation and sum of benchmark functions

5 Conclusion

In this paper, we proposed a new approach for animal migration optimization (AMO) and analysed the performance of AMO on the basis of few benchmark functions. The factors which calculated the performance of AMO are global minimum, mean and standard deviation. The performance of AMO is shown in the format of graph. There are many optimization techniques that are used for clustering, but they do not provide efficient results. Here we modify AMO to provide efficient solution. We calculate mean, global minima and standard deviation through AMO. The problem with the AMO is that it does not provide efficient results with respect to time. Here we improved the performance of AMO.

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A Character Image Classification Technique for Collecting Training Data for Very Large Classes

Dharam Veer Sharma and Harmohan Sharma

Abstract The major task in any pattern recognition application is collection of training data which is sufficient representative of the underlying patterns. In Urdu, this problem is aggravated due to the difficulty in the segmentation of words into characters. Due to the structure of Urdu scripts, Naskh or Nastaleeq, it becomes very difficult to segment a word into identifiable individual characters. Segmentation is only possible up to ligatures, where a ligature is a word or part of the word and consists of one or more characters. Corpora analysis has revealed that there are more than 25,000 ligatures which make the problem of image data collection and classification very gigantic. For the current work, the set of most commonly used ligatures, which comes out to be 1197 primary components and covers maximum ligatures used, has been considered. More than 850,000 ligatures have been isolated from scanned pages of 30 Urdu books. Manually classifying these ligature components into different classes for training is extremely time-consuming, monotonous, and error-prone task. The current work focuses on automatically separating isolated primary components of ligature images into separate classes based on their similarity.

Keywords OCR · Urdu · Nastaleeq script · Ligatures

1 Introduction

For development of any OCR system, some input images are required for training and testing of the system. Collection of such images is a very tedious task, and it becomes more difficult for scripts with very large number of classes like Chinese

D. V. Sharma
Department of Computer Science, Punjabi University, Patiala, India
e-mail: dveer72@hotmail.com

H. Sharma (✉)
Department of Computer Science, M. M. Modi College, Patiala, India
e-mail: harmohan.sharma@gmail.com

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and Nastaleeq script of Urdu. Urdu text images cannot be segmented up to character level, particularly if Nastaleeq script is used for writing the text, as the shape of some of the characters change with its location within the word. Some characters may have entirely different shapes based on their position.

All Urdu characters can be categorized into two sub-categories aptly named non-joiners and joiners. The joiners can be in either the isolated, initial, medial, or final shape and can also merge with the succeeding character, whereas in a contrast, the non-joiners acquire only the isolated and final shape and, as expected, do not join with the next character. A ligature emerges with the confluence of a collection of joiners and/or non-joiner joined or interconnected with each other. A ligature might end either with a space or optionally with a character of the non-joining character type. We can figure out a ligature clearly as a connected component of characters. Each individual word in Urdu is a congregation of one or more ligatures. To cite an example, the word (ہندستان) (Hindustan) is composed of three ligatures ہند, ستا and ن. Each of the first two ligatures is further comprised of three individual characters while the third ligature is an isolated character.

- د + ن + ہ = ہند
- ا + ت + س = ستا

Statistical analysis of Urdu corpus reveals that there are in all around 25,000 unique ligatures used in Nastaleeq script. Of these, 2190 primary components and 17 secondary components of ligatures cover about 98% of the total text. For the purpose of development of an Urdu OCR using Nastaleeq script, a total of 2190 primary components are sufficient to achieve a reasonable degree of accuracy. Considering the entire set of nearly 25,000 distinctive ligatures for development of an OCR will reduce the recognition accuracy causing more confusion. The rest of the paper contains properties of Nastaleeq script in Sect. 2, review of the literature in Sect. 3, proposed system in Sect. 4, conclusion in Sect. 5, and references at the end of the paper.

2 Properties of Nastaleeq Script

Urdu is a Central Indo-Aryan language of the Indo-Iranian branch, belonging to the Indo-European family of languages practically spoken/written by millions of people in India, Pakistan, and other neighboring countries as primary or secondary language. Urdu has also been declared as the national language of Pakistan, and one among the 23 scheduled languages spoken in the various states/regions of India and at the same time, enjoys the status of being one of the official languages of five Indian states.

Urdu, written in the Nastaleeq style of Persian calligraphy, has 40 characters and 10 diacritical marks. The other characters/symbols used in Urdu are 20 digits (both Roman and Urdu), 7 punctuation marks, 5 honorifics, and 2 poetic marks. Many other sources give slightly different character set.

Urdu characters do not distinguish between lower-case and upper-case forms. They relatively change their shapes according to the contextual use, often depending upon the characters that precede or follows. In general, they tend to acquire one of four shapes, namely isolated or standalone, initial, medial, and final in the word. Urdu character set and both Urdu and Roman numerals are given in Fig. 1. Non-joiners and joiners are given in Figs. 2 and 3.

It is also interesting to note that the 40 main characters in Urdu script can be segregated into 21 classes on the basis of visual similarity. The similar looking characters in same class can be differentiated by presence/absence of dots, diacritic marks, or a small line. The above property can be used for reducing the ligature classes for identification. Instead of taking 40 basic characters, we consider the basic shapes of the characters and classify the dots and diacritic marks separately. This reduces the basic classes at character level from 40 to 21. A ligature usually is comprised of 1–8 Urdu characters. A compound character or a ligature is a combination of two or more characters written in such a way that there is no space between the characters, i.e., all the characters in a group are connected to each other. Every single word in Urdu is an assortment of ligatures, whereas every ligature is a compilation of well-connected components. One or a set of ligatures gives rise to an Urdu word. From OCR point of view, a ligature consists of one primary connected component and zero or more secondary connected components. The primary component is the contiguous part of a ligature that is written at a

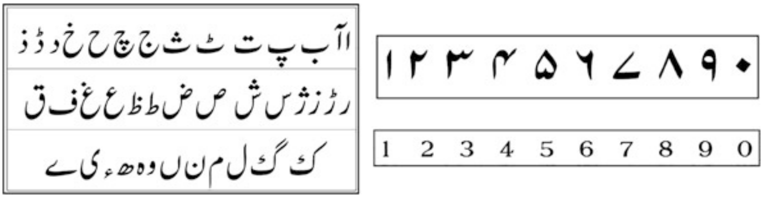

Fig. 1 Urdu character set and both Urdu and Roman numerals

Fig. 2 Isolated form of non-joiners

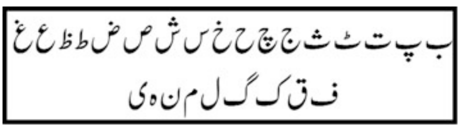

Fig. 3 Isolated form of joiners in Urdu

stretch, without any break, while the secondary connected component corresponds to the set of dots, diacritic marks, and special symbols written above or below the associated ligature. Very clearly the primary component gives the visual characteristic of a ligature.

The writing style of Nastaleeq is observed to be highly cursive in nature with multiple baselines and an obvious overlapping of characters in adjacent ligatures, along with a vertical stacking of characters within a single ligature. As expected, these characteristics make the character recognition in Nastaleeq more complex and difficult. Some of the characteristics are as follows:

- It is written diagonally, directionally from top right to bottom left with a accompanied stacking of characters. It is observed that all the ligatures tend to be categorically tilted to a certain degree to the right side.
- Being highly context sensitive, Nastaleeq imposes a characteristic to the letters to adapt different shapes. The shape of a character depends on the succeeding characters. A character may end up to a whopping 45 different shapes.
- Significant vertical overlapping, both within ligatures and among ligatures, is observed.
- The position of the Nuktas (dots) may be replaced during joining process. The Nuktas present in Urdu characters may change their positions when joined with other characters.

3 Review of the Literature

The field of OCR has received significant focus in the recent years. A number of methodologies for the recognition of Latin script [1] and Chinese script [2] have been proposed. The Oriya language leads the Indian scripts on which a lot of research has been done [3], Bangla [4, 5], and Devnagari [6, 7] scripts. Some studies have also been reported on Gurmukhi [8], Telugu [9], and Tamil [10] scripts. Naz et al. [11] endeavor to provide survey on OCR work on Urdu-like cursive scripts with special emphasis on segmentation-based and segmentation-free Nastaleeq and Naskh scripts. The survey encompasses work related to the recognition of printed, handwritten, online character, and on the various techniques being applied for preprocessing, segmentation, feature extraction, classification, and recognition. The study of the current recognition methods for Urdu OCR acknowledges that most of the research focused on isolated characters or ligature-based recognition. Sharma and Sharma [12] also discussed state-of-the-art in Nastaleeq Script Recognition.

At CENPARMI in Montreal, Canada, authors [13] have created an Urdu handwriting database of 109,588 images from 343 various writers from the various regions of the world for the Urdu off-line handwriting recognition, which includes 14,890 samples of 44 isolated characters, 60,329 samples of isolated digits, 1705 samples of five special symbols, 19,432 samples of 57 financial related Urdu words, 12,914 samples of numeral strings with/without decimal points, and 318 samples of Urdu dates in different patterns. Experiments are conducted on Urdu digits recognition with an accuracy of 98.61%.

In a paper presented by [14], they have discussed the variety of shapes of Urdu characters. The aim of this paper is to identify all possible shapes of characters based on the context in which they occur in ligatures. Since it is not possible to study all possible ligatures, they have limited their study up to four character ligatures. The study mentions 474 shapes of different ligatures based on the classification of Urdu characters.

Pal and Sarkar [15] have suggested a system for recognition of text printed in Urdu. In this system, a scanned image of the document is captured using a flatbed scanner and then pipelined through the subsequent procedures of skew correction, line segmentation, and character segmentation modules, in that order. By combining techniques like topological features, contour-based features to name a few, the recognition of individual characters is done. The system thus developed has been used to conduct a prototype test on printed Urdu characters. The system recognizes basic characters only and does not deal with recognition of compound characters. The system's identification rate for individual text lines is 98.3% and character segmentation accuracy is 96.6%. The segmentation errors largely exist because of touching characters. The recognition rate for the basic characters and numerals is 97.8%.

The online handwriting recognition has great potential to improve user and computer communication. Online handwriting recognition requires a transducer that captures the writing as it is written. The most common of these devices is the electronic tablet or digitizer. These devices use a pen that is digital in nature. Malik and Khan [16] created a system that accepted online Urdu characters written by the user with the help of stylus pen or mouse, and converted the inputted information into Urdu text. The system had the capability to recognize only individual characters and Urdu numerals though the ligatures were not addressed. The system performs the recognition of 39 Urdu characters, 10 numerals, and 200 words (two character words). There are, in all, six phases involved in the process of online handwritten text recognition. Individually, each phase is implemented using a different technique depending on the speed of the input and the level of accuracy. A tree-based dictionary search for the classification of characters has been used resulting in a recognition rate for isolated characters and numerals as 93 and 78%, respectively, (for two character words).

Husain et al. [17] devised an approach involving the cursive Urdu Nastaleeq script which is specifically handwritten. About 250 ligatures are recognized presently. In this system, there is a minimization of errors by using segmentation-free approach. There has been a substantial increase in the number of identified ligatures, therefore recognizing 250 base ligatures and 6 secondary strokes. When combined, they form 864 single characters, 2 characters, and 3 character ligatures and can recognize 50,000 common words from Urdu dictionary successfully. The recognition rate of base ligatures was 93% and of the secondary strokes was 98%.

An OCR for Urdu Nastaleeq with a recognition rate of 93.4% has been developed [18]. This technique revolves around the approach avoiding the usage of a lexicon for the purpose of OCR of Urdu Script using the inherent complexity of Urdu script for character recognition. A word is scanned and analyzed for the level of complexity and as the level changes; the point is marked for a character. Following this, the character is segmented and later fed to a neural network. Three-step character segmentation is explained in the sequence—lines of text are identified, secondly words are identified, and finally each character is segmented and extracted from a word/sub-word using its complexity level. Once this phase is covered, then the output of segmentation is fed into the neural network for final classification/recognition.

Javed et al. [19] proposed a technique implemented on Nastaleeq Urdu wherein the ligatures are used without breaking them up into smaller segmental units. Extraction of global transformational features from a non-segmented ligature followed by which the extracted data is fed into the Hidden Markov Model (HMM) recognizer. First the shape of the character is identified by its shape and then recognized sectioning it into the class of feature vector. Using this, a count of 3655 ligatures were tested and 3375 ligatures were identified perfectly thus giving an accuracy of 92%.

A system in which an Arabic word as a single unit using a HMM is recognized. The system works on a predefined lexicon acting as a look-up word list. The skeleton of the word is derived using the thinning algorithm using the centroid of the skeleton is calculated. After all the skeletal segments are extracted, resulting in an eight-dimensional feature vector. Each feature vector is mapped to the closest symbol in the codebook. A 294-word lexicon acquired from a variety of script sources using this methodology, and recognition rates of up to 97% have been achieved [20].

Pathan et al. [21] brought up a technique to recognize off-line handwritten isolated Urdu characters based on the concepts of invariant moments, primary and secondary component separation. The characters of Urdu alphabet were segregated into single component and multi-component characters. If the letter is multi-component, it was further segmented into primary and secondary components, with their invariant moments being calculated and classified using SVM. The developed technique was then implemented on a Dataset of 36,800 isolated characters. 200 image samples were used for training and 600 for testing, for each of the 46 characters. This system resulted in an overall recognition rate for all off-line handwritten isolated Urdu characters with the accuracy of 93.59%.

A hybrid approach was adopted for breaking up the text by the line segmentation implemented by the top-down technique, while the bottom-up segmentation furnished the contributing ligatures. This approach, [22] faced quite a few intermediary challenges like the horizontal overlapping of ligatures, diacritic issues, merged ligatures, or even broken lines. The count of associated primary and secondary components is also analyzed. 42,441 connected components from 45 Urdu images are considered, and it is found that 55.5% of the components are primary and remaining are secondary components. The system is tested to classify the primary and secondary components correctly with 99.02% accuracy.

The recognition set of ligatures is componentized into different the primary and secondary classes of connected components using the connected component analysis procedure. Though the individual count of the ligatures covered stands at 4657 (90% coverage), which is substantially reduced to 2212 post segmentation, thereby increasing the percentile of data coverage to about 99%. The split-up of this count is 2190 primary connected components and 22 secondary connected components. Urdu script also has 41 isolated characters that are further classified as 21 primary and secondary connected components. It is concluded thus that classes for recognition of Urdu text stands at 2233 inclusive of 2211 primary and 22 secondary components [23].

Lehal and Rana [24] proposed a recognition system applied on a total of 9262 ligatures formed from 2190 primary components and 17 secondary components. The usage of DCT, Gabor filters, and Zoning-based features coupled with kNN, HMM, and SVM (polynomial) classifiers have been experimented to attain a recognition accuracy of 98% on presegmented ligatures. The Unicode string of the ligature is constructed once the primary and secondary components are identified. For the same, a binary search tree is structured with all the nodes in the BST represent the primary component codes. The associated secondary components are nicely managed using the linked list data structure. The search sequence in a binary search tree starts off from the node of the primary component, moving on to the secondary level linked list attached to a specific node, resulting finally in a Unicode string.

4 Proposed System

The proposed system is meant for classifying the unknown images based on [23] from the collection of ligature images to known classes. For the purpose of collection of images of ligatures, 2467 pages from 30 books of Urdu have been scanned and more than 850,000 ligatures have been extracted using connected component analysis. Manually, filtering the unknown images of more than 850,000 ligatures into 1197 classes is an extremely difficult and time-consuming task. For the purpose of classification single image of each primary component of the known 1197 is used and compared with the unknown images. Different feature extraction methods including zoning, moments, DCT and DTW have been tried. Moments based methods are ruled out due to their time complexity and after analysis zoning was found to be the most suitable method of feature extraction. For classification of unknown images into know classes, technique like kNN and SVM have been tried.

During filtering process, the unknown images are divided into two categories. One of those images whose Euclidean distance under kNN comes out to be less than 0.5 and other whose distance is between 0.5 and 1.1. The images of second category are manually scanned for wrong classification.

5 Conclusion

Since the task of comparing known 1197 images with more than 850,000 unknown images is quite difficult the need of automation was felt. The system has successfully classified the unknown images to known classes with accuracy of 97.64%. The degree of accuracy has been manually calculated by observing all unknown images after their classification into know 1197 classes. Though the system has been used for filtering ligatures of Urdu in Nastaleeq script, it can be used for any other script as well. However, its suitability remains to be tested for other scripts. The filtered images can also serve as a benchmarking database.

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Feature Extraction and Classification Techniques in Character Recognition Systems—A Comparative Study

Preeti Malviya and Maya Ingle

Abstract Character recognition (CR) process has been extensively used in transformational research areas of computer science. It has been observed that these areas mainly cover recognition of various languages such as Devnagari, Marathi, Gurumukhi, Bangla, Malayalam, and Modi. Feature extraction and classification techniques play an important role in CR. Accuracy of recognition is subjective to selected feature extraction and classification techniques. These techniques involve mainly chain code, zoning, Zernike moments, projection histogram, template matching, etc. A comparative study of various feature extraction and classification techniques has been carried out based on some vital parameters such as data type, sample size, accuracy. Some important observations have been presented at a glance out of this study. These observations will be highly useful to the researchers putting efforts in the domain of recognition of characters in terms of improving the recognition rate highly.

Keywords Character recognition · Feature extraction · Classification
SVM · ANN

1 Introduction

Character recognition (CR) process has always grappled its importance in various research domains of computer science. There exist different recognizers for various languages such as Devnagari, Marathi, Gurumukhi, Bangla, Malayalam, Chinese, Arabic, Modi accompanied with different feature extraction and classification techniques. In this perspective, there subsist different feature extraction techniques

P. Malviya (✉) · M. Ingle
School of Computer Science & Information Technology, DAVV,
Indore, Madhya Pradesh, India
e-mail: Preetiamalviya@gmail.com

M. Ingle
e-mail: Mayaingle22@gmail.com

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such as intersection, shadow chain code, histogram, and straight line recognition along with fitting including multilayer perceptron classifier in order to recognize handwritten Devnagari characters. In this regard, an experiment is performed with a data set of 4900 samples and overall recognition rate observed is 92.80% using a decision algorithm based on weighted majority voting technique [1]. In case of recognizing Devnagari numerals, an Automated Numeral Extraction and Segmentation Program (ANESP) operated along with moment invariant and Affine Moment Invariant feature extraction techniques. Further, extracted features (i.e., 18) are classified using Support Vector Machine (SVM), providing 99.48% accuracy [2]. In order to recognize Bangla characters, a model is developed using template matching algorithm based on normalized cross-correlation. Experiment is carried out over 1250 character images that are captured by digital camera with .jpg format and gained 93.92% average accuracy [3]. Additionally, Arabic printed characters identify in a manner that it reduces data processing time and increases efficiency of recognition. In this view, features of characters have been extracted and used instead of the whole character matrix. For that purpose, skeleton of characters and structural information are traced using an algorithm. It provides thinned image which is used for feature extraction. After extracting appropriate features, back-propagation neural network is used for classification and gaining 97% accuracy [4]. Moreover, numerals of Modi script recognized using decision tree as classifier along with morphological operations. At each node of decision tree, these operations are used to extract features of input data set, obtaining 75% recognition rate [5]. It is observed that a lot of research efforts have been made on the CR for various languages. However, there exists a wide scope to present the comparative study of different feature extraction and classification techniques explored at a glance so as to provide ease of use guidance to the research community.

Numerous feature extraction and classification techniques play an important role in character recognition. Recognition rate depends on selected feature extraction techniques. Section 2 deals with existing feature extraction techniques in brief. Extracted features may be efficiently classified using classification techniques such as SVM, template matching. Recognition rate may be improved by applying appropriate classifier. Different classification techniques are elaborated in Sect. 3. We present comparative study of various languages on the basis of different parameters mainly sample type, sample size, recognition rate, etc. in Sect. 4. Finally, we listed important observation and conclude the results in Sect. 5.

2 Existing Feature Extraction Techniques

In general, feature extraction techniques are applied to extract features from image and construct feature vector for training data set images. Literature reveals that there exist different types of feature extraction techniques for various existing languages such as Devnagari, Modi, Bangla, Chinese. Accordingly, feature extraction techniques are further classified on the basis of features mainly statistical, geometrical, structural, topological, global transformation, series expansion, etc., [6, 7]. Few of them are discussed briefly as follows.

2.1 Statistical Features Based Techniques

In general, statistical feature extraction techniques are based on some quantitative measurement. It is used to reduce the dimension of the feature set and provide high speed and low complexity, whereas these techniques do not allow reconstruction of the original image. There subsist different statistical feature-based techniques such as zoning, projection histograms, N-tuples, crossings and distances [8–10]. We discuss them as follows.

Zoning

In this method, the character frame is divided into N × M zones and feature vector is created from extracted features of each zone. The density of each zone is calculated using $D(i) = N(i)/T(i)$, where D is density of each zone, i represents number of pixels, whereas N and T are number of foreground pixels and total number of pixels in each zone, respectively. It is noticed that using zoning method, different combinations of pattern pixels may yield to same feature values. In order to overcome the problem, zone-based method applied in such a manner that each pattern pixel contributes a unique value to feature computation. Hence, modified feature values provide 88.9% recognition rate for Devnagari handwritten numerals as well as characters [11]. Also, zone-based method for feature extraction along with SVM as classifier is used to develop a system called PANHINDA. It recognizes handwritten articles in offline mode using a set of 200 sample images providing 99.5% accuracy [12]. In addition, zone-based hybrid approach is used to recognize Tamil characters. It extracts 54 directional features from characters image, namely number of horizontal, vertical, and directional lines along with their total length of each zone. After extracting zonal features, Euler number is calculated as an extra feature for entire image. Total 55 features are extracted using Artificial Neural Network (ANN), gaining 98% accuracy [13]. A system has been developed to recognize Arabic digits using zone-based features including SVM classifier, providing 97.9% accuracy [14].

Projection Histogram

Projection histogram method is used to extract number of black pixels in the vertical and horizontal directions of the specified area of particular character. Projection histogram, run histogram, and entropy are used to extract features from compressed data in spite of decompressed data in order to reduce decompression time. Using above-mentioned techniques, extracted features from compressed data are identical as compared to features extracted from decompressed data [15]. Furthermore, Hidden Markov Model (HMM) has been used to recognize action along with projection histogram and shape descriptors as feature sets on the UT Tower and Weizmann data set. Projection histogram provided 96% accuracy. On the other hand, the better results may be achieved using shape descriptors as compared to projection histogram on Weizmann data set [16]. Moreover, a comparative study is performed on projection histogram, zonal features, chain code histogram, and histogram of oriented grade features in recognition of Malayalam characters. Performance of these techniques is analyzed by two-layered feed-forward network classifier, gaining best accuracy of 94.23% using histogram of oriented gradient features [17].

2.2 Global Transformation and Series Expansion-Based Techniques

Global transformation and series expansion is compact encoding of the linear combination of the coefficient. Deformations such as translation and rotations are invariant under global transformation and series expansion. This class pertains to various techniques mainly wavelets, Zernike moments, Fourier transform, Gabor transform, Karhunen–Loeve expansion, etc. [7, 8]. Here, few of them are discussed as follows.

Wavelets
Wavelet transform is used to recognize Chinese character-type information (i.e., font families, printed/handwritten) of character image. It extracts wavelet features from the transformed image and achieves 95.84% accuracy using MQDF classifier [18]. Furthermore, multistage feature extraction and classification scheme along with single-level wavelet decomposition are used to recognize Marathi compound characters. Generated approximation coefficients are again modified and used as another set of features. The recognition rate of 96.14 and 94.22% is achieved for training set and testing samples with wavelet approximation features, respectively. Similarly, the recognition rate of 96.68 and 96.23% is achieved with same training set and testing set with modified wavelet features, respectively [19]. In order to recognize Arabic characters, ANN is used along with Discrete Wavelet Transform (DWT) and Discrete Cosine Transform (DCT) on 5600 character data set, respectively. It is observed that DCT technique provides higher recognition rate as compared to DWT technique [20].

Zernike Moments
Zernike moments are used to feature extraction along with SVM as well as K-NN classifier to recognize handwritten Devnagari (Marathi) compound characters. An experiment has been performed with 27,000 handwritten character images into 30×30 pixel images. The overall recognition rate of 98.37 and 95.82% is obtained using SVM and K-NN classifier, respectively [21]. It is observed that reliability and accuracy of Zernike moments attained better than Hu’s seven invariant moments for recognition of handwritten Modi numerals. Zernike moment with Zernike features depicted 86.66% recognition result higher than recognition rate achieved by Hu’s

seven moments [22]. On the other hand, central moment along with density-based zoning method recognizes 12,690 isolated Marathi numerals with 5-fold cross-validation process. It has been noticed that 97.80% accuracy obtained using SVM, whereas 96.31 and 96.55% accuracy was achieved using minimum distance classifier and K-NN classifier, respectively [23].

2.3 Structural Features Based Techniques

Structural features are related to the geometry of the character set such as concavities and convexities in the characters, number of end points, number of holes, number of loops, number of turns in the characters. Different techniques are used to extract these features such as coding, graphs, and trees, extracting and counting topological structures, measuring and approximating the geometrical properties [7, 8]. Discussion of aforementioned techniques is presented as follows.

Chain Code Method
It is used to represent the boundary by a connected sequence of straight line segment of specified length and direction [24]. Normalized chain codes and wavelet filters are used to design an algorithm to recognize handwritten Kannada vowels, gaining 95.3% accuracy [25]. Also, 80% accuracy has been gained in recognition of offline cursive characters using chain code method along with neural network classifier [26]. On the contrary, to improve the recognition rate of Modi vowels, an additional feature centroid of the image is employed using chain code method. Applied method along with two-layered feed-forward network provides 68.15% accuracy [27]. Directional features of Modi numerals are usually composed of triangular, rectangular, and horizontal cells which are recognized using chain code algorithm providing 95% detection rate [28].

Extracting and Counting Topological Structures
In this method, predefined structure is searched in a character or word for feature extraction. Characters and words are represented by extracting and counting many topological features such as dots, extreme points, number of holes, vertical end points of character etc. [6, 7]. In this context, several topological features are used to recognize Telugu printed numeric characters. These features are extracted for particular character based on counting the number of closed regions (holes) of that character. Further, different types of morphological unification performed to extract specific attributes of the targeted characters. Above-mentioned technique provides better accuracy as compared to other existing techniques and especially suitable for Indian languages such as Hindi, Telugu. [29]. Besides, convex hull feature set is used to recognize Bangla character and numeral data set. Graham scan algorithm is used to compute convex hull features over data set that are designed with 10,000 samples of Bangla character including 1200 samples of numeral data.

Consequently, 76.86 and 99.45% accuracy is achieved for Bangla characters and numerals, respectively, using multilayer perceptron (MLP) [30].

3 Classification Techniques

It is the decision making part of a recognition system that utilizes extracted features to create class membership in CR. Numerous techniques for classification are available such as statistical method, syntactic or structural method, template matching, Artificial Neural Network, Support Vector Machine [6, 8]. Here, we discuss few of them as follows.

3.1 Template Matching

Template matching method is used to recognize images by matching recognized character with stored prototype [8]. It is deployed with optical character recognition system that is implemented using MATLAB to recognize multifont (i.e., font style, size). Templates are designed in such a way that includes varieties of font size and style. Due to this variety, system recognizes character irrespective of font size and font style. Accuracy is tested over 5 different character sets, each set formed with different font size and style gaining 90% detection rate [31]. In addition, different template matching techniques, specifically, normalized cross-correlation, correlation techniques, and performance index method, are used and compared in recognition process of scanned document images which contain characters (both uppercase and lowercase) and numerals. It has been noticed that performance index method provided better accuracy as compared to normalized cross-correlation method for document images [32]. Besides, template matching is used to extract normalized Musnad Arabic characters. Further, extracted characters are compared with each template in database to match closest representation of that character. Classification has been performed using matching metric that is computed using 2D correlation coefficient. Consequently, 100% accuracy is obtained for 512×512 and 256×256 pixel resolution images, whereas it reduced (i.e., 90%) for 128×128 resolution images [33]. In the same manner, an algorithm is developed for Offline Typewritten Odia Character Recognition using template matching using Unicode Mapping. Aforestated algorithm extracted features and matched the template with Unicode from each individual character, providing 97% precision rate [34].

3.2 Artificial Neural Network

In general, ANN architectures can be classified into two major groups, namely feed-forward and feedback (recurrent) networks. The most common ANNs are used in the CR systems, namely multilayer perceptron of the feed-forward networks and the Kohonen's self-organizing map of the feedback networks [8]. In this perspective, Kohonen neural network is used to develop Modi Script Character Recognizer System (MSCR) using Otsu's binarization algorithm. It recognizes 22 different characters of Modi script including vowels as well as consonants, achieving 72.6% accuracy with certain limitations [35]. In the same view, ANN followed by back-propagation algorithm is used to recognize English language character set and numerals. However, characters used for recognition purpose are captured by digital camera and preprocessed to remove noise before feature extraction. The recognition rate gained by implementation is 85% for all the data set [36]. Further, Malayalam language has been investigated for recognition of its characters using Hu invariant moments. Neural network is used for classification providing 93.7% recognition rate [37]. Moreover, neural network including multistage multifeature scheme is used to recognize compound character of Marathi language. Neural network is trained and tested by huge compound character data set collected from different writers. Next, different multilayer perceptrons (MLPs) are used for classification gaining 97.95% accuracy [38].

3.3 Support Vector Machine

SVM is used as pairwise discriminating classifier that is able to identify decision boundary with maximal margin. SVM is compared with K-NN method in recognition of handwritten and printed Devnagari characters. Using SVM, 82 and 94% accuracy has been achieved for handwritten and printed characters, respectively. It provides better accuracy as compared to K-NN classifier [39]. In the same manner, three different feature extraction techniques along with SVM are used to identify 12,240 Devnagari character data sets, obtaining 94.89% accuracy [40]. In case of Gurumukhi character recognition, SVM-based system has been developed. It prepared skeleton of character in order to extract diagonal, open end point, and intersection features. SVM is used to classify these features using different kernels such as linear kernel, polynomial kernel, and RBF kernel. Therefore, SVM using polynomial kernel provides higher accuracy 94.29% as compared to other approaches [41].

4 Comparative Study

We have explored various feature extraction and classification techniques in CR for several languages in detail. The parameters of interest are data type, sample size, number of extracted features, data validation, and accuracy as depicted in Table 1. It is worth to state that CR is highly influenced by above-mentioned parameters. The parameter data type defines nature of data that is used in recognition process. It is classified into two categories, namely printed and handwritten. Further, numerals and characters are sub-types of aforementioned categories. Sample size represents the total number of characters/numerals in a sample. Additionally, sample size is divided into training data set and testing data set. The training data set is used to train classifiers, whereas testing set is used to test performance of that classifier. Moreover, number of extracted features defines total number of features extracted using feature extraction techniques. The data validation process ensures the integrity of results obtained using recognition process. Lastly, accuracy is used to evaluate the recognition rate.

5 Results and Conclusion

In this paper, different parameters such as data type, sample size, number of extracted features and accuracy. are used to compare various feature extraction and classification techniques. The following are the important observations associated with the performance issues of feature extraction and classification techniques in CR.

- Higher accuracy 99.5% has been achieved in recognition of English language using zone based features extraction method with SVM classifier.
- SVM and K-NN along with Zernike moments have been used to recognize Devnagari characters. The recognition rate 98.37 and 95.82% obtained using SVM and K-NN, respectively. Using SVM, 94.89% recognition rate achieved for Devnagari characters with the sample size 12,240 and 10-fold cross-validation. On the other hand, SVM using zone-based method has been acquired the lowest recognition rate 88.9% with 4750 sample size of Devnagari characters.
- In recognition of Modi characters, accuracy of 68.15 and 72.6% has been achieved using chain code method and Kohonen's NN, respectively.
- In recognition of Modi numerals, the highest recognition rate of 95% using chain code method has been obtained, whereas the lowest recognition rate is observed as 75% using morphology approach.
- The recognition rate majorly depends on feature extraction techniques and classification techniques as well as on sample size, character type, and number of extracted features.

Table 1 Comparative study of different languages

Source language	Data type				Sample size			Feature extraction techniques	Total extracted features	Classification techniques	Data validation method	Accuracy (%)
	Printed		Handwritten									
	Numeral	Character	Numeral	Character	Total size	Training set	Testing set					
English [12]	No	No	No	Yes	200	100	100	Zone-based	–	SVM	–	99.5
Devnagari [1, 11, 21, 40]	No	No	No	Yes	4900	3332	1568	Chain code, histogram intersection, shadow features, straight line fitting features	–	ANN	3-fold cross-validation	92.80
	No	No	Yes	Yes	4750	–	–	Zone-based	64	SVM	–	88.9
	No	No	No	Yes	27,000	9600	17,400	Zernike moments	–	SVM and K-NN	5-fold cross-validation	98.37 (SVM) 95.82 (K-NN)
	No	No	No	Yes	12,240	–	–	Foreground pixel, distribution zone density features, background direction distribution features	314	SVM	10-fold cross-validation	94.89
Modi [5, 22, 27, 28, 35]	No	No	Yes	No	60	–	–	Morphology	–	Decision table	–	75
	No	No	Yes	No	100	70	30	Zernike moment	–	–	–	86.66
	No	No	No	Yes	65 pages	70%	15%	Chain code method	–	Two-layered fee forward network	–	68.15
	No	No	Yes	No	–	–	–	Chain code method	–	–	–	95
	No	No	No	Yes	–	–	–	–	–	Kohonen NN	–	72.6

(continued)

Table 1 (continued)

Source language	Data type				Sample size			Feature extraction techniques	Total extracted features	Classification techniques	Data validation method	Accuracy (%)
	Printed		Handwritten									
	Numeral	Character	Numeral	Character	Total size	Training set	Testing set					
Tamil [13]	No	No	No	Yes	200	100	100	Zone-based hybrid approach	55	Feed-forward backpropagation ANN	–	98
Arabic [4, 14]	No	Yes	No	No	–	–	–	–	–	Backpropagation NN	–	97
	Yes	No	No	No	–	–	–	Zone-based method	–	SVM	–	97.9
Chinese [18]	Yes	Yes	No	Yes	730 Set	635	95	Wavelet transform	702	MQDF	–	95.84
Bangla [3]	No	No	No	Yes	1250	–	–	–	–	Template matching	–	93.92

- The study reveals that there exist a few researches in recognition of Modi script, thereby providing a vast scope of research in the same domain.

The observations drawn will be useful to the researchers putting efforts in the domain of recognition of characters in terms of improving the recognition rate highly.

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Capability-Based Multipath Routing for Increasing Scalability and Reliability in Ad hoc Networks

Jyoti Shrama and Ashish Singh Baghel

Abstract The mobile sensors or nodes in mobile ad hoc network (MANET) are in motion continuously without presence of any authorized administration or authority. The dynamic link in between sender and receiver is created through intermediate nodes. The routing protocol MANET is completely different from traditional wired and wireless routing protocols. In this research, we proposed the reliable and scalable multipath routing with OLSR routing protocol in MANET to control congestion in dynamic network. The normal OLSR protocol is proactive in nature and stores routing information for communication. The updation in OLSR is multipath OLSR, i.e. M-CML. M-CML performance is better than OLSR because more than one route is available for data sending. In proposed congestion control routing scheme, we slightly improved the performance of OLSR through estimating the processing capability of mobile node and link capacity with queue management. The nodes and link between nodes which have minimum load are selected for routing the data in network. The heavy-loaded shortest paths are ignored because the possibility of congestion is more. The proposed protocol improves the packet receiving and minimizes the routing overhead which is the sign of better network performance. The packet dropping is minimized because of that the delay in network is also reduced. The performance of three protocols including the proposed protocol is evaluated in this research, and in each metrics, the proposed protocol is more robust and reliable for communication.

Keywords OLSR · M-CML · Proposed routing · Congestion · MANET

J. Shrama (✉) · A. S. Baghel
Department of Computer Science, Vindhya Institute of Technology and Science, Satna, India
e-mail: jyotisharma0patnaha@gmail.com

A. S. Baghel
e-mail: baghel.ash.12@gmail.com

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1 Introduction

Depending on the network behaviour, the infrastructureless and infrastructure-based are the two categories of the wireless sensor network. While the base station present in the scenario that that type of the network form star topology and other side while each node capable to containing and managing route table and dynamical change the network topology it means network is infrastructureless [1]. Wireless mobile ad hoc network offers number of advantages as compared to wired network because it is a self-configured, distributed management, costless communication and light-weight device. In comparison to wired solution, the key attraction of the MANET is its fluctuating mobility of the node. The established path between senders and receivers pair contains multiple intermediate nodes, and each node takes the responsibility as a router. Route decision in mobile ad hoc network [2] has been a difficult job because node mobility is not controlled by other nodes or devices. Number of protocols are developed to accomplish this task. There are many variety of problems that have an effect on the dependability of ad hoc networks and limit their viability for various scenarios; lack of centralized structure among MANET needs that every individual node should act as a router and is answerable for performing packet routing tasks; this is often done using one or a lot of common routing protocols across the MANET [3]. Carrying out routing tasks needs memory and computation power, but mobile devices feature physical size and weight limitations essential for his or her quality; this reduces the obtainable memory and process resources moreover as limiting battery power. MANETs containing a lot of nodes need larger processing power, memory and bandwidth to keep up precise routing data; this introduces traffic overhead into the network as nodes communicate routing information, and this successively uses a lot of battery power. The frequent movement of nodes is additionally a serious issue inside MANETs as a result of restricted wireless transmission range; this may cause the configuration to vary unpredictably as nodes enter and leave the network [4–7]. The paper contains the proposed multipath routing that has the network scalability with dependability exploiting multiple path existence between source and receiver node.

2 Literature Survey

Ladas et al. [1–8] projected a title “Multipath Routing Approach to boost Resiliency and scalability in Ad hoc Networks”. The title substantiates the efficiency of the protocol through a simulation scenario at intervals of a MANET utilizing the NS-3 machine. The non-hereditary results indicate that M-CML routing approach combined with associate intelligent link metric just like the ETX reduces the results of link instabilities and enhances the network performance in terms of resiliency and quality.

Liu and Li [2–9] projected a title "Quality of service aware and load balancing for mobile ad hoc network". During this paper, scientists focussed to mix the multiple constraints primarily based on QoS to attain and balance the network load that choose the trail between origin and receiver. Author traces the load of every intermediate node and alters the trail according to network scenario or its utilization.

Rama Devi and Srinivasa Rao [3–10] projected a title "QoS enhanced Hybrid Multipath Routing Protocol for Mobile Ad hoc Networks". Throughout this title, we have got an inclination to propose a QoS-increased hybrid multipath routing protocol for MANET. Throughout this protocol, topology discovery is performed proactively and route discovery is performed at intervals of the reactive manner. In proactive topology discovery section, each node collects the battery power, queue length and residual system of measurement of every various nodes and stores at intervals of the topology information table (TIT). By exchanging the TIT among the nodes, the topology is discovered. Once the origin node wishes to forward the knowledge packet to the destination, it utilizes the reactive route discovery technique where the multiple strategies are established by applying multipath Dijkstra algorithm. Once any intermediate node does not acknowledge following 2-hop information from TIT towards destination, the new multipath route discovery is performed. By simulation results, it is shown that the projected approach reduces the overhead.

Ali et al. [4–11] projected a title "QoS Aware Multipath Threshold Routing for Mobile ad hoc Networks". In this title, a different threshold-based multipath routing approach for enhanced QoS in MANETs is presented. In this approach, once the out there system of measurement of a link decreases below a defined threshold or average load or the forwarding delay at a node can increase on the so much aspect a defined threshold, traffic is distributed over fail-safe multiple routes to chop back the load at a full node. Through simulation results, we have got an inclination to point out that the projected approach achieves improved QoS in terms of end-to-end delay, packet delivery relation and output for constant bit rate (CBR) traffic when compared to optimized link state routing (OLSR), a popular single-path proactive protocol for MANETs.

Chopra and Kumar [5–12] projected a title "Efficient Resource Management for Multicast Ad Hoc Network: Survey". Throughout this title, multicast routing protocol got to be able to manage those resources as a result of their consumption depends upon varied factors, i.e. Unicast/Multicast network operations, dynamic topology attributable to quality, management overhead attributable to quality, packet loss and retransmission attributable to collision and congestion etc. of those factors may cause unnecessary network load, delay and unfair resource utilization. Multicast impromptu routing protocols are lot economical than unicast routing protocols, but they collectively suffer from performance degradation factors mentioned on prime of researchers who have developed various layerwise solutions for resource improvement. During this title, we will explore the varied schemes for truthful utilization of network resources.

Singh et al. [6–13] projected a title "A Survey on challenges in Multipath Routing for Ad hoc Networks". Throughout this analysis title, we have got mentioned about the issues of multipath routing in MANETs and performances of such MANETs which are compared for application of multipath routing and its effects on completely different labels to remain QoS.

Yi et al. [7–15] projected a title “M-OLSR for mobile ad hoc sensor network”. During this title, they described multipath routing through Dijkstra algorithm which is projected to induce multiple ways. The algorithm gains nice flexibility and extensibility by exploiting entirely different link metrics and value functions. In addition, route recovery and loop detection are implemented in MP-OLSR and thus it boosts the quality of service regarding OLSR. The backward compatibility with OLSR supported science offer routing is studied in addition. Simulation-supported QualNet machine is performed in many things. A test bed is in addition begun to validate the protocol in planet. The results reveal that MP-OLSR is acceptable for mobile, huge and dense networks with huge traffic and can satisfy necessary transmission applications with high on time constraints.

3 Our Approach for Network Congestion Control

In this section, we describe our proposed mechanism that represents how the network behaviour performed while we apply enhanced AOMDV protocol in MANET. The reliable scheme uses the multipath concept and also measures the link capacity and nodes storing and forwarding capacity. The main role in communication is that the networks are intermediate nodes responsible for receiving and forwarding data in network. In this section, given algorithm balances the network load and increases the reliability as well as scalability of the network using node capability-based load distribution methodology. Proposed routing mechanism initially searches the multiple routes from source to destination on the basis of node capability and selects the multiple paths based on capability of intermediate nodes. Link capability between two nodes identifies basis on data rate and bandwidth retrieval methodology. Select the link based on available bandwidth of the link and arrange the multipath with higher availability base. We also use the queuing technique that is useful for data storing and forward mechanism while the outgoing link bandwidth is lower than the incoming link bandwidth. The proposed multipath link estimation and node identification are totally different ways that will enhance the capability of AOMDV route selection mechanism which corrects load equalization in network.

The proposed algorithm controls congestion and provides reliable routing in MANET.

The number of senders = $S_{s,}$ Number of receivers = R_R and number of mobile nodes considered for simulation is M_n.

Step1 Sender (S_s) Broadcast Route Request (RREQ) and receive RREP to neighbours for finding Receiver (R_R)

Step 2 Select MPR units for further flooding of routing packets // MPR selection is reduces unnecessary flooding.

Step 3 If (Route in between S_S to R_R found)

Step 4 If (route > one) // alternative path are available

{

Step 5 If (Queue Length <=50 && Link Bandwidth <=10mbps)

{

Step 6 Select nodes for data transmission having maximum queue length space and link has maximum remaining bandwidth capacity.

Step 7 Send data through that path up to destination;

}

Step 8 else

{

Step 9 Go to step number 6

}

Else

{

Steps 10 **go** to step 2

}

Step 11 else

{

Route not exist

}

}

The unipath OLSR protocol is not able to handle the load in network but the proposed multipath is the protocol that handles the load in network efficiently by providing the alternative path possibility in network. In OLSR, each RREQ, respectively, RREP arriving at a node defines an alternate path to the source or destination. Just accepting all such copies will lead to the formation of routing loops.

4 Result Analysis

In this section, we measure the performance of normal OLSR proactive routing protocol. The multipath version of same OLSR protocol is named as Multipath-Cha Me Leon (M-CML) protocol. The third protocol proposed is multipath approach to extend performance by available node buffer capacity and link capacity with queue management.

A. Packet Delivery Ratio Analysis

The performance of proposed protocol is better as compared to existing OLSR and proposed M-CML protocol. The packets percentage is more because with multipath routing, the proposed approach also identifies the nodes and link that have maximum available capacity for communication. This shows that the proposed multipath protocol is able to handle more load in dynamic network. PDR performance of proposed protocol is about 99% in node density scenario of 20, 30 and 40 but in 10, the performance is about 94% while rest of the two protocol performance are not more than 85% in network. This shows that the performance of proposed protocol provides better routing performance in MANET (Fig. 1).

B. Average End-to-End Delay Analysis

The delay in network disturbs the whole performance, and this performance is affected by congestion and dropping of packets. In this performance metrics, the performance of proposed protocol is improved. The delay in all scenarios of node density of proposed routing is not more than 0.1 ms but the rest of the performance is more than 1.2 ms. The maximum delay in routing is measured in normal OLSR protocol. The proposed scheme minimizes packet dropping and reduces the possibility of retransmission that is why delay performance is also minimum (Fig. 2).

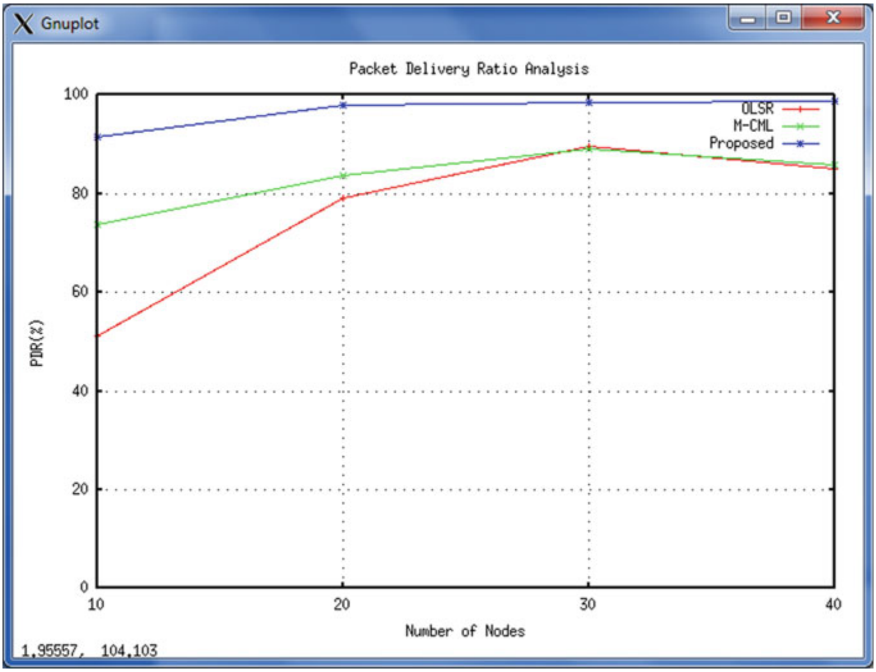

Fig. 1 PDR analysis

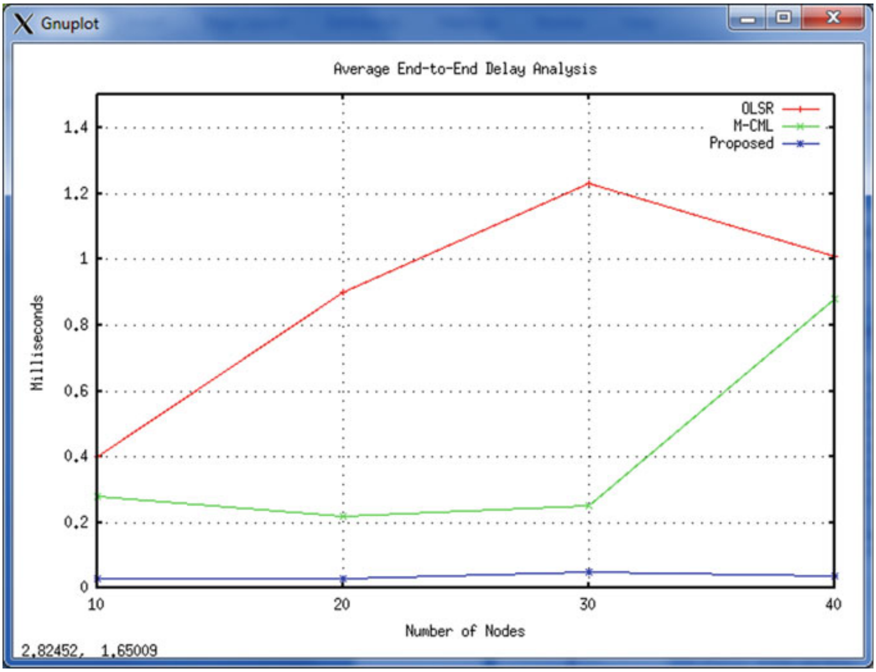

Fig. 2 Average delay analysis

C. **Throughput Analysis**

The proposed multipath protocol has better throughput as compared to existing normal OLSR and multipath M-CML. The throughput is evaluated to measure the performance of packets received per unit of time. In this graph, different node density scenarios show the better throughput performance. The throughput is almost about three times more as compared to normal OLSR and existing M-CML. The congestion control proposed scheme provides the lightly loaded path because of that the congestion possibility does not occur and packets receiving is increasing in dynamic network (Fig. 3).

5 Conclusion and Future Work

The congestion occurrence in MANET is due to limited bandwidth and node's limited processing capability. The link in between two nodes up to destination from source is creating the complete path in between source and destination. In this research, we compared the performance of three protocols. First one is original OLSR proactive routing protocol, i.e. routing table created on each node. Second scenario represents the performance of multipath version of OLSR, i.e. M-CML.

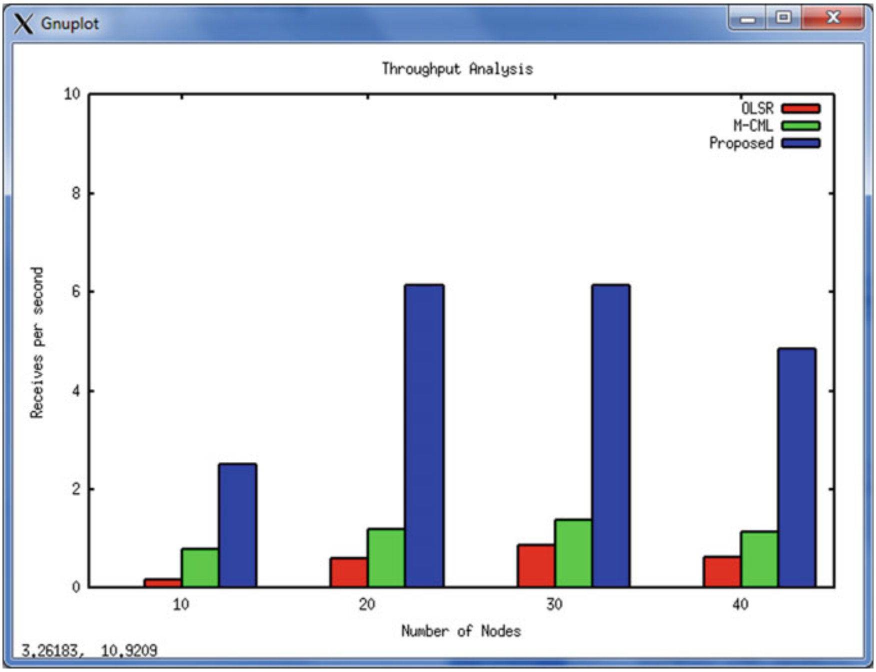

Fig. 3 Throughput analysis

Here the performance of normal OLSR is modified and provides the alternative path for routing to sender. In the third proposed scenario, OLSR protocol performance with multipath is measured but also including the new concept of more than one path selection on the basis of minimum available link and node's processing capability with nodes buffer management in MANET. As we know that if data load in network is routed through lightly loaded path that means the congestion possibility reduces in network. The proposed routing is degrades the drop of packets by that clearly visualized in results the routing overhead and delay in network is really more than two times is reduced. The performance of proposed scheme improves the network performance by providing better throughput and packets percentage ratio in dynamic network. The proposed routing performance is better than existing two protocols in MANET.

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A Comparative Study of Various Techniques Used in Current HGRSs

Akanksha Mantri and Maya Ingle

Abstract As computers become an integral part of our society, advancement in human–computer interaction (HCI) has benefited differently abled individuals. The absolute aim of HCI is to provide ease for interaction with computers and keep it as natural as interaction among humans. Communication through hand gesture is universally performed, though there are unresolved existing issues such as sensitivity to shape and size of hand, identification of gesture in less illuminated environment. However, there exists a lot of scope of research in Hand Gesture Recognition System (HGRS). In this paper, we present the current techniques used in each phase of the HGRS. A comparative study covers twenty-five current HGRSs based on key parameters which includes recognition rate, recognition time, techniques used for image enhancement, image acquisition. The main goal of the study is to explore the opportunities for research aspirants in this domain.

Keywords Hand Gesture Recognition System (HGRS) · Human–computer interaction (HCI) · Feature extraction · Recognition

1 Introduction

Human–computer interaction (HCI) has been one of the most prominent areas of research since early 1980s, and since then it has evolved from the use of punch cards to multimedia user interface [1]. HCI system includes character recognition, hand gesture recognition, voice identification, facial expression identification, facial expression recognition, etc. There has been a substantial increase in development of Hand Gesture Recognition System (HGRS) especially in perception of sign

A. Mantri (✉) · M. Ingle
School of Computer Science & Information Technology,
D.A.V.V, Indore, MP, India
e-mail: aakankshakutumbale@gmail.com

M. Ingle
e-mail: mayaingle22@gmail.com

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language. The foremost HGRS has been developed using hand gloves in 1981, and since then numerous systems have been evolved for different sign languages, for instance Indian Sign Language (ISL), Bangla Sign Language, American Sign Language (ASL), Chinese Sign Language (CSL), Brazilian Sign Language [2–6]. However, the intended users specifically the hearing- and speech-impaired audience are unable to exercise HGRS for interaction purpose. The problem of limited usability has arisen due to some limitations in the present systems such as availability of high-tech cameras or electronic gloves to the user. In this paper, a comparative study is performed to identify the limitations which will be an aid to the researchers for developing a user-friendly HGRS. Different techniques are used in HGRSs focusing mainly on accuracy and recognition time. Section 2 provides an overview of these techniques employed in current HGRSs especially. A comparative study of various HGRSs based on some vital parameters is presented in Sect. 3. Finally, we conclude with some important results in Sect. 4.

2 Hand Gesture Recognition Systems (HGRSs)

HGRS comprises of various phases, namely image acquisition, image enhancement, feature extraction, segmentation, gesture recognition, and translation. Over the years, a large variety of methods have been used in each phase to realize HGRS which decides the applicability of the system. The methods employed in current HGRSs are discussed briefly as follows.

2.1 Image Acquisition

Image acquisition is the initial phase of the HGRS which involves capturing gestures using sensors, camera(s)/electronic gloves. Before an image is captured, a number of specifications which includes the type of camera used, image frame resolution, lighting conditions, type of background, type of gestures have to be speculated. HGRS using three-axis accelerometer (ACC) and multichannel electromyography (EMG) recognizes 40 CSL sentences, 72 CSL words, and 18 hand gestures [2]. Other devices such as Kinect RGB-D sensor camera, CyberGolve II, and stereo camera have been used in HGRS which provides additional information about the gesture formed. To recognize the ISL gestures with single hand and double hand, Kinect RGB-D sensor camera has been used [3]. The Nuvo Minrou stereo camera made it easier to capture six motional hand gestures and six fingerspell gestures in variable lighting condition [7]. A four-camera HGRS model consisting of three black and white cameras, and one color camera captures images in the static plain background, produces images of 312×214 frame size, and identifies ASL gestures with optimum accuracy [8]. User wearing black sleeves during the image acquisition process using a simple web camera helps greatly in segmentation phase [9].

2.2 Image Enhancement

In this phase, feature of interest is highlighted from an image exercising various techniques, for instance color space conversion, image resizing, noise removal, image smoothing. Color space conversion is most commonly used technique in HGRS in which the RGB image is commonly converted into gray scale, YCbCr, CIE, HSV, or CMYK [4, 10, 11]. Image resizing is observed to be useful when capturing images of varying size, while it is generally avoided when the frame size is held constant during image acquisition phase [5, 9]. Generally, smoothening of the image is succeeded by using Butterworth low-pass filter, Gaussian filter, Median filter, Kalman circular filter, and homomorphic filter which are likewise utilized for image sharpening [12–15]. Hamming window is a sophisticated method to smooth images and works better with ACC and EMG sensors [2].

2.3 Feature Extraction

Feature extraction phase incorporates techniques that extract features, for example edge, finger spelling, gradients, haar-like feature, contour, moments, depth. The Canny edge detection algorithm gives much better results in HGRS as compared to other algorithms, especially when compared to Sobel [15–17]. The edge oriented histograms (EOH) technique does not yield satisfactory results in accurately distinguishing gestures when compared to aforementioned techniques [5]. The histogram of oriented gradients (HOG) technique depends on the pixel intensity and incurs best results with RGB-D sensors [3]. Contour and silhouettes are yet another way of using pixel intensity, though they do not produce consistent results [6, 14]. Haar-like feature is advancement over the above-mentioned intensity-based features and provides faster results, especially when used with SVM classifier [18–20]. HGRS based on depth provides the least recognition time [21, 22]. Moments are easily extracted from the images captured using stereo camera and yield better results as compared to features extracted from images captured using a normal webcam [7, 10]. HGRS employing finger spelling has limited application and is not consistent with a variety of gestures [23].

2.4 Segmentation

Segmentation phase incorporates techniques that comprise of background subtraction, color-based segmentation, contouring, thresholding, etc. In this phase, an image is segregated into its elements such that Region of Interest (ROI) is received from the remaining section. The remaining section is normally experienced as background and ROI as the foreground of the picture. The background subtraction technique is suitable only when the background is static and images are captured in constant lighting condition [15]. Color-based segmentation is majorly used in HGRS considering skin color isolates the hand gesture and it can be applied in combination with contouring, K-means clustering, or blob detection [7, 9]. Thresholding is the most trivial approach for segmentation based on the intensity difference of the ROI and background. Otsu's method for optimum global thresholding is frequently employed to carve up the hand and face from the background. It also assists in noticing the hand trajectory in the frame sequence [13]. In some cases, variable data obtained from sensor device such as Kinect helps to segment the ROI [6].

2.5 Gesture Recognition

Gesture recognition phase consists of techniques based on pattern recognition and classification. Classification techniques are mainly of two types of classification based on decision-theoretic methods and structural methods [12]. Dynamic time wrapping (DTW), feature covariance matrix, support vector machine (SVM), and hidden Markov model (HMM) are some popular techniques used for gesture recognition. DTW is able to cope with different speeds of motional gestures, and it helps in recognition of motional hand gestures [7]. Image-to-class DTW (I2C-DTW) is an innovative approach to classify ASL-based gesture. Using the method, static gestures are classified based on the concept of fingerlets and hand trajectory gestures are classified based on the concept of stroklets [16]. Feature covariance matrix has been a convenient way to classify the multiple features extracted from the images and creates a compact representation of gestures [8]. Similarly, SVM is more efficient means of classifying gestures based on multiple features [6, 9, 14, 19]. HMM embedded in level building algorithm efficiently classifies the CSL sentences with five signs each. This method reduces the error rate from 33.80% (using threshold HMM) to 13.40% [24]. The Euclidean distance, Manhattan distance, K-Nearest Neighbor (KNN) and Artificial Neural Network (ANN) are pattern recognition techniques used to identify gestures [13, 15, 25].

2.6 Translation

The last phase of HGRS is the translation phase which is responsible for generating the actual output of the HGRS based on the functionality of the system. Generally, the recognized character/word/sentence is displayed on screen after the recognition of gesture(s) [2, 12]. Instead of only displaying the result on screen, an audio sound can be produced which helps the differently abled population to communicate hassle-free with common public. We can also take some action such as controlling the position of the mouse pointer based on the movements of hand [26].

3 Comparative Study of Existing HGRSs

We have examined discrete HGRSs for several languages, and thus analysis is based on different techniques used in each phase. The techniques implemented in the image acquisition phase determine the usability of the system in variable environments, by scrutinizing the system based on specific hardware. In image enhancement phase, the preferred techniques selection depends on the image captured, for instance image captured in ideal environment with constant lighting condition and plain background. Also, if images are captured using multiple cameras, image resizing is necessary as features are based on the size of the image. The techniques involved in feature extraction phase determine the complexity of the system and the recognition time required by it. The low-level features based on pixels are less complex to deduce than the high-level features. On the other hand, recognition time of the system is huge for low-level features as compared to high-level features. The high-level features such as moments, finger spelling, HOG, depth, like feature are obtained from depth-based cameras as well as electronic gloves. The segmentation techniques totally depend on how an image was captured, identical to image enhancement techniques. The Kinect RGB-D sensor camera allows to segment an image using largest blob extraction method. The classification technique used in gesture recognition phase is the key factor to decide the size of the database required. Hence, Euclidean distance requires larger database and ANN requires a small set of training database. In translation phase, the techniques used define the application domain of the system where the system that produces an audio sound for the gesture recognized will be useful for the deaf and dumb audience to directly interact with normal audience. The comparative study includes distinct HGRSs that have unique combination of different techniques to analyze all on a common base, and few parameters have been defined. The parameters used to compare HGRSs are mainly database size, type of gesture to be recognized, recognition rate as well as recognition time. These parameters allow us to investigate the influence of various methods on the overall performance of HGRS. Database size reveals the amount of space required by the system for recognition of gestures. Further, larger database as compared to the number of distinct gestures to

Table 1 Comparative study of various HGRS techniques

Ref. paper	Image acquisition	Image enhancement	Segmentation	Feature extraction	Gesture recognition	Translation	Database size	Type of gesture	Recog. rate	Recog. time
[2]	ACC and EMG	Hamming window	Moving average algorithm and thresholding	ACC mean absolute value	Decision tree and HMM	Output on screen	Not given	40 CSL sentences, 72 CSL words, and 18 hand gestures	85.95% avg.	Not given
[3]	Kinect RGB-D sensor camera	Difference of Gaussian (DoG)	Histograms of oriented gradients (HOG)	HOG scale-invariant feature	Support vector machine (SVM)	Output on screen	80 ISL gestures	ISL gestures with single and double hand	93.9% avg.	Not given
[7]	Stereo camera	NA	Color-based K-means clustering	Hue moments	Dynamic time wrapping (DTW)	Output on screen	Not given	6 motional hand gesture and 6 fingerspell hand gestures	92.5% avg.	Not given
[8]	4-camera model	Median, mode, and serial particle filters	Background subtraction	Serial particle filter	Feature covariance matrix	Output on screen	RWTH-BOSTON-50	ASL gestures	87.33%	Not given
[9]	2 Web cameras	Image resizing	Color segmentation	HOG	SVM	Output on screen	60 samples	0-10 digits	95.03%	Not given
[4]	Vision-based	Color space conversion	YCbCr	Linear discriminant analysis (LDA)	Multilayer perceptron with backpropagation	Output on screen	330 samples	15 Bangla Sign Language letters	100%	Not given
[10]	USB camera	Color space conversion RGB to HSV	Skin detection and contour extraction	Template formation	Euclidean distance	Output on screen	Not given	10 digits	91% avg	Not given
[11]	Vision-based	Color space conversion RGB to HSV	Background subtraction and object tracking	Skin color detection	Centroid gesture trajectory	Output on screen	Not given	10 gestures	(80–100)%	Not given
[5]	Vision-based	Median and Gaussian filters	Extract largest BLOB	Edge oriented histogram (EOH)	K-cluster EOH match algorithm	Text	2600 samples	26 ASL alphabets	88.26%	0.5 s

(continued)

Table 1 (continued)

Ref. paper	Image acquisition	Image enhancement	Segmentation	Feature extraction	Gesture recognition	Translation	Database size	Type of gesture	Recog. rate	Recog. time
[15]	Vision-based	Median and Gaussian filters	Background subtraction	Sobel edge detection	Euclidean distance	Text	2600 samples	26 ASL alphabets	90.16%	0.5 s
[12]	Vision-based	Median and mode filters	Otsu's method	Horn–Schunck method	Absolute difference between histograms	Output on screen	RWTH-BOSTON-50	50 isolated ASL gestures	22.92 error rate	Not given
[6]	Kinect RGB-D sensor camera	NA	ROI through Kinect sensors	Using sensor data	SVM and Hamming distance	Output on screen	Not given	34 Brazilian Sign Language	(70-97)%	Not given
[16]	Kinect RGB-D sensor camera	NA	Contour extraction	Canny edge detection	Image-to-class dynamic time wrapping (I2C-DTW)	Output on screen	UESTC-HTG 1600 and UESTC-ASL digits 1100	ASL gestures	96.14% avg	Not given
[17]	Vision-based	Morphological dilation	Skin color segmentation	Sobel edge detection and area calculation	The Gaussian three membership curves	Output on screen	390 gestures	ASL alphabets	85.30%	0.68 s
[13]	Kinect RGB-D sensor camera	Median filter	Contour extraction	Polygon regression fitting curve	Manhattan distance	Output on screen	180 images	Digits 0-5	Not given	61 ms
[18]	Vision-based	Not given	Sub-window	Haar-like feature	AdaBoost algorithm	Output on screen	450 samples of 4 postures	4 hand postures	95.7%	2.56 s
[19]	Vision-based	Color space conversion, RGB to gray	Color-based ROI	Haar-like feature	SVM	Output on screen	Not given	4 dynamic and 2 static gestures	94.62%	3.81 ms
[20]	RGB-D sensors	Not given	Hand segmentation	Haar-like feature	Feature selection-based class separability	Output on screen	MSR gesture 3D dataset	Not given	89.60%	Not given

(continued)

Table 1 (continued)

Ref. paper	Image acquisition	Image enhancement	Segmentation	Feature extraction	Gesture recognition	Translation	Database size	Type of gesture	Recog. rate	Recog. time
[21]	RGB-D sensors	Not given	Based on depth maps	Mean subtraction	Convolutional neural networks (CNN)	Output on screen	31,000 depth maps	Not given	99.99%	3 ms
[22]	Kinect RGB-D sensor camera	Not given	Depth motion maps	HOG	DMM +HOG	Output on screen	MSR gesture 3D dataset	Not given	94.94%	Not given
[23]	Vision-based	Color space conversion, RGB to YCbCr	Skin color segmentation	Parallel edge feature	Proposed finger detection	Output on screen	85-150 sample of 14 gestures	14 gesture	Not given	Not given
[27]	Kinect RGB-D sensor camera	Linguistic filter	Sensor-based	Guided cross-validation a(HCCV) with three-state Bakis HMM			CASIIE-SL-Database 1200 samples	Not given	Word error rate - 2.98%	Not given
[14]	Kinect RGB-D sensor camera	Circular and Kalman filter	Hu moments	Centroid of ROI	SVM	Output on screen	80 gestures	ISL	97.50%	Not given
[25]	Kinect RGB-D sensor camera	NA	DTW and Vertibi	SIFT and BOW model	KNN	Output on screen	ChaLearn gesture dataset	Not given	19.26% Levantine distance	Not given
[28]	Kinect RGB-D sensor camera	NA	Sensor-based	Level building fast HMM	HMM	Output on screen	100 sentences	CSL	12.20% method error rate	8.98 s per sentence

be recognized scales down the efficiency of HGRS. It is important to determine the range of gestures a system has identified in such a way that it implies its usability. The recognition rate expresses the accuracy of the system to identify correct gesture where recognition time states the overall speed of the system. A comparative study of discrete HGRSs and their performance is summarized in Table 1.

4 Results and Conclusion

The comparative study of various HGRSs performed using the aforementioned parameters and techniques reveals the following observations correlated with the overall performance and usability of the existing system.

- More serious outcomes are obtained when high-tech cameras and sensors are used/when user wears gloves during image acquisition phase, whereas result depicts that the system becomes extremely dependent on the hardware configuration.
- Color space conversion method using YCbCr and HSV provides the best outcome with the highest recognition rate, but it only works for certain color background.
- HGRS using high-level features attains recognition rate above 90%, while it is highly dependent on the hardware configuration.
- Two-Hand Gesture Recognition System provides 100% recognition rate much as this system calls for constant lighting conditions and training images have to be provided before actual recognition [4].
- Finger spelling HGRS gives 99.99% recognition rate where it is highly dependent on depth data that reduces its usability which employs simple cameras. Similarly, it takes a much larger database and lowers the overall efficiency of the system [21].
- I2C-DTW HGRS obtains a recognition rate of 96.14% using edge detection techniques based on depth-based camera that reduces system's usability with a simple camera [16].
- Real-time HGRS provides 90.16% recognition rate that requires smaller database as compared to the aforementioned systems. Also, the images are captured with a simple USB camera with complex background that widens system's usability [15].

These observations reveal that though high accuracy is obtained using high-tech cameras however, computing high-level features has limited usability. However, systems using USB cameras/any simple camera that extract low-level features have wider usability. Consequently, a great deal of scope still exists in the development of HGRS using simple cameras. These deduced observations will be helpful to the researchers from the domain of hand gesture recognition.

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A Compact Monopole Antenna Using Meander Lines and Defected Ground Structure for Applications in TV Band

Sanjeev Kumar, Ajinkya Joshi and Neela Rayavarapu

Abstract The paper presents an antenna design suitable for applications in TV white space frequency band. Monopole antenna incorporating meander lines and defected ground structure (DGS) are proposed in this paper. The antenna is designed on Rogers RO3203 substrate fed by microstrip line over DGS. Meander lines and DGS techniques are combined together to reduce the physical size of proposed antenna and to enhance the performance. Meandering structure helps in increasing effective electrical length while DGS provides improvement in bandwidth. The fabricated antenna resonates at 620 MHz with reflection coefficient of −16 dB and wide 98 MHz bandwidth. Also measured VSWR is less than 2. In addition, omnidirectional radiation patterns are observed at operating frequency.

Keywords TV white space · Meander lines · Defected ground structure (DGS) Microstrip patch antenna

1 Introduction

TV white space (TVWS) range of frequencies is unused broadcasting frequencies after conversion of analog TV transmission to digital TV transmissions, worldwide. TVWS band at sub-GHz frequency range has excellent propagation characteristics and is being widely considered for wireless applications to meet the growing demand for data. To design an antenna which will serve wireless handheld

S. Kumar (✉) · A. Joshi · N. Rayavarapu
Department of Electronics & Telecommunication, Symbiosis Institute of Technology, Pune, India
e-mail: sanjeevkumar@sitpune.edu.in

A. Joshi
e-mail: ajinkya.joshi@sitpune.edu.in

N. Rayavarapu
e-mail: neela.rayavarapu@sitpune.edu.in

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applications at these frequencies, size is a major consideration. The challenge is to shrink the size of the antenna.

Various methods have been implemented to reduce the size of an antenna. Illustration of TVWS spectrum sharing and details about 802.11af standard are available in [1]. Different methods for antenna miniaturization have been enumerated in [2]. In [3], three designs have been implemented by using meander line and planar inverted-F antenna (PIFA) methods in the sub-GHz range. Meander lines increase the path for current flow hence helps in reducing antenna size. In [4], a compact dual-band monopole antenna using meander line is proposed which has operating frequency above 2.4 GHz. Defected ground structure (DGS) is an etched recurrent or irregular cascaded layout defect in ground of a planar transmission line (e.g., microstrip, coplanar, and conductor-backed coplanar waveguide) which interrupts the shield current distribution in the ground plane. In [5], the fundamental idea and transmission characteristics of DGS segment and the identical circuit models of DGS segments are presented. DGS is a suitable way to realize the slow wave effect. It has been broadly used in the progress of miniaturized antennas [6–8]. In [9], partial ground plane is proposed for ultra-wideband (UWB) antenna which has reduced antenna size. A compact printed monopole antenna using DGS for applications in TVWS is reported in [10].

However, almost all the reported methods and designs are being used for antennas operating above one GHz range. This paper, however, presents antenna design which incorporates two different miniaturization methods to obtain better results. The TVWS refers to the frequency range of 470–790 MHz, which is the lower part of UHF band. Among the techniques to reduce the size of the antenna, meander line and DGS have been discussed in the literature as separate techniques. The paper describes the use of both of these techniques together in the proposed design.

2 Methodology

The aim of this paper is to design an antenna for a handheld device which will work at TVWS band of frequencies. This paper describes the use of meander lines and DGS for reducing the size of an antenna. The antenna is designed, simulated, and analyzed using ANSYS HFSS tool.

2.1 Meander Lines

Meander line structure geometry helps in obtaining broadband performance in small antenna envelope. Meander lines increase effective electrical dimensions of the patch. This, in turn, makes the antenna work at a lower range of frequencies without further increment or change in antenna dimensions. Meander line antennas also feature reduced specific absorption rate (SAR) due to their distributed near-field radiation. Therefore, meander line antennas can be safely used in handheld mobile devices as it can cause lesser amount of damage from radiation to human bodies.

2.2 Defected Ground Structure (DGS)

DGS means intentionally designed defects in the ground plane, which creates beneficial inductive and capacitive effects on the designed structure. DGS is an etched recurrent or irregular cascaded layout defect in ground of a planar transmission line (e.g., microstrip, coplanar, and conductor-backed coplanar waveguide) which interrupts the shield current distribution in the ground plane. This interruption will modify characteristics of a transmission line such as line capacitance and inductance. Essentially, any fault etched in the ground plane of the microstrip can give soar to enlarging effective capacitance and inductance.

The disadvantage in patch antennas is the stimulation of surface waves that takes place in the substrate layer. Surface waves are unwanted because when a patch antenna radiates, a part of total obtainable radiated power becomes trapped across the surface of the substrate. It can divert total obtainable power for radiation to this space wave. Therefore, a surface wave can minimize the antenna efficiency, gain, and bandwidth. This can be overcome with the use of DGS.

Thus, these two size reduction methods are combined together in the proposed design to achieve better results. The meander line can increase the effective electrical length of the patch and because of defected ground plane can result into higher bandwidth.

3 Antenna Design and Simulation

The configuration of the proposed antenna is shown in Fig. 1. The antenna is designed on 76 mm × 44 mm Rogers RO3203 substrate with dielectric constant of $\varepsilon_r = 3.02$ and thickness $h = 1.6$ mm. The antenna is fed by a 4 mm width microstrip line over DGS as shown in Fig. 1. The size of meander line structure is 54 mm × 44 mm with a width of 2 mm and a gap of 2 mm between the spirals.

Figures 1 and 2 show the design of the proposed antenna along with associated dimensions in simulation tool. Since the direction of the current on the meander line is usually opposite for neighboring wire, therefore, the antenna gain will be low. To overcome this problem in our proposed design, the current in the meander wire follows the same direction, and thus, the transmission gain and the radiation efficiency are enhanced. Modifications are intentionally done in ground plane to increase the bandwidth. Such modifications in a ground plane also help in miniaturization. The main advantage of defected ground plane is to reduce the excitation

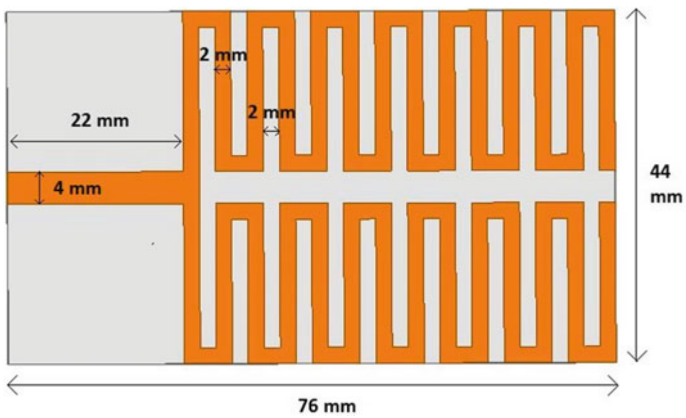

Fig. 1 Meander line patch

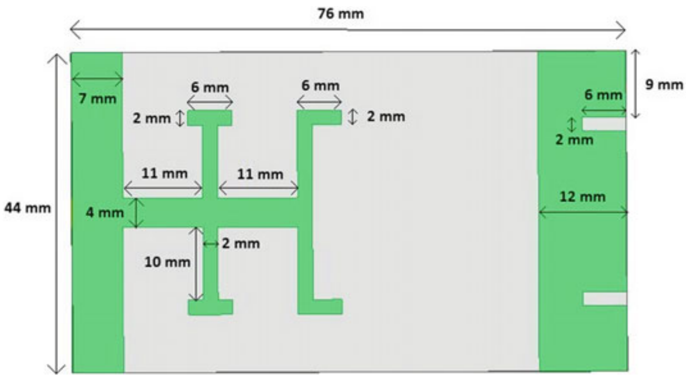

Fig. 2 Ground plane

of surface waves which arise in substrate layer due to which transmitting power is trapped between substrate. Thus, maximum power is being used for radiation.

Plots of S_{11} and 2D radiation have been shown in Figs. 3 and 4, respectively. The reported antenna design in [3] can be compared with the proposed design in the paper. Reported design in [3] uses partial ground plane with measured reflection coefficient of −23 dB at 825 MHz and around 50 MHz bandwidth at −10 dB as mentioned. The reflection coefficient of −26 dB at 737 MHz is obtained during simulation of the proposed antenna design. Also the −10 dB bandwidth of 94 MHz is obtained. Generally, the patch antenna or planar antennas have low bandwidth. Here the use of DGS improves the bandwidth by a significant amount. Comparing the bandwidth mentioned in [3], it is almost doubled in the proposed design.

The 2D radiation plot of the proposed antenna is shown in Fig. 4. The maximum radiation occurs on the broadside axis, i.e., 0°–180°. The gain of the antenna is

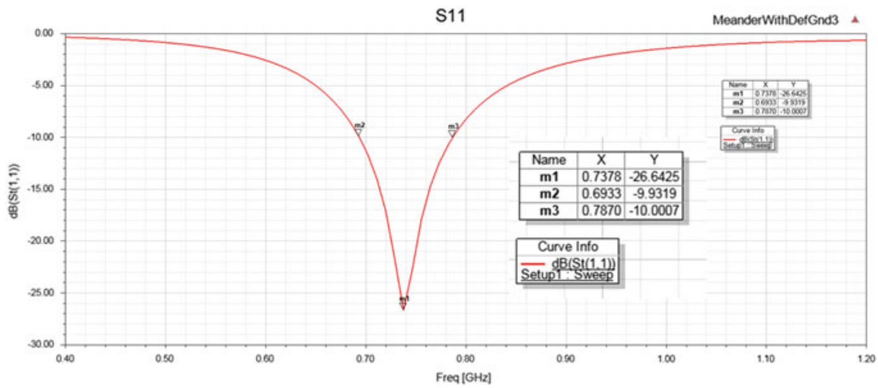

Fig. 3 Simulated S-Parameter plot

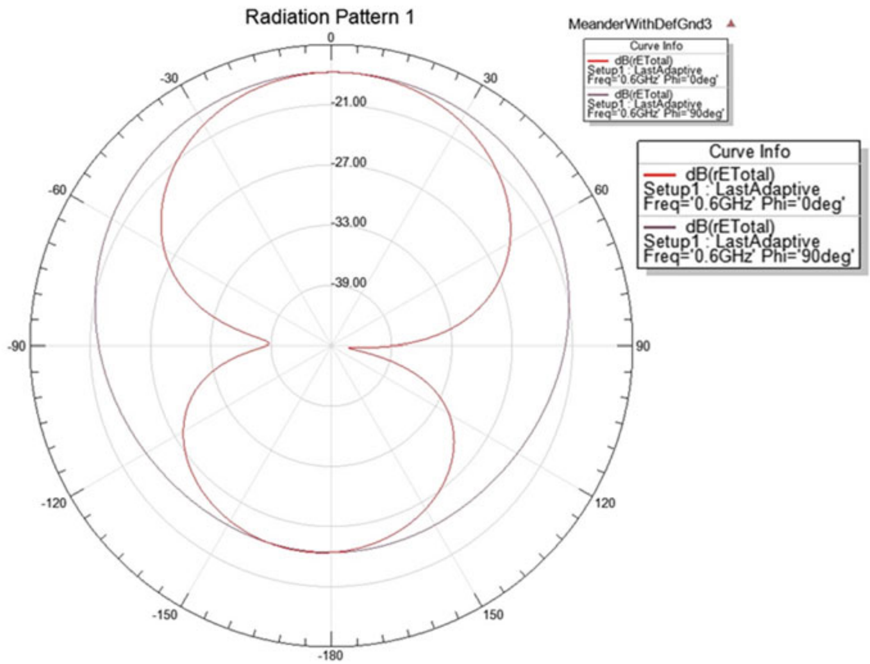

Fig. 4 Simulated 2D radiation pattern

maximum on the broadside, and it reduces as the angle increases with the broadside axis.

Figures 5 and 6 show the current distribution in patch and ground plane, respectively. The maximum current on the feedline is about 8 A/m. It gets distributed as it encounters meander line, and then, it starts to reduce as we go on

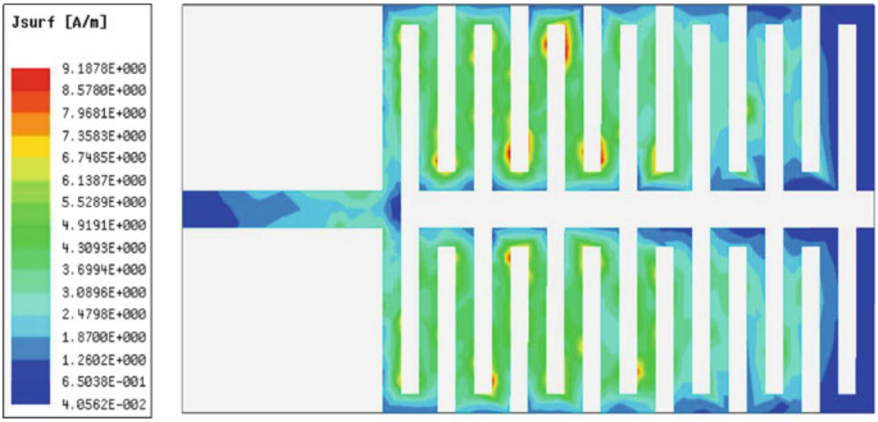

Fig. 5 Current distribution in patch

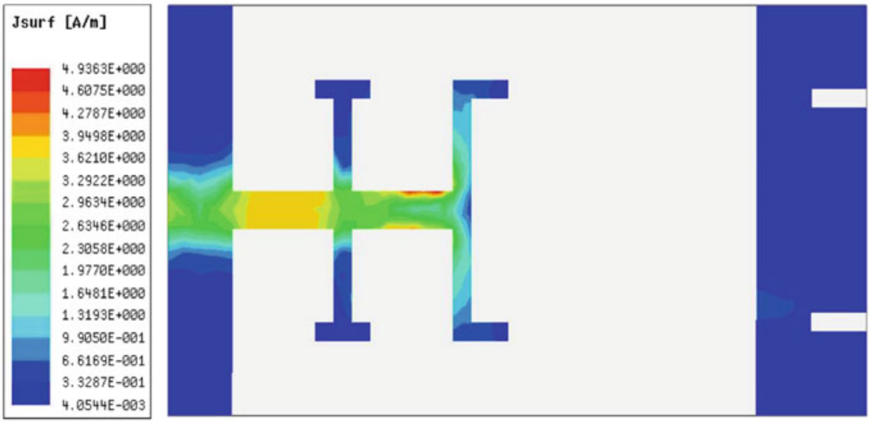

Fig. 6 Current distribution in ground plane

further. The vector represents the radiation which shows that the proposed antenna radiates from its edges just like a regular patch antenna. In Fig. 6 the ground plane experiences current of about 4 A/m on the area which is exactly below feedline. The current is maximum, i.e., 5 A/m near the port and as you move along y-axis in both directions from the port the current starts to reduce. Current is more focused on the straight area from the port and then at the end of the structure it gets distributed. It can be understood from Fig. 6 that most of the current is associated with the edges. Figure 7 depicts simulated value of voltage standing wave ratio (VSWR). Table 1 shows a comparison of simulated and measured value of SWR. The amount of reflected power has been observed to be more in case of measured parameter due to the impedance mismatch.

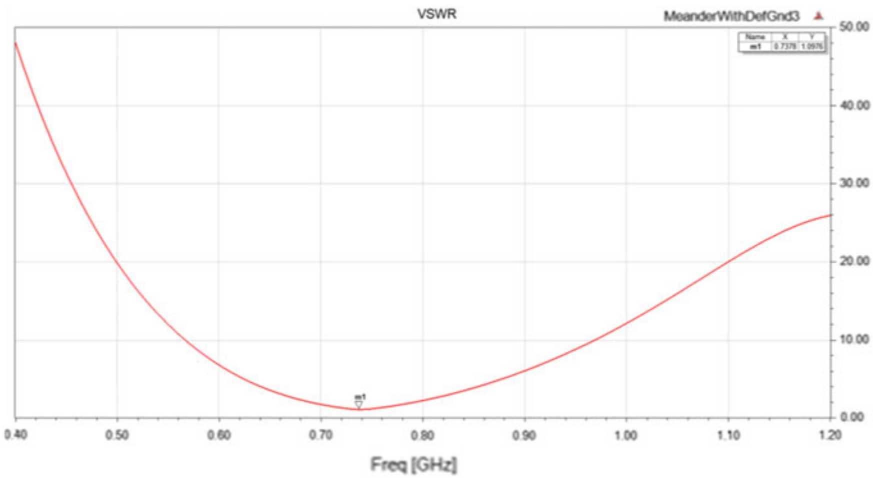

Fig. 7 Plot of VSWR

Table 1 SWR versus reflected power

Parameter	Simulated	Measured
SWR	1.09	1.6
% power reflected	0.185	5.30

4 Fabrication and Results

Figures 8 and 9 show patch and ground surfaces, respectively, of the fabricated antenna. It can be seen from Figs. 8 and 9 that the size of an antenna is $76 \times 44\ \text{mm}^2$, and thus, it can be installed into mobile handheld devices easily.

The fabricated antenna was subjected to test on a ROHDE & SCHWARZ ZVB4 vector network analyzer having a range from 300 kHz to 4 GHz. Figure 10 shows screenshot of the measured results of standing wave ratio (SWR), S_{11} (S-Parameters), and Smith chart.

The fabricated antenna resonates at lesser frequency compared to simulated design results. It can be seen from Fig. 9 that the fabricated antenna radiates at 620 MHz which fits into the required frequency band. The value of $S11$ is −16 dB at 620 MHz as shown in Fig. 10. The measured bandwidth is about 98 MHz at −10 dB which is an encouraging result. SWR of 1.6 is obtained at 620 MHz which is also in the acceptable range. The plot of Smith chart which shows impedance value of around 56 Ω which is close to the characteristic impedance of 50 Ω of the transmission line.

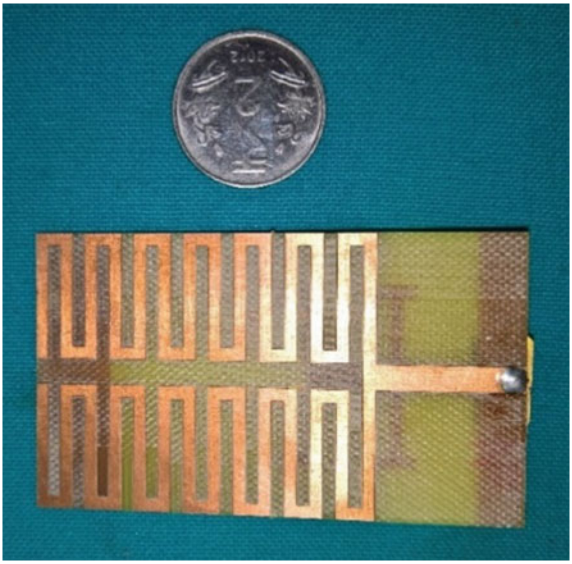

Fig. 8 Meandering patch structure

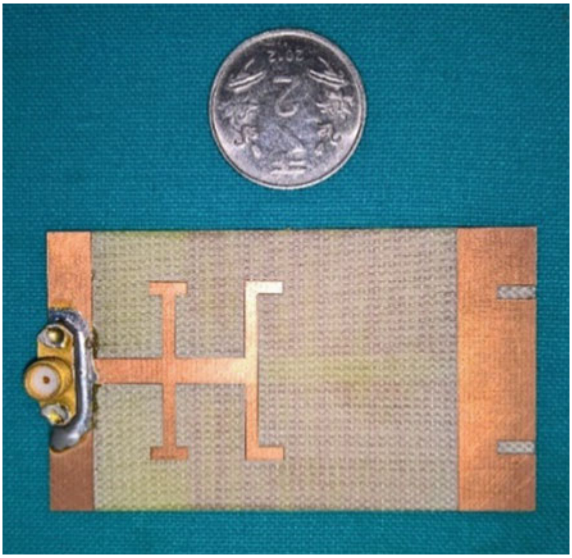

Fig. 9 Defected ground structure

Overall, the results of the fabricated antenna observed on the vector network analyzer are in the acceptable range. Hence, proposed antenna design can be useful in real-time applications. Table 2 shows comparison of simulated and measured quantities of the different parameters.

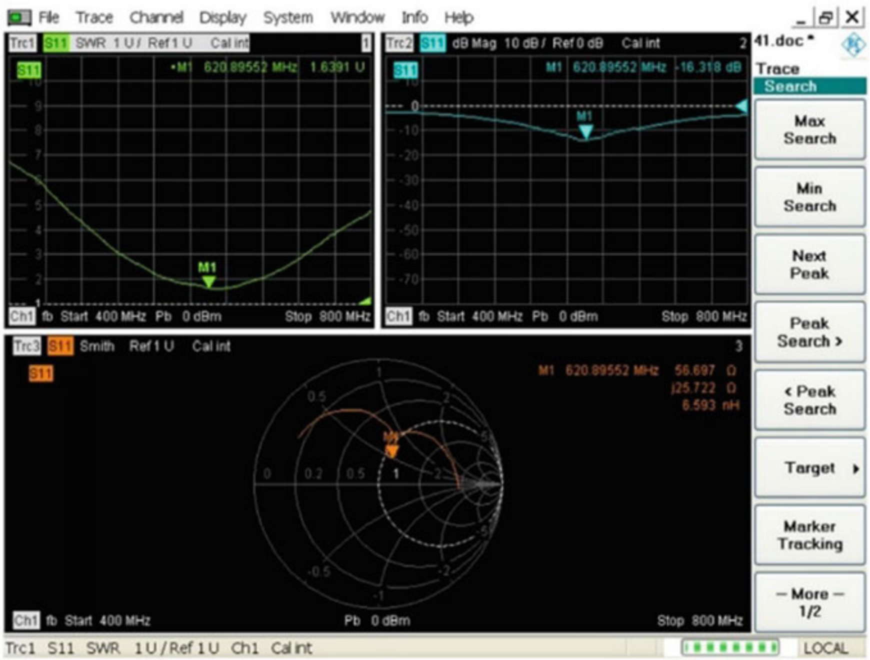

Fig. 10 Results on vector network analyzer

Table 2 Comparison chart of simulated and measured results

S_{11} (S-Parameter)		Bandwidth		SWR	
Simulated	Measured	Simulated	Measured	Simulated	Measured
−26.6 at 737 MHz	−16.31 at 620 MHz	94 MHz at −10 dB	98 MHz at −10 dB	1.09 at 737 MHz	1.6 at 620 MHz

5 Conclusion and Future Directions

In this paper, the design of miniaturized antenna with the combination of meander lines and DGS techniques suitable to function at sub-GHz TV white space range is proposed. The simulated and measured results are compared, and it can be stated that the results of the fabricated antenna are at a lesser resonant frequency compared to simulated results. There is some difference in the resonating frequency between simulated and fabricated design but bandwidth obtained is almost same in both the cases. The variation in results is attributed to impedance mismatch which can be improved upon. Optimizing the parameters of designed antenna in ANSYS HFSS leads to achieving better results.

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Interference and Congestion Control Using Multichannel Energy-Based Routing in MANET

Astha Mishra and Ashish Singh Baghel

Abstract Mobile ad hoc sensor communication is a recent trend of network structure which provides dynamic, decentralized service to the end users. Due to node mobility and energy issue, these networks face many challenges, i.e., security, interferences, congestion limited channel availability. In this paper, we incorporate various existing research studies and found that most of them resolve the problem of congestion and energy issues. So here we proposed a methodology that overcomes the problem of interference, congestion using multichannel energy-based routing approach. In the result section, we compare the outcome through packet delivery ratio, throughput, delay analysis in three different cases, i.e., ITCD, enhanced ITCD, and our proposed approach, and conclude that proposed approach is more suitable for the MANET environment.

Keywords MANET · ITCD · Delay · Multichannel · Energy AODV

1 Introduction

Nowadays, wireless mobile ad hoc sensor communication is incredibly the research area in the field of network communication. In mobile ad hoc sensor network each device are dynamic move and form infrastructure less communication. That also generates the interference because multiple nodes simultaneously execute single route, interference consume the power of transmission of nodes and drop the data packets. While another side, wired communication easily manage the interference because cable connection protect the interference between links [1]. In this paper we enhanced the AODV routing protocol using interference and delay control

A. Mishra · A. S. Baghel (✉)
Department of Computer Science, Vindhya Institute of Technology and Science, Satna, India
e-mail: baghel.ash.12@gmail.com

A. Mishra
e-mail: asthamishra391@gmail.com

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mechanism that work increase the network lifetime and minimized the data drop from the network. In this title, we control the interference with the multichannel and clear to send/request to send methodology. In any case while the multiple node wants the channel through same intermediate nodes than request to send message generate by the each sender and forward to the intermediate nodes and while the intermediate node receives those RTS message than generate the CTS message and assign the priority order as well as grant the different channel to the sender node so that no collision and interference occur in the network. A network partitioning will occur where the topology becomes too distributed. Similarly, a network that is just too dense is at risk of interference at the medium access (MAC) layer, the physical layer of the network. If the network got to neither be too dense nor too distributed for reasonable communication amongst nodes to want place. Mobile spontaneous wireless networks are energy-based approach since nodes operate with restricted battery energy. If some nodes die early owing to lack of energy, they cannot communicate with one another. Therefore, undue consumption of nodes energy ought to be prevented. Node energy consumption ought to be balanced so as to extend the energy awareness [2–4] of networks and determine the theme has been planned that utilizes energy standing of every mobile node and less energy consumption methods.

2 Literature Survey

In MANET, power aware is important challenge issue to improve the communication energy efficiency at individual nodes. Most of the researchers have recently started to consider power-aware development of efficient protocols for MANET which is discussed below:

Namdev et al. [1] proposed a paper on the title “Interference based network topology management mechanism for delay constrains mobile ad hoc communication”; in his title, they provide link stability method using interference identification of nodes and increase reliability of the network.

In his work, they select the route from source to destination using higher energy of nodes with minimum movement. If the node movement is considered low than the possibility of nodes out of radio range is really minimum and due to sufficient amount of energy presence in node is not unpredictably break of link and provide minimum interference based communication. Rajaram and Muthuramalingam [5] work in network clustering algorithm minimized the number of network clusters and enhanced the network load balancing factor that also increase the network lifetime. The proposed mechanism managed the network structure as well as energy consumption on the bases of node coverage range. If the interference of nodes is near than required signal strength is higher and required transmission power is lower. The proposed approach provides the reliable communication between communicator nodes. Thuan et al. [6] proposed a local tree-based reliable topology that modified the effects on network connectivity. It uses the edge connectivity which is greatly reliable as compared to another approach. Those mechanism increases the network coverage area under mobile ad hoc network. Their simulation result gives better result as compared to existing mechanism and increases the transmission range of the network.

Qin [7] has proposed a mechanism that construct network topology and fulfill the requirement of quality of service of the data with low power utilization of the network that work layer wise different significant work are done i.e. physical layer, it is adopted that cooperative communication which combines partial signals to obtain completer information and network layer perform, the whole routing strategies and suitable route are selected from source to destination nodes. In this title, they also work in the field of energy-based routing that provides the strength to meet quality of service for the communication. Saranya and Bharathi [8] proposed a secure adaptive decentralized control algorithm which provides control topology with secure communication to the network connected nodes that work in four phases, i.e. attacker node detection, group generation, security key allocation, and security key regeneration. For the attacker node, detection encryption and decryption methodology apply and detect the attacker nodes from the network. In the group formation or cluster formation election message are broadcasted and elected the cluster head that manage the communication and treated like a head of the network. In next step, of security key allocation that provide by the cluster head is allocated key to all sender nodes so that the data exchanged in secure manner. Rout et al. [9] proposed distance primarily-based sleep scheduling to modify topology management drawback at network layer and additionally facilitate to cut back total energy consumption of network to maximize network life in this protocol; it takes farthest node in its transmission range for routing. That node is geographically nearer to the destination. The amount of nodes in packet transferring is a smaller amount. Energy conservation is completed by utilizing energy of little set of nodes. Sleep based mode, is mostly approaches for the opposite idle node minimizes energy consumption of the network. Uma and Shantharajah [10] proposed energy-efficient network topology management mechanism under mobile sensor network. Their proposed work dynamically regulates the transmission, receiving power of mobile sensor devices and builds a new topology which convenes the requirement of bandwidth and network end-to-end delay and further minimizes the overall power consumption of network. That model has been evaluate through comparison between on-demand (AODV) with table-driven (DSDV) protocols in constant bit rate traffic model, and also the simulation experiment shows that the proposed mechanism provides greater performance as compared to existing system.

Zhang et al. [11] proposed a communication link delay and interfering control between nodes using decent coordination of CTS/RTS mechanism under mobile ad hoc network and minimized the network delay as well as interferences of the communication. In this title, they adjust the power of transmission, network topology management that satisfied the condition of delay constraint and interference control. However, those work balances the all network aspect parameters. When the link distance is greater between two nodes, the required transmission power is greater. Those identified path are remove from the communication path and minimized the power utilization and delay of the network. Sisodia et al. [12] proposed a energy issue under table-driven protocol and evaluated the experiments results. Their proposed work is divided into two segments named as receiver mobile node expected position estimation and other is mobile node power-aware methodology. In first step, they found the node expected location in real-time scenario and then established route from source to receiver using energy utilization-based link. In this technique we are aware the network life time, energy utilization by each nodes, remaining energy of nodes and identifies the dead nodes.

3 Proposed Work

After survey, we decided to propose the new scheme to reduce delay and interference in dynamic network, maximizing the lifetime of the network. The node lifetime completely depends on the energy depletion of mobile nodes. That is why it is necessary to reduce the energy consumption of mobile nodes to improve the routing performance on network. All number of nodes that are participating in routing have different energy and all these nodes working capability are decided through of them and this capability is decided amount of data sending and receiving in dynamic network. Another issue to control the network performance is delay and interference. Interference in network, due to delay in transmission of data by sender and also the delay in receiving of data through receiver in network also interference occur while multiple sender simultaneously sends the data through single channel or link. The proposed scheme improves the lifetime of network by improving the energy-efficient consumption of node energy. The energy-efficient routing provides the connection between sender to receiver and minimizes the delay of network. The proposed scheme controls the transmission energy according to range of mobile nodes. The long-range communication required more energy for sending data packets, and short-range communication required less energy for communication. That is why the energy consumption is reduced and lifetime is enhanced.

In our proposed mechanism, use the multichannel-based communication that sends the data using more than one channel by the single or multiple senders. Multichannel wireless mobile ad hoc network minimized the interference, collision, and delay of the network while the multiple sender simultaneously demands the channel from the intermediate nodes.

4 Proposed Algorithm

Algorithm: Interference and congestion control using multichannel energy-based routing

```
Parameters:
    M: Mobile nodes
    S: Sender nodes
    R: receiver's nodes
    I: Intermediate nodes
    Req_e: required node energy
    CTS: clear to send
    i_s: interferences
    C_n: multichannel
    d: delay
    R_r: radio range 550
Output: Delay, throughput, data drop, routing and PDR impact
    Proto: ITCD
Procedure:
    S use ITCD routing
    ITCD(S, R, E, C)
        If M in range && M! = R then
            M check self status busy or idle
            If M idle then
                Check E of M
                If Req_e of M is <= Req_e of M-1 then
                M set as intermediate node
                Forward route pkt to next hop
                    Else
                        Other path select
            Else
                M busy
                Other path select
            If next hop == R then
                R← cerate backward path
                R_ack←    R sends acknowledgment
                Call send(S, R, data)
                Else
                    R not found or out of range
            Else
                M not in range network congested
    Send(S, R, data)
        S sends data to R by available path
        Check intermediate node status
        If I receive data by > one S nodes then
            Synchronized all senders
            Remove collision using CTS msg
            Calculate delay
            If delay > normal delay && i_s in C_n by S senders then
                Assign C_n > 1 to higher priority S node
                Stop communication of lower priority S node
            Else
                Normal communication
        Else
            Sends data to R nodes
```

5 Simulation Result

In this section, analyze the result through network simulator-2 and compare the performance with respect to packet delivery ratio, throughput, routing load, and other parameters; those are described in pointwise.

A. **Routing load**

Routing load is a number of routing packet or search packets broadcasted by the senders or intermediate nodes for the path finding between sources to link. More routing packet means more overhead of the network that increases the network delay and congestion (Fig. 1).

During our simulation, we take hundred mobile nodes and analyzed the routing overhead in three cases—ITCD, enhanced ITCD, and proposed multichannel-based mechanism. In this graph, *X*-axis shows simulation time in seconds and *Y*-axis shows number of routing packets broadcasted by the senders. Proposed approach case routing overhead is lower than the other two cases, where existing approach gives more overhead as compared to two other approaches.

B. **Packet Delivery Ratio Analysis**

The below graph shows the packet delivery ratio analysis during ITCD, existing and proposed methodology time. Packet delivery ratio is a percentage of data

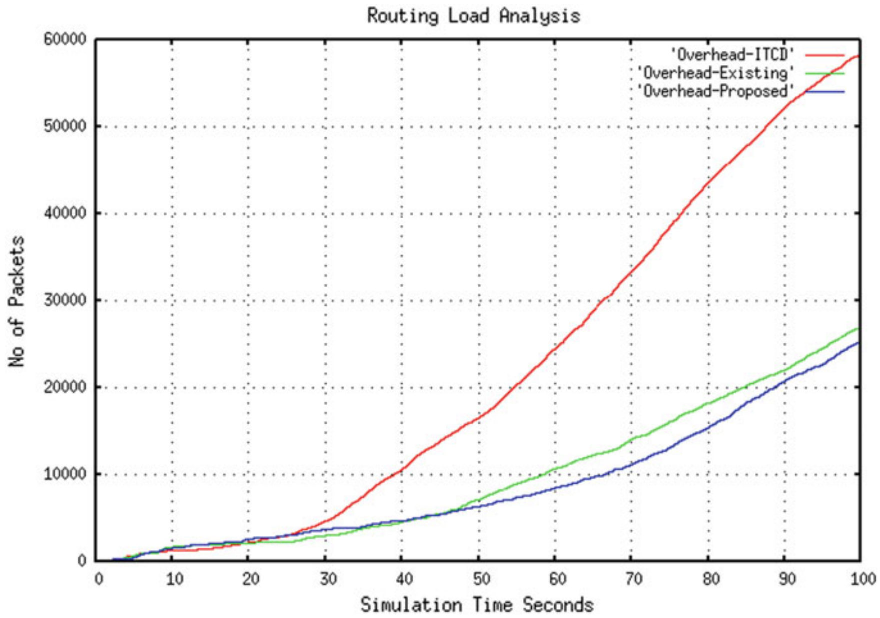

Fig. 1 Routing overhead analysis

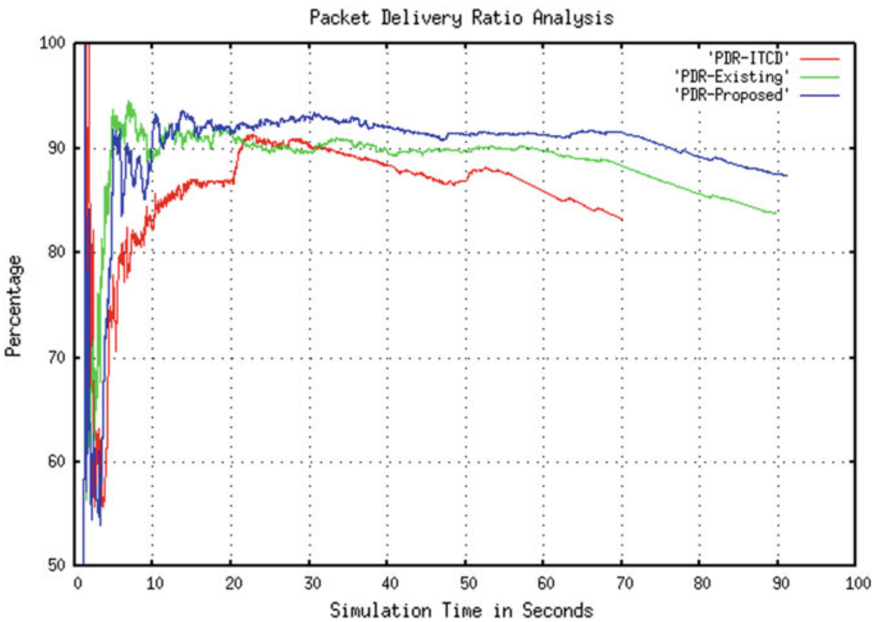

Fig. 2 Packet delivery ratio analysis

received, where *x*-axis shows simulation time in seconds and *y*-axis shows percentage of data received. In the Fig. 2 proposed multichannel gives better result it's nearly about 90% but in case of ITCD the performance is nearly to 85%.

C. Throughput Analysis

Throughput is a data received per unit time by the receivers, while throughput is inversely proportional to end-to-end delay. If the throughput is greater then end-to-end delay is lower. In this graph, our proposed multichannel energy-based routing gives higher throughput as compared to existing routing and ITCD (Fig. 3).

D. Overall Analysis

In this below table the network behavior is analyzed in all aspect of network. Resultant table shows that our proposed multichannel energy-based routing is efficient in all aspects of network, i.e., provide better PDF, minimum data drop, and delay (Table 1).

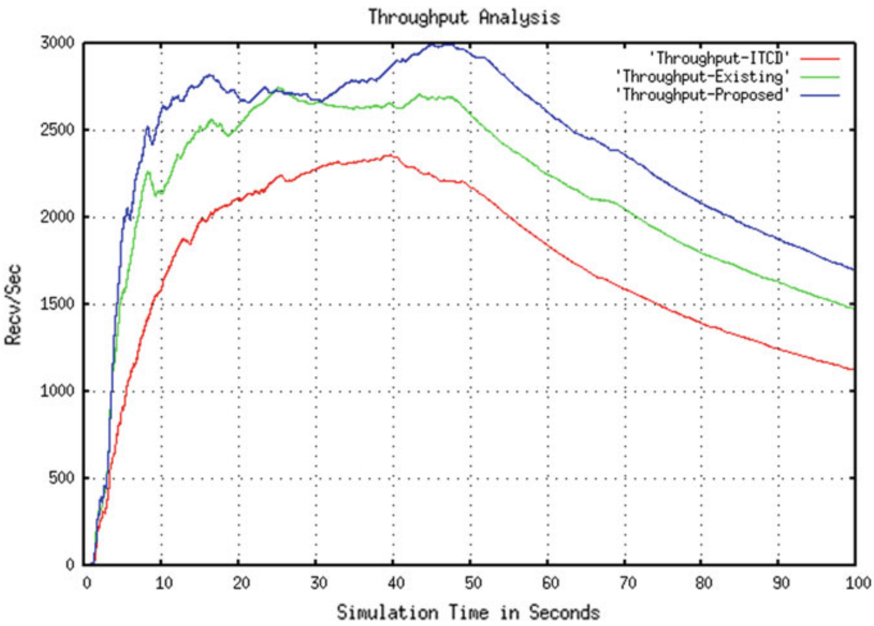

Fig. 3 Throughput analysis

Table 1 Overall summary analysis

Overall summary			
Parameters	ITCD	Existing	Proposed
SEND	4728	5922	6183
RECV	3497	4816	5268
ROUTINGPKTS	58,544	41560	25,403
PDF	73.96	81.32	85.2
Average e-e delay (ms)	86.96	80.92	79.44
NRL	16.74	8.63	4.82
All type packet drop analysis			
Drop from contention	222	183	203
Drop from queue	673	680	294
Total drop via congestion	336	243	418
Total drop	1231	1106	915
Percentage drop (%)	26.04	18.68	14.80

6 Conclusion and Future Work

Mobile ad hoc network provides the uncertainty for the communication, due to node mobility, interferences, and energy issues. In this paper, we overcome the problem of interference, congestion, energy discharging using multichannel and energy-aware-based route selection methodology and compare the result under three different cases—ITCD, enhanced ITCD, and our proposed approach. Result concludes that proposed approach is more suitable under all aspects of network parameter while communication is mobile ad hoc environment. In future the work will be more realistic and we must apply security for the communication.

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Computational Study of Duality in Facial Expressions

Ritesh Joshi and Maya Ingle

Abstract Automatic detection of human facial expressions grappled the interest of researchers in last decade. The face is the most obvious modality for recognition of human affective states. Facial expressions may be broadly classified as postured or natural. Humans recognize duality of facial expressions equally well and accurately, but the challenge lies in the computational aspect of distinguishing this duality. A comprehensive study of various postured, spontaneous, and posed versus spontaneous facial expression recognition methods has been carried out based on some vital parameters such as the number of subjects, sample size, cue used, discrimination basis, accuracy. Facial features extracted and classification methods used highly affect performance. Some important observations have been drawn from the study. These observations will be useful to the researchers putting efforts in distinguishing the duality of facial expressions with high accuracy.

Keywords Facial expression recognition · Facial duality · Emotion recognition Posed and spontaneous expressions

1 Introduction

Automatic detection of human emotion expressions is an important research area. Face is considered to be the most important modality for determining human affective states. Most of the research in emotion computation has focused on recognition of six fundamental emotions, namely joy, sadness, fear, disgust, surprise, and annoyance. Mostly the information has been postured on request and recorded in research laboratory settings [1]. In recent years, there exists a shift

R. Joshi (✉) · M. Ingle
School of Computer Science & Information Technology,
DAVV, Indore, Madhya Pradesh, India
e-mail: Riteshjoshi.indore@gmail.com

M. Ingle
e-mail: Mayaingle22@gmail.com

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toward recording affective cues in naturalistic settings as opposed to posed ones. It switches emotion computation research toward uninterrupted and context-specific interpretations of emotional displays captured in real-world settings. In addition, it is oriented toward combining multiple modalities such as vocal intonations, facial displays, head movements, physiological signals, hand postures, body movements, and postures for recognition and analysis of human emotions [2]. Further, research is also directed in exclusively chosen subclass of expressions such as eyelid movements, smile, temporal dynamics of facial behavior, and eyebrow actions [3–5].

Human facial expressions are broadly classified as postured or natural. The notion of humans to display dual (posed as well as natural) expressions needs to be revealed during human–computer interactions (HCI). Humans recognize the duality of facial expressions equally well and accurately but challenge lies in the computational aspect of distinguishing the duality. Volitional expressions are considerably different from naturalistic expressions in manifestation, timing, head movements, and some other body gestures [4]. Differentiating spontaneous from posed facial expressions has many applications. It plays a significant role in safety, security, health care, behavioral sciences and psychiatry, deception detection, and visual analysis of human affective states. For example, police may use it for surveillance systems; doctors may recognize genuine pain in patients, student's boredom may be recognized while interacting with auto-tutor [6].

In this paper, the theories, methods, and data that support the identification of duality in facial expression have been identified. Section 2 focuses on facial expression recognition based on posed expressions recorded in laboratory settings. Later, efforts have been made to recognize spontaneous expressions recorded in real-world settings, and it is the focus of Sect. 3. Further, research has been directed in discrimination of naturalistic and volitional expressions, and it has been addressed in Sect. 4. Various parameters are detailed in psychological research for discrimination between posed and spontaneous expressions, and these parameters have been experimented in vision-based affect recognition systems. Section 5 covers these evaluating parameters for discrimination between naturalistic and volitional facial expressions. In Sect. 6, we conclude with discussion of evaluating parameters.

2 Facial Expression Recognition—Posed Expressions

The majority of earlier affect detection research has concentrated on detecting the fundamental emotions from postured facial expressions. Automated facial expression analysis comprises of three steps: face discovery in an image or sequence of frames, facial data derivation from detected face region, and facial expression classification. There exist numerous models and algorithms for face detection in an image such as Point Distribution Model (PDM), HSV color model, analytic model, potential net, AdaBoost learning algorithm, Piecewise Bezier Volume Deformation (PBVD) tracker [7–12]. After face detection in an image, the next step is feature extraction. For feature extraction, three models are broadly used: holistic, analytic, and hybrid. Based on the selected model, a feature-based method or a template-based may be applied for feature extraction. Template-based methods fit well in a holistic face model while the feature-based methods suit to analytic face model [9, 13, 14]. The last step is facial expression classification. There exist various methods for classification, namely template-based, neural network-based, or rule-based. Principal component analysis (PCA), elastic graph matching, hidden Markov model (HMM), and linear discriminant analysis (LDA) are some methods used in template-based classification. Neural network with back propagation and neural network with RPROP propagation are some methods used in neural network-based classification, and expert system rules are used in rule-based classification [15, 16].

Active appearance model (AAM) is one of the holistic approaches that are used for interpreting face images and series of image frames. The training data has been used for extracting features, and AAM decouples them into ID and non-ID parts. For static face identification, AAM proves to be as consistent as labeling the images manually, and classification accuracy of 88% is achieved [17]. Universality of Facial Action Coding System (FACS) for recognition of facial expressions is evident from its wide acceptance. In FACS system, facial expressions are recognized based on facial muscle activities which are grouped in 44 action units (AUs). Automatic coding of AUs in frontal and profile view images has been achieved using multi-detector approach for localization of facial feature and to spatially sample the facial components and profile contours. From these extracted contours, 29 fiducial points (10 profile contours and 19 facial component contours) have been extracted. A rule-based reasoning has been applied on these extracted contours, and a recognition rate of 86% is achieved [19]. A spatiotemporal approach for recognizing six prototypic emotion expressions has been reported to achieve a recognition rate of 90.9% on fivefold cross-validation Cohn–Kanade facial expression dataset. A two-step classification approach is adopted. Firstly, in training phase, a linear classifier is applied and characteristic signatures are produced. Secondly, these signatures are used to train discrete HMM corresponding to each facial expression [20].

3 Facial Expression Recognition—Spontaneous Expressions

Efforts have been made in automatic recognition of AUs based on the semantic relationship among AUs and their dynamics. Human intervention is generally required in initial frames to ensure the reliable reference to subsequent frames in both the holistic or local approaches of feature extraction. Further, AUs classification may be performed using either spatial or spatiotemporal approach. The dynamic Bayesian network is applied to model the relationship between AUs.

A recognition rate of 93.27% has been reported for Cohn–Kanade database [22]. Facial subregions are found to be effective for automatic detection of duality in facial expressions. Specifically, different facial subregions on the face such as lips, eyes, nose, facial muscles, and eyebrows are identified as means of edifying posed and naturalistic expressions [4, 5]. The automatic detection of voluntary and naturalistic facial elucidations has application in the medical domain such as automatic discrimination of real from fake pain or monitoring of depression [23, 24].

Automatic recognition of spontaneous facial actions has been performed based on the 3D wrapping of images into canonical views. Facial appearance feature like Gabor filter has been used for feature extraction. Classification accuracy of 75–98% has been achieved using Support Vector Machine (SVM) and HMM [25]. Emotion-inducing videos are used to record subject's affective reactions and self-report labels to code data. Facial features have been extracted by Piecewise Bezier Volume Deformation 3D face tracker. Classification accuracy of 95% is achieved on Cohn–Kanade database using k-Nearest Neighbor (k-NN) [26].

4 Discriminating Posed and Spontaneous Facial Expressions

Characteristics of facial expressions, such as symmetry, speed, and timing advocate that diverse facial portions contribute differently to the discrimination of duality of facial expressions. The facial dynamics for diverse face portions and the eye region incorporate the most useful clues for spontaneous and posed expression identification [4, 27, 28]. Postured smiles usually only comprise of the movement of the mouth (zygomaticus), while natural smiles are more symmetrical and also comprise of the muscles neighboring the eyes (orbicularis oculi). Further, posed smiles are more irregular with respect to amplitude and duration than spontaneous smiles with smaller amplitude [4, 29]. Lip-corner movement in fabricated or social smiles appears discontinuous as compared to felt smiles. This exhibit may be due to disparity in neural control to the degree that fabricated smiles involve conscious efforts, and hence showing difference in the proportionate equilibrium of cortical and subcortical control [30].

Distance-based and angular physiognomy of eyelid motions has been used to classify natural versus postured smiles. The trustworthiness of these features has been assessed with continuous HMM, Naive Bayes, and k-NN classifiers on BBC and Cohn–Kanade public datasets with classification rates up to 91% for postured smiles and up to 80% for natural smiles [3]. Temporal dynamics of brow actions revealed that speed, time interval, and chronological order of brow actions are highly related parameters for discriminating posed and naturalistic brow actions. Further, it is observed that automatic recognition of AUs and the temporal partitions (onset, apex, offset) produced due to brow actions significantly shore in discriminating posed from spontaneous brow actions [5, 32]. Emotional facial expressions with facial asymmetries divulge prominent cues that comply with the fact that they are produced and apparent asymmetrically. The onset asymmetry has been recorded, and it is observed that naturalistic expressions begin earlier in the left-hemi-face (LHF), as opposed to postured ones that begin earlier in right-hemi-face (RHF). Onset asymmetry (OAS) mostly influences the recognition of the upper-face emotional expressions (e.g., anger expressions) with limited influence on the lower-face emotional expressions (e.g., happy expressions) [33].

5 Evaluating Parameters for Discriminating Duality of Expressions

Existing psychological research revealed that temporal characteristics of the face such as morphology, apex overlap, symmetry, total duration, and the speed of onset and offset are essential for revealing duality in facial expressions. The association of morphology is with the occurrence of an AUs and its temporal phase, whereas total duration refers to the episode of particular emotional expression (e.g., smile) [28, 48]. Apex overlap process refers to such facial expressions where multiple independent facial actions are involved, and it is highly probable that their apex overlaps. Speed of onset and offset of a facial expression (e.g., smile) refers to the fact that posed expressions are quicker as compare to their spontaneous counterpart [49]. It is observed that posed smiles are more asymmetrical as compared to spontaneous smiles [27]. We have explored various feature extraction and classification methods for emotion recognition using facial modality, and Table 1 covers the same with classification accuracy. The table also depicts the basis of discrimination between posed and spontaneous expressions with other relevant parameters: expression type (posed or spontaneous), number of subjects, sample size, modality/cue used, discrimination basis (posed versus spontaneous), system process images or videos, facial characteristics used, and classification accuracy. Facial feature used indicates the feature used to extract the appropriate features from recorded facial image. Classification method indicates classifiers experimented for detecting posed, spontaneous and posed versus spontaneous expressions. Subjects and facial characteristic parameter indicates the number of subjects participated and facial characteristics exercised for experimentation. Modality/Cue indicates the modality/facial subcue used, and stimulus highlights the method used to induce particular emotional expression among subjects. A challenge lies in building the dynamic posed and spontaneous emotion discrimination system.

Table 1 Parameters for detection of duality in facial expressions

Ref.	Facial feature used	Classification method	Exp	P versus S basis	Sub.	Facial characteristic	Modality/cue	Sample size	Accuracy
[17]	Active appearance model (AAM)	LDA	P	———–	400	Discriminant parameters	Face	Im: 400	88%
[18]	Piecewise Bezier Volume Deformation Tracker	Template matching using dynamic Prog. & HMM	P	———–	5	Eye/eyebrows and mouth region	Temporal cues	Im:	89%
[19]	29 fiducial points	Horizontal, vertical mouth classifier	P	———–	25	Facial muscle activity	Profile view face images	Im:	86%
[20]	Spatiotemporal features	Linear classifier and discrete HMM	P	———–	97	Apex frames	Eyes, lip corners	Vi: 480 sequences	96.2–100%
[21]	18 characteristic points (eyes, eyebrows, and mouth corners)	One association rule-based classification	P	———–	55	Occurrence order	Eyes, lips, mouth, eyebrows	Vi: Sequences	87.5–100%
[39]	64 facial landmarks	SVM	S	———–	80	25 facial action units	Eyes, lips, nose regions	Im:	79%
[40]	Facial texture points	One class classification	S	———–	2	Geometric	3D face tracker	Vi: AAI	90%
[42]	Deformation, transient features, contextual info.	Sequence expression classification	S	———–	20	Eyes, eyebrows, mouth	Nasal root wrinkles, context	Thermal heat stimulation	92%
[43]	20 facial feature points	BLSTM-NNs, SVR	S	———–	4	Eyebrows, eyes, nose, mouth, and chin	Face, shoulder, acoustic	Im:, Vi	64.2–79.6%

(continued)

Table 1 (continued)

Ref.	Facial feature used	Classification method	Exp	P versus S basis	Sub.	Facial characteristic	Modality/cue	Sample size	Accuracy
[44]	Block features	MKL, SVM, RF	S	———	7	Spatiotemporal	Macro- and micro-facial expressions	Vi: film clips	78.8%
[33]	OAS side (left, right) for emotion (happy and angry)	Onset asymmetries categorization	P, S	Varied OAS timings for LHF and RHF	68	Facial asymmetry, symmetrical images of avatar faces	Video displayed onset asymmetries	Vi: 96 trials, 32 trials	97.21% OAS detection
[4]	Lips, eye corners and 12 other points	Linear discriminant classifier	P, S	Dynamic changes in appearance over time	81	Amplitude and duration of smile onsets	Smile	Im: Sequence	93%
[5]	4 points on brow, 2 on nostrils, and 2 on inner corners of nose	Gentle relevance vector machines (RVM)	P, S	Temporal dynamics of brow actions	52	AUs + Temporal segment (onset, apex, offset)	Brow actions	60:MMI, 63: CK, 139: DS118	90.7%
[34]	4 action units (onset, apex, offset, neutral)	Dynamic Bayesian network	P, S	Morphology, apex overlap, duration, symmetry, speed of onset and offset	18: S 11: P	4 Temporal phases of AUs: neutral, onset, offset, apex	Smile	MMI: 50 Vi	97%
[35]	20 action units	SVM and AdaBoost	P, S	Dynamics of facial muscles	119	Speed of onset and offset	Brow raise, head pose	False opinion paradigm	93%
[36]	11 facial feature points	SVM	P, S	Temporal phases of smile	400	Fusion of facial features over different regions	Smile, dynamics of eyelid, cheek, lip corners	Vi:	87.10%

(continued)

Table 1 (continued)

Ref.	Facial feature used	Classification method	Exp	P versus S basis	Sub.	Facial characteristic	Modality/cue	Sample size	Accuracy
[31]	Cylindrical head tracker, 12 fiducial points on face	Kernel method	P, S	Fusion of head, face, shoulder, temporal dynamics	102	Head, face, and shoulder	Smile	Vi: Cartoons, clips nauseating footage	94%
[37]	10 points on the face	SVM with n-class classification	P, S	Micro-expressions	97	6 regions (eye brows, left and right eye, between eyes, nose, and mouth)	Facial subregions	Im: Vi: CK dataset	95% on images 80% on videos
[38]	Temperature different of apex, onset images, 6 statistical features	Bayesian networks	P, S	Infrared thermal images	40	Apex and onset facial expression frames	Temperature variances on face	Im: USTC-NVIE database	76.7%
[41]	20 action units	Nonlinear SVM,	P, S	Effect of cortical, subcortical system	26	Combination of AUs	Posed and real pain expressions	Im: Cold pressor pain	72%
[3]	21 facial features in 4 groups	Continuous hidden Markov k-NN, Naive Bayes	P, S	Eyelid movements	100	Eyebrows, eyelids, eye corners, nose tip, mouth corner	Smile	Im:	80–91%
[45]	68 facial fiducial points	SVM with RBF	P, S	Discriminative texture and geometric features	215	Facial animation parameters (FAP)	Distance between key points on face	Vi:	76.1–83.4%
[46]	22 feature points	Binary SVM classifier	P, S	Deviation in geometric and appearance features	52	Active appearance model	Geometric and texture features	Im:	91%

(continued)

Table 1 (continued)

Ref.	Facial feature used	Classification method	Exp	P versus S basis	Sub.	Facial characteristic	Modality/cue	Sample size	Accuracy
[47]	27 feature points (intensity and orientation features)	Bayesian network	P, S	Difference images (apex and onset images)	846	Geometric and appearance features (Gabor + LBP)	Eye brow, lid, chin	Im:	82.38–93.93%

Exp posed/spontaneous expression, *Im/Vi* image/video based, *Sub.* number of subjects

6 Results and Conclusion

In this paper, we attempted to identify some vital parameters for discrimination between posed and spontaneous expressions such as expression type, the number of features extracted, sample size, modality/cue used, discrimination basis. Some important observations have been drawn from this study and are as below:

- Higher accuracy up to 96.2–100% is achieved for posed surprise, joy, and sad expressions using the occurrence order of facial actions and spatiotemporal features, respectively.
- Automatic detection of non-basic affective states such as boredom, engagement/flow, frustration, pain, fatigue, confusion, and neutral has been experimented, and accuracy of 72–90.9% has been achieved.
- Initial efforts have been made for discriminating postured from naturalistic expressions using infrared thermal images, and classification accuracy of 76.7% is achieved.
- Facial asymmetries have experimented for discrimination between postured and naturalistic expressions. Onset asymmetry is recorded, and it is observed that naturalistic expressions begin earlier in the left-hemi-face (LHF), as opposed to postured ones that begin earlier in right-hemi-face (RHF). Classification accuracy of 97.2% is achieved for emotion categorization.
- The study reveals that most of the research efforts have been put forward only in discrimination of posed and spontaneous smile expressions, thus there exist vast scope in the same domain.

Automatic detection of duality in facial expressions has received an immense attention as it helps in discriminating posed and spontaneous expressions in real-world settings. This study provides the review of available ways to discriminate the emotional facial expressions captured in the form of images or video clips. The observations drawn will be useful to the researchers putting efforts in the domain of discriminating posed and spontaneous expressions in terms of improving the recognition rate highly.

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Computation Offloading in Hand-Held Devices Using Ternary Decision Maker in Accountance with Time and Energy

N. L. Chourasiya and Tanu Preet Singh

Abstract Nowadays smartphones have become popular among people since they are running more number of applications at the same time, which helps the user do things quicker and easier. Few computation-intensive task applications cannot be run on smartphone due to availability of limited resources such as storage space, network speed and processor performance. We have addressed this problem to implement the task offloading system for smartphone to increase the efficiency of its energy level and time. This mechanism determines part of applications to be offloaded for cloud execution. The TDM framework is used to take the correct decisions of choosing the appropriate device (i.e. android phone or cloud process) for performing the offloading process. This results in reducing the computation power of using our applications in mobile cloud rather in smartphone. In addition to that, it also provides security for offloading data in mobile cloud.

Keywords Smartphone · Android app · Offloading · Security AES · TDM · Mobile cloud

1 Introduction

Rapid raise in the usage of hand-held devices and the growing demand for availability of technology at fingertips had led smartphones as a part of day-to-day life. Nowadays these mobile devices equipped with latest hardware configurations to meet the users demand of execution of almost any kind of application software up

N. L. Chourasiya (✉) · T. P. Singh
Department of Computer Science, Punjab Technical University, Jalandhar, Kapurthala, India
e-mail: Chourasiya.neelesh@gmail.com

T. P. Singh
e-mail: tanupreet.singh@gmail.com

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to an extent. But still due to the growing demand of heavier application software, these devices lack their hardware support. All of these devices come with a word processor, image processor, voice recognition and video processor, and these are the software applications that consume a huge computational power, system memory and bandwidth, resource constraints. Battery power is drained due to more number of applications. The growing trend of using compact devices had led people to stop using laptop and desktop computers, and usage of smartphones is raising substantially which in turn demands more hardware to fulfil their needs and these mobile devices have a limited power house, i.e. its battery.

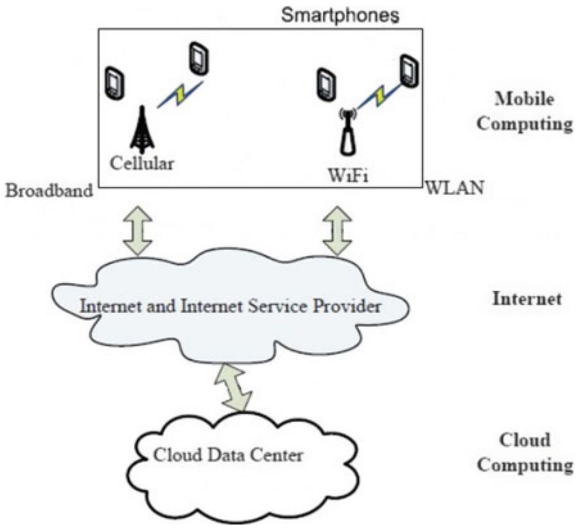
Smart android devices are not capable to do complex task which laptop or desktop can do. Mobility solution using cloud computation is the resolution for resource limitation. Using this concept, the task that requires more hardware and power, calculated by using a decision maker known as Ternary Decision Maker and shifted it to the cloud, which in turn reduce the resource usage from hand-held devices.

1.1 Mobility Cloud Computing

Cloud computing in mobility devices is combination of cloud and mobile services. Mobility cloud is accessible using Internet and applications. It can considered as a layer service, to which user can upload all kind of data. Cloud provides its users with flexibility of demand access to an ocean of manually configurable computing environment. This environment consists of online servers and storage solutions, online hardware availability, online rack of applications, and its services and features can be accessed or made available to almost unlimited number of users. The only need to reach these services is Internet. Cloud services provide industries with various options to store, access and process their data in the way they want. Cloud computing offers its users with portability, i.e. users are free to get access to their data from anywhere across the globe irrespective of the devices they use. These services can be accessed using any of the mobile networks or using wireless Internet. Cloud computing is a cost-effective way of resource management.

Smartphones use computation-offloading approach as per which computations performed remotely in the cloud instead of executing on a device due to which the device can become resource constraint free. Once the execution is completed, the results are transferred and showed on the device. This mechanism proves out as an efficient way for application quick response and energy management in smart mobile devices (Fig. 1).

Fig. 1 System model



1.2 *Computational Offloading*

The technique of computational offloading is used in resource-constrained devices. Once the user executes application from smartphone device, a decision maker called as Ternary Decision Maker came into scenario, which then has responsibility to check whether device supports computation offloading. Part of application, i.e. computation, will get transfer to cloud and processed. If any of two factors came out negative, i.e. Internet availability or device cloud support, then rest of operation is performed in device itself. Any kind of variations in above-mentioned two parameters will not be allowed for successful offloading implementation.

Several offloading techniques used by systems to overcome these limitations, out of which opportunistic communication, have proved out to be an efficient way to computation offloading. Opportunistic communication takes place when two device networks are in each other's proximity range in a way such that both devices can manage to set up a local connection, i.e. peer-to-peer. These type of connections can be created using Bluetooth, NFC, Wi-fi, WLAN, etc. This type of local connection also depends upon several factors such as distance between devices, signal strength, network quality, atmospheric constraints and device battery. This type of communication is based on the active behaviour of the user's device; therefore, it is not a reliable solution to depend upon.

To address this problem, existing catechist solution needs to carefully analysed and using the heterogeneous node, mobility content has to disseminate. Then an ideal strategy needs to be find out which will cut the load on hand-held devices, especially the smartphone, while these meet the above-mentioned constraints. Computation offloading has proved out as a great solution to increase performance and device power. Offloading proves out as a standard resolution to overcome the constraints; previously mobility devices address especially in the key areas like time and energy. Hence, it is clear that there is practical need of an offloading framework, which has to perform the decision-making mechanism before performing the offloading task. After performing several researches, TDM, i.e. Ternary Decision Maker, framework has developed to cut the response time as well as power consumption in the hand-held devices at the same time.

Reducing the energy consumption and extending the life of device battery found out to be the most challenging task that needs to be addressed. Battery constraint becomes a major factor in case of compact devices. Manufacturers use profiling partitioning mechanism to reduce power consumption in offloading devices. They first analysed the energy consumption of each application and its function and developed a cost graph. In this graph, every node represents the task needs to done, and each edge of the graph depicts the data to be transferred. Algorithms like optimization, maximum flow and minimum cut implemented to partition the graph and to find out the server and client parts to reduce the energy consumption. Afterwards, partitioned parts executed in the cloud. Lin et al. found out the chances of uploading data to the network processors and reducing the mobility computational load from the mobile devices.

Ternary Decision Maker internally uses several algorithms to disseminate application, time and energy components analysed, and then parts and functions executed.

1.3 Cloud Management

Cloud management can be done in various ways. Performance is the key factor in field of computation. Work management in cloud usually depends on number of users accessing cloud at a time. Resources configured and distributed among users determine response time of the server. Load balancing techniques were opted to handle workload in cloud server systems. Therefore, it is very important that our offloading framework should adapt with workload on cloud server.

Cloud Architecture. In computation offloading, cloud services play a very important role and cloud architecture defines the network layout for resources available in the cloud. It opens several ways and provides us with several opportunities to use the hand-held devices without any technical barrier in almost any kind of environment. Many limitations, which have faced due to the limited hardware availability, have possibly sorted out as the usage of cloud become popular.

Execution time of an application directly depends upon resource device possessed, and more resources in a device are directly proportional to more power consumption that means battery drainage time will be very less. To overcome the problem, a decision-making framework is necessary to perform the computational offloading in these hand-held devices, and hence Ternary Decision Maker, i.e.

TDM, has been introduced to reduce the latency time and power consumption concurrently.

The purpose of this system is to:

- Minimize energy consumption by maintaining low delay for processing.
- Calculate memory utilization and the execution time for making decision where system application executes.
- Provide affordable and quality energy-efficient analysis system to every user.
- Analyse steep complexity like no. of sharp turns, potholes, etc.
- Computation on mobile can be offloaded into cloud system for reducing mobile overhead, less power consumption, etc.

2 Related Work

Many techniques have been previously introduced for offloading mechanism in smartphones, which consist of full and partial offloading. Bowen et al. [1] suggest a method to find appropriate cloud resources in which code based on the cellular network available. Some resources used public cloud, cloudlets, MANET, etc. The wireless interface is selected based on different criteria, such as energy consumption, cost, link, accuracy, network reach ability, data link performance, vulnerable cost and annexation level of channel by using AHP and TOPSIS algorithms. This algorithm gives a suitable cloud resource management that utilizes execution time, found by cost estimation system model. It enhances system performance.

Shiraz et al. [2] describe an offloading code frame that reduces the number of computational intensive data, migrated to cloud and decreases the overhead, generated by system components. Firstly, this application runs on android devices, then implementation method is used for application execution time. Pandey et al. [3] presented a dynamic offloading decision method that uses depth first search (DFS) algorithm for calculating the offloading point at runtime. Control flow graph consists of different nodes in this method. Each node represents its execution cost and transmission cost. Call sequence is generated from call flow graph by using depth first search sorting algorithm. Linear searching is used to find the best beginning and ending offloading points.

Saab et al. [4] proposed a free sequence rule that accomplished application effectual by using control flow graph. The work extended to include the safety measures for smartphones. The author used min-cut algorithm for system partitioning to resolve energy optimization problem. This algorithm consists a profiler. To calculate the software and hardware engine that provides decision by using min-cut maximum flow algorithm and android device application based on FSP. Results show that it saves energy consumption and improves performance.

Dinh et al. [5] finalized the idea of offloading and explained its several applications. Kaur et al. [6] a comparative study of code offloading techniques and application partitioningmethods in mobile cloud computing. Lin et al. [7] extended their work. A Firefox framework is used to transparently compute in cloud server. These works used special package software to reduce energy losses in android device. Ben et al. [8] a mobile cloud computing system consisting of one user with multiple tasks, one CAP, and one remote cloud server has been considered. We aim to minimize a weighted total cost of energy, computation, and delay through optimal tasks offloading by the mobile user. Ben et al. [8] gave semi-definite relaxation approach to mobile cloud offloading with computing access point. Lee et al. [9] finalized the idea of offloading and explained its several applications. Sharifi et al. and Gao et al. [10] proposed an application execution framework in mobile cloud server. This method firstly started in mobile device, then process stopped, and information report saved the state of execution framework and sent this report to cloud server and finally executed in server. Loss of input is neglected by integrating application with a state saving method. The data synchronization prioritized by adding application and categorization of information. computational offloading to be used. Lin Gao et al. [7].

3 Problem Formulation

This paper mainly focuses on energy consumption, energy efficiency and system response time of offloading devices. Energy consumption has categorized into mainly two categories: computational energy and communication energy, and this system targets consumption of both types of energy in hand-held devices. Several previous works introduced offloading mechanism by assembling existing software modules rather than coding it from scratch. Hence, it becomes very difficult to extend their interfaces to multiple execution environments.

Control flow graph is used which consists of different nodes. Each node represents its execution cost and transmission cost. Call sequence is generated from call flow graph by using depth first search sorting algorithm. Linear searching is used to find the best beginning and ending offloading points.

In reference to Table 1, application consists of a data processing module, which processes data at a size of N_{input} and stored into memory. Saved data are then executed by the processing unit, which could be device or cloud. Later $N_{\text{output},}$ i.e. the result data, fed back to memory. T_{cpu} represents time of execution if application executed in a local system. T_{cpu} divided into two. First is transmission time, i.e. $t_{\text{trans},}$ used for data fetching. Second is $t_{\text{comp},}$ i.e. computation time, time taken by processing unit to execute.

3.1 Challenge

In a heterogeneous computational environment, correlation between time and energy of the system may not be directly linked.

Lot of previous works have proved that as execution time get reduced energy consumption in that system will reduced. This concept does not prove good

Table 1 Notation table

Cost function			Definition
Target			Major unit for computation, e.g. CPU/coprocessor/cloud
T_{target}			Measured execution time when execute on target
T_{target}			Estimated execution time when execute on target
E_{target}			Measured energy consumption when execute on target
E_{target}			Estimated energy consumption when execute on target
Decision factor	Unit	Variable	Definition
B	[Kbps]	O	Transmission bandwidth
T_{comp}	[Second]	O	Module execution time on mobile CPU
T_{input}	[KB]	O	Amount of processing data into processing unit
T_{output}	[KB]	O	Amount of resulting data from processing unit
μ_{cpu}	[MHz]	X	Mobile CPU speed
μ_{cop}	[MHz]	X	Mobile coprocessor speed
μ_{cld}	[MHz]	O	Cloud speed
μ_{mem}	[Mbps]	X	Memory access bandwidth
P_{basic}	[Watt]	X	Basic power when idle
P_{cpu}	[Watt]	X	Mobile CPU running power
P_{cop}	[Watt]	X	Mobile coprocessor running power
P_{nic}	[Watt]	X	Network interface power consumption

especially in a multicore computation environment. In a multicore development environment, execution time of CPU and GPU may vary and their energy consumption of few tests have shown that even though execution time of GPU to complete a task is lower as compared to CPU, still energy consumption is more than CPU. Therefore, main factor, i.e. execution time reduction and overall energy consummation, still stands as an unsolved challenge.

Execution time and energy consumption both are having different standard measures to calculate and hence different units, so it becomes necessary to maintain a function, which can hold summation of time of execution and consumption of energy, which is not a suitable solution to the problem. Therefore, a naïve function needs to develop which can depict both the above-mentioned factors properly. All equipment mainly work under heterogeneous environment where system power is a key factor therefore a method for cross-platform energy calculation desired, So that upon whose calculation, the decision maker can make proper decisions for offloading. However, most of the hand-held devices do not contain any metres or energy data acquisition card, and absence of these components in the hand-held devices makes it more difficult to obtain certain data necessary for decision-making. Therefore, a software-based power consumption measurement method, which is cross-platform based, required to achieve the desired results.

4 Proposed Method

For mobility devices, we evaluate an offloading technique as a solution to constrained optimization problem, to reduce power usage by mobility devices. System develops a framework, called Ternary Decision Maker (TDM). We proposed a real-world application, i.e. to find road roughness. When the task will start using maximum energy consumption and time, it will be shifted to the cloud. We find the operational platform on which execution will be carried out. It may be android device or cloud service execution.

We introduced a computational offloading framework to tackle offloading task and reduce the energy consumption on mobility and cloud services, considering time delay factor. Nowadays, mobile devices can support sensors, for example accelerometer, gyro and proximity sensors. Thus, road bump analysis technology is required to access all information from these sensors and compute operations on mobile devices. System is targeted to decrease the battery usage of mobile devices and cloud engines in a low delay. For mobility devices, “Time-and-Energy-Aware Computation Offloading in Hand-held Devices to Coprocessor and Clouds” introduced an offloading mechanism to delay optimization problem. For cloud engines, we developed this offloading mechanism to reduce stability optimization problem. System is introduced an algorithm to dispatch tasks to engines, which can decrease power usage while confirming queue stability. By properly selecting the control variable, this introduced algorithm takes off three used algorithms, having low time average power usage and queue length. Therefore, a naïve function needs to be developed which can show both the above-mentioned factors properly, which needs to be solved.

The purpose of this system is to reduce power consumption by maintaining low delay time for processing, calculating memory utilization and execution time for making decision where system application execute, providing affordable and quality energy-efficient analysis system to every user. Road bump analysis using accelerometer and orientation sensor and analyzing steep complexity like number of sharp turns, potholes, etc., offloading in mobility devices can be done using cloud system by Ternary Decision Maker to reduce mobile overhead, which results in less power consumption.

5 Implementation and Result

In this work, a computational offloading framework is introduced whose decision entirely depends on device’s time of execution and device’s battery usage. We aim to reduce both device time of execution and battery usage at the same interval. Binary decisions are considered in previous works, Project enhancement of existing technique by using code-partitioning techniques, reliable for several offloading targets. Here research is presented to evaluate the efficiency in different

Table 2 Factor table

Create factor table	Without partitioning		With partitioning	
	Existing time	Existing energy	Time (ms)	Energy (mJ)
Factors	3150	2150	2000	400
Collected factors	850	2000	580	200
Build cost function	52	2425	1400	635
Make decision	3000	1775	10	315
Update factor table	1730	1200	500	20

environment. On basis of this framework, matrix multiplication module tends to uploaded to processors that are more capable.

5.1 Code-Partitioning Techniques

A test case design technique called partitioning is used to multiply the software input into several parallel data-level classes. Equivalence data class needs test cases to design. Processing of test object is influenced by input data derived from the requirements specifications of the equivalence partition. This testing method reduces time factor for software testing by using effective test cases. In this method, only one condition is tested from each partition as it assumes that each partition reacts in a common manner, i.e. proper working of one partition implies the whole system's proper functioning and vice versa. Equivalence testing technique consists of setting values into the classes (Table 2).

Valid Input = holds all inputs, i.e. valid.

Invalid Input = holds all inputs, i.e. invalid.

5.2 Measurement of Decision Factor

1. Calculation of bandwidth with reference Table 1

   Wireless bandwidth (B)

$$B = (\text{data sent in kb})/(\text{time in second}) = [\text{kb/s}] \tag{1}$$

2. Component speed: μ_{cpu}, μ_{cld} , μ_{mem}

   To calculate the local CPU speed, i.e. $\mu_{\text{cpu},}$ and transfer it to the cloud environment at runtime to calculate the cloud engine speed, i.e. μ_{cld},

$$\mu_{mem} = (\text{amount of data accessed in mb})/\text{time in second}(20\,\text{s}) = [\text{mb/s}] \tag{2}$$

3. Execution time: T_{comp}, T_{trans}

$$T_{\text{comp}} = T_{\text{cpu}} - T_{\text{trans}} \tag{3}$$

where total execution time and memory transmission time are denoted by T_{cpu} and T_{trans}.

Ternary Decision Maker: After intense study of the situation, an offloading framework has proposed, to reduce the time of execution, device to cloud response time and power usage reduction at the same moment. Under this newly developed offloading environment, execution targets mainly consist of a mobile CPU, a board build GPU and cloud environment which is actively connected to the hand-held devices which include smartphones and several other compact devices. Both execution time slot and power consumption are having different standard units to calculate, hence it becomes necessary to maintain a function, which can hold summation of time of execution and consumption of energy, which is not a suitable solution to the problem.

First, we consider time of CPU's execution, i.e. $T_{\text{cpu,}}$ as shown in Eq. (4). CPU's execution is divided into two parts, i.e.

$$T_{\text{cpu}} = t_{\text{trans}} + t_{\text{comp}}. \tag{4}$$

First part calculates the time taken for transmission, which mentioned as t_{trans}, whose function is insertion and retrieval of data from system's memory; similarly second part calculates the computation time, which denoted as $t_{\text{comp,}}$ i.e. the time consumed by the device's CPU to execute the line of codes. Transmission time purely depends on processed data amount. Here we have,

$$T_{\text{trans}} = N_{\text{input}} + N_{\text{output}}\ \mu_{\text{mem}}. \tag{5}$$

Power consumption by the local CPU can be calculated as

$$E_{\text{cpu}} = \left(P_{\text{basic}} + P_{\text{cpu}}\right) \times T_{\text{cpu}}. \tag{6}$$

If the task is performed by the GPU of the hand-held device, then its time of execution is estimated by $T_{\text{cop,}}$ i.e.

$$T_{\text{cop}} = t_{\text{trans}} + t_{\text{comp}} \times \mu_{\text{cpu}}\mu_{\text{cop}}. \tag{7}$$

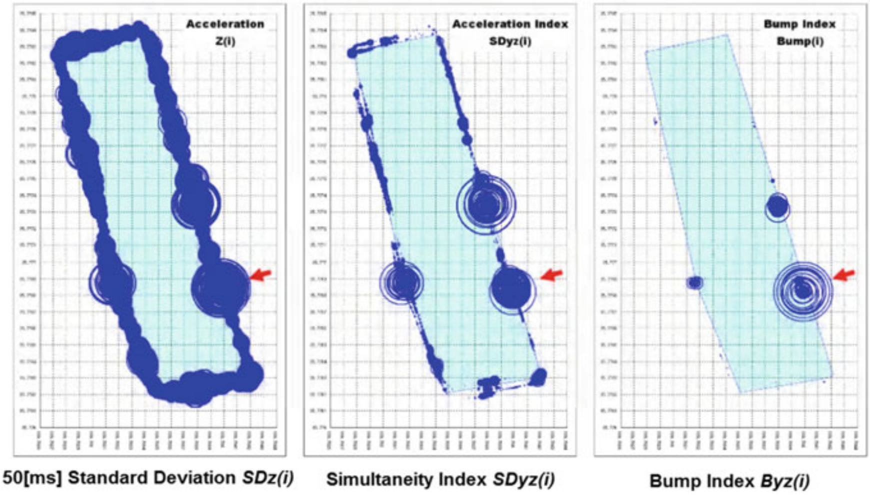


Fig. 2 Bump index

Finally the overall consumption of energy, i.e. $E_{\text{cop},}$ is measured as

$$E_{\text{cop}} = \left(P_{\text{basic}} + P_{\text{cop}}\right) \times T_{\text{cop}} \tag{8}$$

After calculating the above factors, time of execution and power consumption in cloud engine, computation offloading performed needs to be considered. Modules' estimated time of execution, i.e. shown by $T_{\text{cld},}$ also needs to be calculated while offloading performed (Figure 2).

6 Experiment Result

After application of the above-considered logic, road bump analysis test has been performed whose output on 50[ms] Z-axis standard deviation of acceleration or vertical direction SD$z(i)$ is drawn. B$yz(i)$, i.e. Bump, index is drawn below:

Result graph with reference Figs. 3 and 4 shows the improvement in the execution time and device energy-saving up to 90% by implementing the proposed methodology.

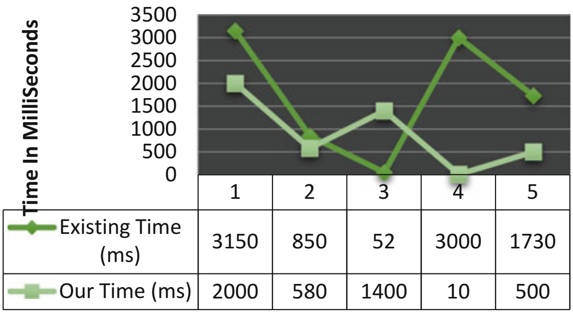


Fig. 3 Execution of proposed versus existing system

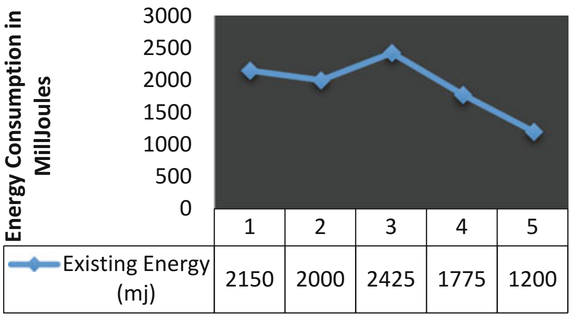


Fig. 4 Energy consumption of proposed versus existing system

7 Conclusion

In this work, an effort has been put to design and implement a computation-offloading decision-making framework, whose decision-making is purely based on estimation of device execution and response time as well as device power consumption. In addition, this offloading framework is suitable for inter-platform offloading tasks. After implementing the above framework into the system, we achieve almost 75% faster execution timings and 56% increase in the device's power consumption.

The proposed work has shown considerable amount reduction of both time and energy consumption. These results exhibit that the energy-saving in batteries is possible because of closing down of applications used for execution.

Acknowledgements This work is promoted by Amritsar College of Engineering and Technology, as the Punjab Technical University, Kapurthala, India, All support is gratefully acknowledged.

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Modelling of Tunnel Field-Effect Transistor for Ultra-low-power Applications

C. H. Pavan Kumar and K. Sivani

Abstract The IC technology always aims at increasing the package density and the speed. The VLSI technology is governed by MOSFETs for the past couple of decades. In the process of increasing the package density, the size of the MOSFETs has been scaled down continuously. Due to this, in MOSFETs the subthreshold leakage current and leakage power increase. And also the scaling of MOSFETs has reached its inactiveness mainly because of short channel effects. Hence, in this regard, an alternative to the MOSFETs has to be studied widely. That particular investigation is a tunnel field-effect transistor (TFET). The particular distinct characteristics of TFET are subthermal SS, delayed saturation, greater gm/IDS, higher output resistance, low on-current and higher miller capacitance. TFET, even with its low on-current, finds important applications in ultra-low-power electronic applications. Sub-nw power range enabled by TFET is unattainable in MOSFET mainly due to the higher MOSFET leakage. However, MOSFET outperforms TFET at a higher performance/power condition. Therefore, TFET presents many opportunities for the ultra-low-power designs/applications. In this paper, we have modelled TFET in such a way that it can be better suitable for circuit simulations. Design parameters for our design are L = 20n and W = 1u. HSPICE results for tunnel field-effect transistor, and its device designs are shown in this paper.

Keywords Quantum mechanical band-to-band tunnelling (BTBT)
Subthreshold slope (SS) · Ultra-low-power applications

C. H. P. Kumar (✉) · K. Sivani
KITSW, Warangal, Telangana, India
e-mail: k_sivani@yahoo.co.in

K. Sivani
e-mail: dattapavan834@gmail.com

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1 Introduction

For many decades, the performance improvement of microelectronic circuits and devices has been based only on continuously scaling down the size of Si MOSFET transistors [1–3]. As scaling reaches the end, a new type of conventional, innovative device architectures, novel materials and new device concepts are required for continuous enhancement of performance [4–13]. The emerging candidate for ultra-low-power applications is tunnel field-effect transistors (TFETs). The I_{ds} in TFETs is produced by quantum mechanical band-to-band tunnelling (BTBT). Tunnelling is a quantum phenomenon, in which a particle is able to cross a potential barrier even though it does not have the energy to overcome this barrier. Such behaviour is not observed in the case of classical particles. Therefore, any classical analogy used to explain the phenomenon of quantum mechanical tunnelling would necessarily be inaccurate. Instead of taking such a classical analogy, it would be more fruitful to picture the quantum particle as a wave and form a link between this quantum mechanical behaviour and the behaviour displayed by waves. In semiconductors, two different types of models are used to calculate the current resulting from tunnelling—local and non-local models. Non-local models treat tunnelling as a process that occurs in spatial coordinates, where electrons tunnel from one point in space to another. The WKB approximation and Landauer's tunnelling formula are classified as non-local models [13]. Local models, on the other hand, treat tunnelling as a phenomenon taking place from one energy band to another in the E–k space of the material. Two commonly used local models for calculating the tunnelling rate in semiconductors. Kane's model developed by E. O. Kane in 1959, this is one of the most widely used models for calculating the band-to-band tunnelling rate in TFET models. Hurkx model was developed by Hurkx in 1992 as a recombination model that included the effects of tunnelling. However, the Hurkx model is also used as a tunnelling model by many device simulators. The advantage of the Hurkx model over Kane's model is the inclusion of effects of trap-assisted tunnelling and density of states.

2 Working Principle of TFET

Figure 1a shows the basic structure of an n-channel TFET. The device has three regions—the source, the channel and the drain. Comparing the structure of an n-channel TFET with that of an n-channel MOSFET, we find that the source doping in a TFET is p-type, whereas it is n-type in the MOSFET. This is the only major difference between a TFET and a MOSFET. The channel region in the TFET is usually intrinsic or very lightly doped. We will now qualitatively examine the behaviour of TFETs. The behaviour of any transistor is usually described by its current characteristics, a plot of the current flowing in the device under various biasing conditions. For a transistor, the most significant current characteristics are the transfer characteristics and the output characteristics. These are plots of the drain current in the transistor with respect to the gate and the drain bias, respectively. In this section, we will develop a qualitative understanding of the behaviour of a TFET. The effect of biasing on the drain current of a TFET is best understood by observing the band diagrams of a TFET under various biasing conditions. While studying these, we will qualitatively predict the variation of the drain current with various biases. This makes the analytical modelling of BTBT in these devices very difficult, and numerical simulation in 2- or 3-dimensions is needed for accurate modelling of transistor. Since band-to-band tunnelling is a quantum mechanical phenomenon, a quantum transport formalism is required to simulate the BTBT current more rigorously.

From the Fig. 2 n-channel TFET energy band diagram of Schematic and Cross section of both in OFF and ON states. Initially, device is in off state. If we apply greater than 0 V to gate potential, then as a result, tunnelling window (qV_{TW}) opens up. So CB (of channel) as to be shifted just below the VB (of a source). Then all electrons in VB will acquire energy and by using tunnelling window, electrons tunnel or enter into the empty states (of channel). Then this mode of operation for transistor is viewed as ON state. Then the principle of operation for p-channel TFET is same as n-channel TFET, but just reverse case. And also switching is same as in n-channel TFET. Illustrating that conventional mode of operation for n-channel TFET, tunnel current or Ids is suppressed when we apply low V_{GS}. If V_{GS} is greater than 0 V, as a result tunnel window at the source junction is opened. TFET (tunnel field-effect transistor) can be turned on at channel drain junction, only when gate bias should be applied as sufficiently negative.

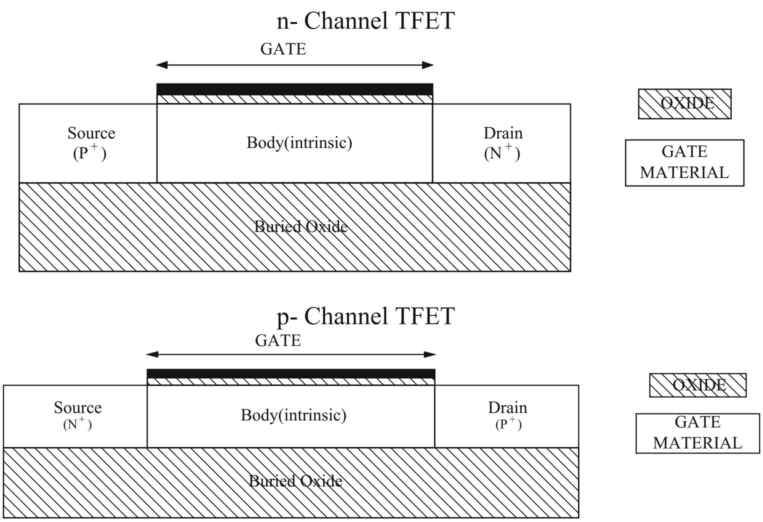

Fig. 1 Basic structure of a tunnel field-effect transistor

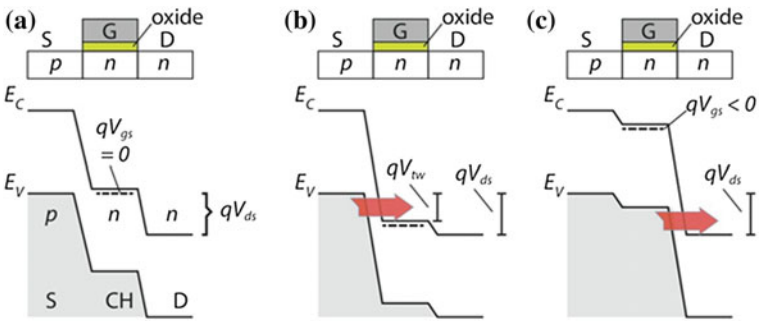

Fig. 2 Cross section of schematic and energy band diagram of an n-channel TFET, when it is operated in **a** OFF state, **b** ON state and **c** Ambipolar state

As shown in below Fig. 2c, if we apply gate bias as in negative, as a result electrons tunnelling occurs from the channel into the drain area. Therefore, we can conclude that tunnelling window (qV_{TW}) opens up once again with tunnelling junction is just shifted from the source-channel junction to drain-channel junction. When this particular state occurs, channel conduction changes or modifies from one carrier type to another. As that particular transfer characteristics are known to be ambipolar state. Then we can call this type of behaviour is generally universal across any TFET geometries.

Tunnel field-effect transistors (TFETs) come under steep-slope transistor group. TFET has been emerged as a leading contender in entire semiconductor industry. This is only due to its capability on scaling down the operating voltage (i.e. operating with low voltages). Then this reduces the power consumption for the circuit. Then it is suitable for ultra-low power design applications. Current generation in TFETs is only due to the band-to-band tunnelling (BTBT) at the source-channel junction. By which the carriers at the high energy tail of the Fermi–Dirac distribution are filtered by a tunnelling window. Then, subthreshold slope (SS) is less than or equal to 60 mV/decade can be achieved by TFET.

From Fig. 3, we can point out the transfer characteristics stating the difference between MOSFET and TFET.

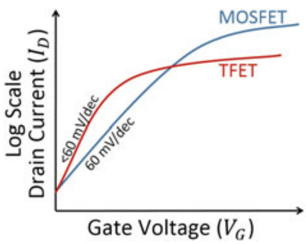

Fig. 3 Transfer characteristics stating the difference between MOSFET and TFET

3 Subthreshold Swing (SS)

In MOSFETs, the current generation is found by the thermionic emission of particular high energy carriers. But only carriers with energy exceeding the source-channel electrostatic potential barrier will only contribute to the on-state current. And these high energy carriers will follow the Fermi–Dirac distribution. Hence thermal subthreshold slope limited of 60 mV/decade at the 300 K (room temperature) it have an energy slope of kT (where k is the Boltzmann constant, T is the absolute temperature). Unlike MOSFETs, TFETs as asymmetrical source/drain doping (p-i-n) like as reverse biased gated p-i-n diodes.

4 Band-to-Band Tunnelling (BTBT)

For semiconductor device simulation and modelling, the modelling of band-to-band tunnelling (BTBT) process is an important aspect. BTBT has been traditionally considered as a second-order effect for mainstream CMOS technology because it contributes to leakage current. Recently, it is proved that simulation of BTBT attracted interest to realize tunnelling transistor (TFET) that gives steep switching characteristics [1–14]. In both TFET and MOSFET, w.r.t location only the direction of band-to-band tunnelling current depends.

5 Simulation Results

HSPICE simulation of tunnel field-effect transistor model.

As shown in Figs. 4 and 5, both ON and OFF states of TFET are also shown in Fig. 6.

As a result of continues scaling the Supply voltage (V_{DD}) we can reduce the power consumption, But without neglecting the performance of the device. For efficient tunnel field-effect transistor design, the following significant parameters have to be improved such as tunnelling reduction of SS and Ion (On-current). For any design of tunnel field-effect transistor, we should involve in reduction of tunnelling barrier. This can be achieved by following parameters like gate electrostatics improvement, low band-gap materials, low interface states to suppress trap-assisted tunnelling (TAT) [13, 15–18] and hetero-band alignment. Simulations of a TFET-based inverter and ring oscillator are shown in Figs. 7 and 8. And device parameters are also shown in Table 1. From that it is evident that TFET is operating with less than or equal to 0.6 V.

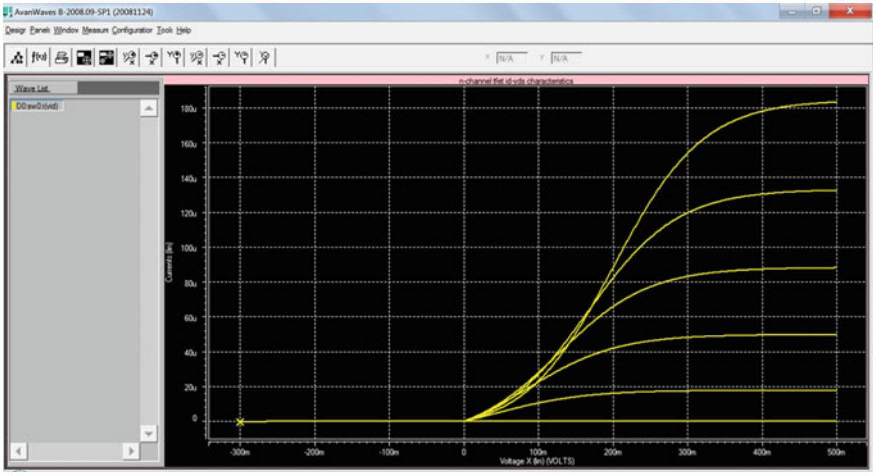

Fig. 4 I_{DS} versus V_{GS} characteristics

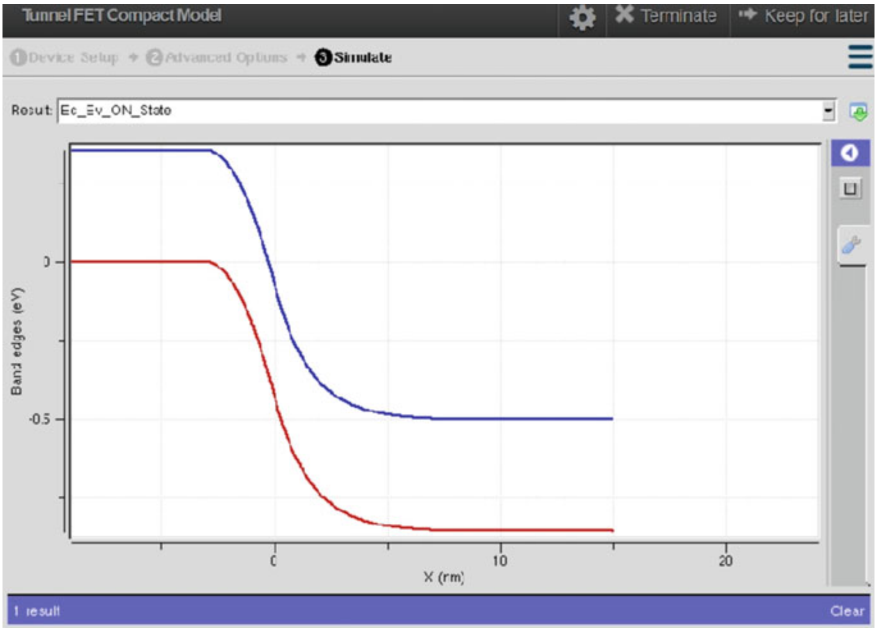

Fig. 5 Tunnel field-effect transistor ON state

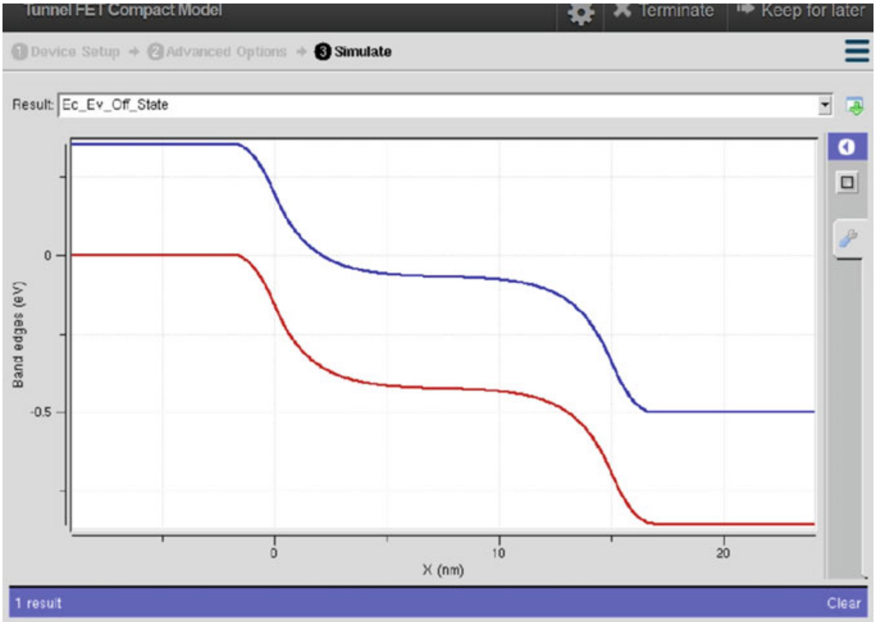

Fig. 6 Tunnel field-effect transistor OFF state

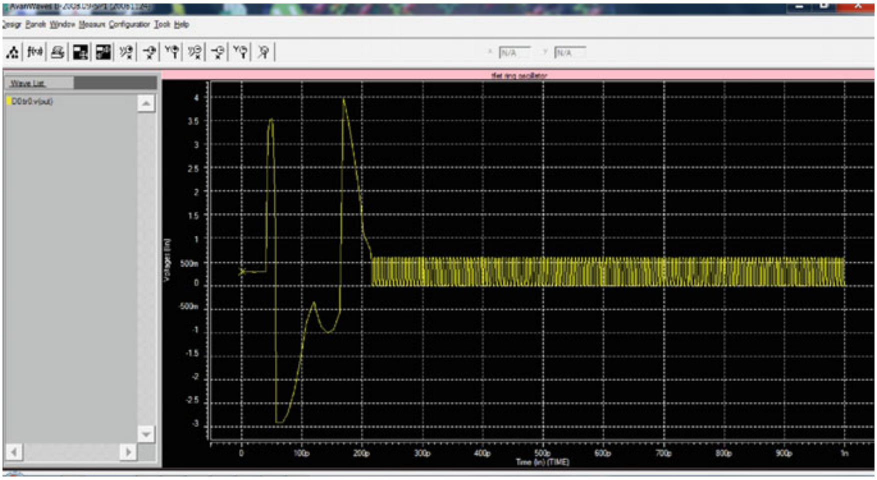

Fig. 7 Tunnel field-effect transistor Ring Oscillator

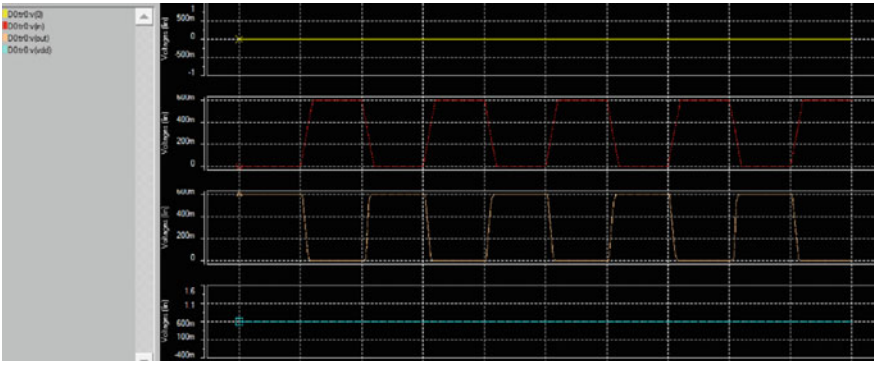

Fig. 8 Tunnel field-effect transistor Inverter

Table 1 Device parameters

Parameters	Value
CHARGE	1.6021918e−19
HBAR	1.05458e−34
PI	3.141592653
EPS0	8.85418782e−12
VDSMIN	1e−12
DELTA	5
VMIN	0.0001
AMIN	0.0001
LENGTH	20n
WIDTH	1u

6 Conclusion

In this paper, we have shown the TFET-based inverter and oscillator simulations. First, it is modelled using HSPICE and Table 1 shows the design parameters that are used for simulation. TFETs are one of the promising candidates for steep-slope switch. Its operating supply voltage is significantly low or equal to 0.6 V, and then, it offers significant power dissipation savings. And because of its low off-currents, they are ideally suitable for both ultra-low power and low standby power logic applications, operating at moderate frequencies.

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Genetic Annealing-Based IDS System for Attack Detection

Soumya Bajpai and Ashish Gupta

Abstract Through proposed work, a new trend of machine learning based on evolution and genetics has been tried to be brought in an innovative way. IDS has been a part of our system development for a very long time, but there is no very effective way to create a new and very efficient system. Due to increasing use of computers and new technologies, threat to the system information has been increasing at an alarming rate. The first step toward it is to increase the capability of the system to detect the attacks and then to encounter them. So, here a new approach has been proposed to detect the attacks with high precision and accuracy. The proposed approach gives a new term "genetic annealing," which is a hybrid of genetic algorithm and simulated annealing technique. The results show the effectiveness of the results, and the proper working of the algorithm is explained in the paper.

Keywords IDS · Attack detection · Genetic algorithm · Simulated annealing

1 Introduction

In our day-to-day life, the use of computer networks is effectively increasing, so security also plays a very vital role for a network. To overcome this problem, we develop protective software systems which can help us to identify the security goals which are confidentiality, authentication, and integrity [1]. This system was first introduced by Anderson in 1980. This system can easily identify the illegal activities. The drawback was in terms of handling high-dimensional data, false positives, and false negatives [2]. The technology to process highly complex algorithm and improve accuracy was needed. The curse of dimensionality is that

S. Bajpai (✉) · A. Gupta
NITM, Gwalior, Madhya Pradesh, India
e-mail: Soumyabajpai2013@gmail.com

A. Gupta
e-mail: guptaashishnitm@gmail.com

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when we include something new in our result, we get performance degradation. One of the techniques we used is feature selection which uses limited features and leads to dimensionality reduction. For strong security point of view, there are different soft computing techniques. IDS is a device which monitors suspicious programs, applications, or activities of a system or a software [3]. An intrusion is also defined as the problem of identifying individuals who are using their computer unauthorized and who have legitimate access to the system but are abusing their privileges.

When we find out the irregular activities in the system which tend to the misuse or change in integrity, confidentiality, or availability of a computer resource, then the process to find out this problem in the system or in the network is known as intrusion detection. There are two types of methods for detection: First one is signature based, which is mainly used for trying to match the action of a system and stored in the system, and the second type is anomaly based, which is used to detect the anomalies by the first learning characteristics of a normal activity. The most important component in this work was to set a benchmark of dataset KDD Cup which is used to carry out the experiments. Therefore, the benchmark dataset KDD Cup is used as database. In this dataset, we use 41 attributes which are used by each record to characterize network traffic behavior. In these 41 attributes, 38 are numeric and 3 are symbolic [4–6].

Genetic algorithm (GA) is an optimization technique from evolutionary computation. It uses the principle of survival of the fittest. It uses the mutation and crossover to provide the optimal number of features. This theory mainly defines that individuals that are adaptable to changing environment or thus fit in that scenario will move further, and the rest of the weak population will be eliminated [7, 8].

In soft computing technology [9–11], the neural network is usually applied in intrusion detection research. Hierarchical perception (MLP), hierarchical BP neural network model, and self-organizing map (SOM) network have gained great experimental effect in the application of intrusion detection. Genetic fuzzy rule mining-based intrusion detection mainly studies rule encoding, fitness function evaluation, genetic operator design, etc. The basic framework of negative selection and genetic process remains unchanged.

2 Literature Review

In this paper [12], an IDS using genetic algorithm-based feature selection approach has been proposed. For machine learning, SVM is used. SVM classifies the data and hence improves the results when evaluated.

In this paper [13], main focus was on a part of IDS which was anomaly detection. The research was focused on false-positive rate (FPR). As the value of FPR reduces, the accuracy and performance of the system increase.

In this paper [14], the authors worked toward finding the solution to intrusion detection by proposing a hybrid approach. The work was done on fuzzy and genetic algorithm. For feature selection to the processing and finding results, the fuzzy genetic algorithm was applied. Crossover and mutation rate were prefixed in this work. The accuracy of the work was improved, while the computation time was increased considerably.

In this work [15], the approach was hybrid but was focused on different databases. They applied their research to both discrete and continuous attributes. Many association rules were derived to enhance the detection ability. The proposed method was flexible and can be applied for both misuse and anomaly detection in data intrusion and detection problems. It worked on improving the process data model and also used clusters and centroids to convert the dataset into training set.

3 Proposed Work

The proposed work is based on genetic approach using simulated annealing as an important aspect affecting the intrusion detection system. There are few main phases in the process:

i. The KDD Cup 99 dataset is used as the dataset. The data are loaded first.
ii. In the feature selection phase, out of 41 attributes, only the important attributes are selected using the soft set theory. The soft set theory helps in selection of the data which are used for the result deduction in less time.
iii. The selected attribute-based data are then saved in a file. The file is further processed using the genetic algorithm and simulated annealing concept to create file having only the data which need to be processed further to get the final result.
iv. The file is then processed in Weka using the classification of the attributes. The algorithm used is tree based and is known as simple cart.
v. Finally, the results are obtained having the measurement parameters named as: TP rate, FP rate, precision, recall, accuracy, etc.

The steps in the proposed algorithm are explained in detail:

1. Loading the dataset: The KDD Cup dataset is not loaded fully. Only the 10% of the dataset is used. For this, the dataset is divided using sql query and then loaded in the MATLAB.
2. The next step is feature selection which aims at determining a minimal feature subset from the problem so as to find the results with high accuracy. The feature selection is a necessity as it contains redundant and irrelevant data too. A feature is considered to be redundant if it is highly correlated with other features. These data need to be removed by various methods. The reduction in unnecessary data will lead to better, accurate, and faster results.
3. The file is saved and soft set; GA and simulated annealing are applied further.

i. The soft set approach is applied on the data so as to reduce the redundant sets.
ii. The data are converted into binary form, i.e., 0 and 1, to represent the data in form of chromosomes. These chromosomes perform crossover at random locations among themselves. Few chromosomes turn out to be the same after crossover is performed, for that a process known as simulated annealing is performed. The chromosomes are changed totally, and the newly formed chromosomes are slowly taken to the point where they may vary with the other chromosomes but have at least 75% features same as others. This process improves the accuracy and diversification both. The coding can be represented as:

```
for i=1:row
      for j=1:col
            if(data< range)
                  chromosome = 0
            else
                  chromosome = 1
      end
end

if(chromosome(i) == chromosome(loc))
      matched = matched+1

%perform crossover
b1= [first(1, 1:cp), second(1,cp+1:end)];
b2= [second(1, 1:cp), first(1,cp+1:end)];

%perform SA
for(chromosome(i) <= chromosome(i+1))
      first = chromosome(setall('1'));
      s_chromosome(k,:)=first - '0';
end
```

4. The final results are calculated using Weka. The algorithm is simple cart. The results generated are discussed further in detail. The results obtained are better than the previous results obtained from the base algorithm.

3.1 Measurement Factors

The final results are shown in the form of confusion matrix. In IDS, the measurement parameters are represented using the confusion matrix having attributes as: TP (true positive), FN (false negative), FP (false positive), and TN (true negative). The matrix is represented in Table 1:

Table 1 Confusion matrix for TN, TP, FP, and FN

	Correctly classified	Incorrectly classified
Valid record	True negative (TN)	False positive (FP)
Attack record	True positive (TP)	False negative (FN)

where TP (true positive), FN (false negative), FP (false positive), and TN (true negative) are defined as follows:

- True negative (TN): These are the negative tuples that were correctly labeled by the classifier.
- True positive (TP): These are the positive tuples that were correctly labeled by the classifier.
- False positive (FP): These are the negative tuples that were incorrectly labeled as positive.
- False negative (FN): These are the positive tuples that were mislabeled as negative.

i. **Precision**: Precision refers to the closeness of two or more measurements to each other. Precision is defined as the number of true positives over the number of true positives plus the number of false positives.

$$\text{Precision} = \frac{t_\text{p}}{t_\text{p} + f_\text{p}} \tag{1}$$

ii. **Recall**: Recall is defined as the number of true positives over the number of true positives plus the number of false negatives.

$$\text{Recall} = \frac{t_\text{p}}{t_\text{p} + f_\text{n}} \tag{2}$$

iii. **Accuracy**: Accuracy refers to the closeness of a measured value to a standard or known value.

$$\text{Accuracy} = \frac{t_\text{p} + t_\text{n}}{t_\text{p} + t_\text{n} + f_\text{p} + f_\text{n}} \tag{3}$$

iv. **Kappa: Cohen's kappa** is a measure of the agreement between two raters that determine which category a finite number of subjects belong to, whereby agreement due to chance is factored out. The two raters either agree on their rating (i.e., the category that a subject is assigned to) or disagree; there are no degrees of disagreement (i.e., no weightings).

$$Pr(a) = \frac{t_\mathrm{p} + t_\mathrm{n}}{t_\mathrm{p} + t_\mathrm{n} + f_\mathrm{p} + f_\mathrm{n}} \tag{4}$$

$$Pr(e) = \frac{\left(f_\mathrm{p} + t_\mathrm{n}\right) \ * \ \left(t_\mathrm{p} + t_\mathrm{n}\right)}{\left(f_\mathrm{p} + f_\mathrm{n}\right) \ * \ \left(t_\mathrm{p} + f_\mathrm{n}\right)} \tag{5}$$

$$k = \frac{(Pr(a) - Pr(e))}{1 - Pr(e)} \tag{6}$$

v. **True-positive rate (TPR)**: The true-positive rate shows the correctly classified attack types, and thus, the value should be higher.

$$\mathrm{TPR} = \frac{\mathrm{TP}}{\mathrm{TP} + \mathrm{FN}} \tag{7}$$

vi. **False-positive rate (FPR)**:

$$\mathrm{FPR} = \frac{\mathrm{FP}}{\mathrm{TN} + \mathrm{FP}} \tag{8}$$

The tools used are MATLAB 2016 and Weka. The feature selection, genetic algorithm, and simulated annealing have been implemented on MATLAB, while the final confusion matrix and the measurement parameters are calculated on Weka. Weka supports various standard data mining job, more specifically data pre-processing, clustering, classification, feature selection, and visualization. We need to classify the KDD Cup dataset and hence, Weka is used.

4 Results and Analysis

This part shows the experimental results calculated from genetic annealing model of IDS in comparison with the fuzzy-based IDS method. The two different algorithms when compared show that the proposed algorithm is better than the base algorithm in all terms. Both the algorithms consequently result in the data classification as

Table 2 Comparison of base and proposed results

	Base	Proposed
Correctly classified instances (%)	99.887	99.927
Incorrectly classified instances (%)	0.104	0.073
Kappa statistic	0.9968	0.9978
Mean absolute error	0.0006	0.0004
Relative absolute error (%)	0.434	0.3311
Total number of instances	32,833	33,162

attack type accordingly. Also, the accuracy obtained for genetic annealing-based IDS is raised appreciably than fuzzy-based IDS (Table 2).

Other factors are also better when compared with the base work. The results are compared further using the graphs that show the differences in the TPR rate along with precision and time factors.

TP rate: The increase in TP rate shows the increase in better results as this results in finding better attributes in terms of performance and accuracy. The graph in Fig. 1 shows the comparison of the TP rate of the base and proposed algorithm.

Precision: It is an important factor to calculate the working efficiency of the algorithm. The precision of the algorithm should be high. A comparative graph-based study is shown in Fig. 2 to ensure the positive working of the proposed work:

Recall: Recall of the proposed algorithm should be high and it is also one of the measures for the calculation of the working of the proposed algorithm (Fig. 3).

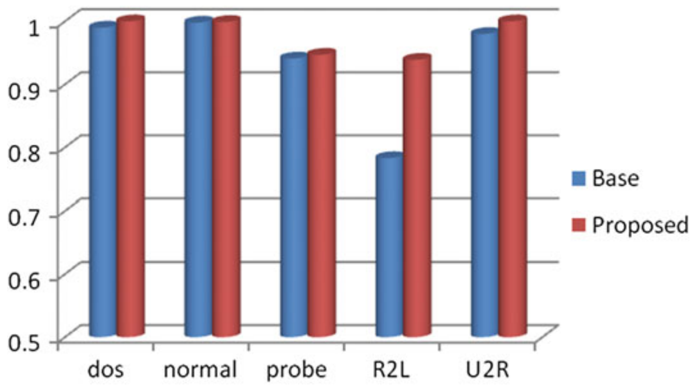

Fig. 1 Comparison for TP rate of the base and proposed algorithm

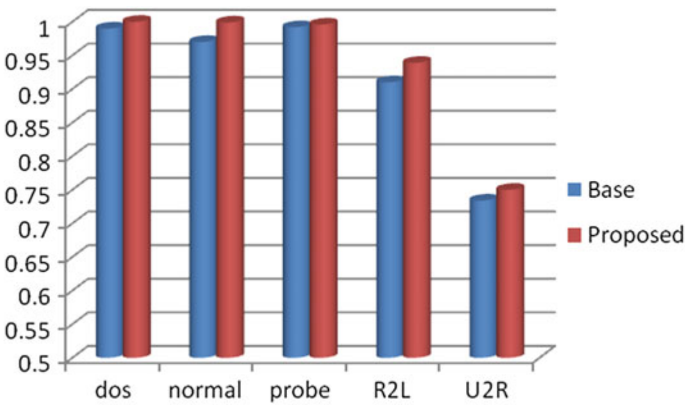

Fig. 2 Comparison for precision of the base and proposed algorithm

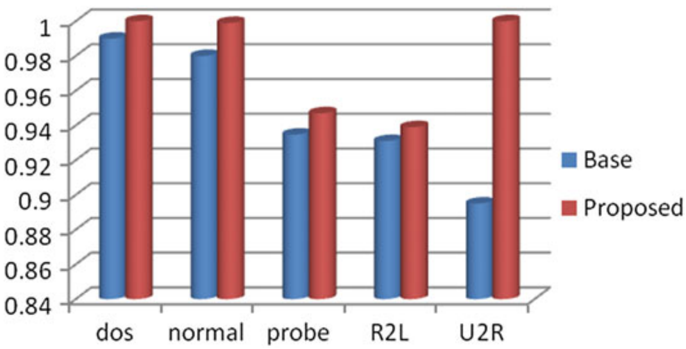

Fig. 3 Comparison for recall of the base and proposed algorithm

5 Conclusion

The proposed research worked a lot over making better IDS. The requirement is increasing and so the research methodologies. The increasing need for a perfect system is leading to the research of the new techniques in this field. IDS is a worth detecting system, and thus, all the work for the betterment of the system is going on. The proposed research has shown better results on comparison. Simulated annealing has never been a part of the research in IDS. This is first time that IDS is created with the help of simulated annealing concept and has proved to be a better system.

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Artificial Immune Recognition System-Based Classification Technique

Kirti Bala Bahekar and Anil Kumar Gupta

Abstract Nowadays, data mining methods are being applied in the field of knowledge generation, which helps in decision making and intersects many disciplines of computer science such as artificial intelligence, database, statistics, visualization, and high-performance parallel computing. An artificial immune system has a set of algorithm inspired by biological immune system. This algorithm supports machine learning, and they are designed to solve difficult problems such as intrusion detection and prevention, data clustering, classification, and exploration. The proposed method focuses on executing a supervised learning algorithm AIRS, i.e., artificial immune recognition system of AIS for classification. AIRS exhibits characteristics as self-regulation, performance empirical, and parameter stability.

Keywords Data mining · Artificial intelligence · Artificial immune system
Artificial immune recognition system

1 Introduction

Data mining is to turn data that are facts, numbers or text into processed information by the computer. It is a method of analyzing and summarizing data from different perspectives and converting it into useful information [1, 2]. Many modern techniques are inspired by the human body like genetic algorithms, neural network, artificial immune system. AIS has an important characteristic, that is, to defend the body from foreign substance known as antigens. It has immune capability to recognize and distinguish between foreign cells entering the body and the body cells [3, 4]. Artificial immune system methods applies biological reckoning as advanced approaches of artificial intelligence. A strong biological process (i.e., immune system) is responsible for destroying microorganisms which may harm our body. It has distributed mechanism with parallel action which is adopted by AIS, designed

K. B. Bahekar (✉) · A. K. Gupta
Department of Computer Science and Applications, Barkatullaha University, Bhopal, India
e-mail: kkirti06@gmail.com

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to solve complex, compound, or obstinate complications of artificial intelligence [5].

Artificial immune system (AIS) has standard methods of computation which involves, experiential immune functions, applied to solve engineering applications [6].

2 Literature Review

2.1 State of the Art

In modern era, researchers have substantial interest toward developing methods of artificial immune systems for computer and engineering applications. More and more present scientific researches inspires and guides in the direction of machine learning. Dasgupta et al. [7] have introduced immunity-inspired algorithms which gained popularity in the field of artificial intelligence (AI). AIS concept is based on the three immunological principles like immune network theory, the mechanisms of negative selection, and the clonal selection principles. Stepney et al. [8] state that bio-inspired algorithms are best to implement new technologies in context of a different conceptual framework; artificial immune system (AIS) has become an increasingly popular area for study by computer science in recent years. The term AIS refers to computational intelligence technique which is inspired by the human immune system.

2.2 Human Immune System

Dasgupta and Nino [4] have given the theory of immune system as an organized regular system. The major function of immune system is to classify, objects encounter as *self* or *non-self*. Non-self is the objects which harm the immune system and require to be destroyed, like bacteria, viruses, and cancer or tumor cells. Usually elements those keeps body healthy should be identified as self and they should be remain undamaged by the system. The *antigens* are those elements which the immune system is able to identify. Antigens are fundamental elements that may be included in both the human cells and pathogens such as bacteria. The self and non-self classification is based on the antigenic patterns done at the cell surface.

Castro and Timmis [9] describe anatomy of the immune system, in which the tissues and organs that compose the immune system are distributed throughout the body (Fig. 1). These are known as lymphoid organs, once they are related to the production, growing and development of lymphocytes, other organs are tonsils and adenoids, lymphatic vessels, bone marrow, lymph nodes, thymus, spleen, and peyer’s patches.

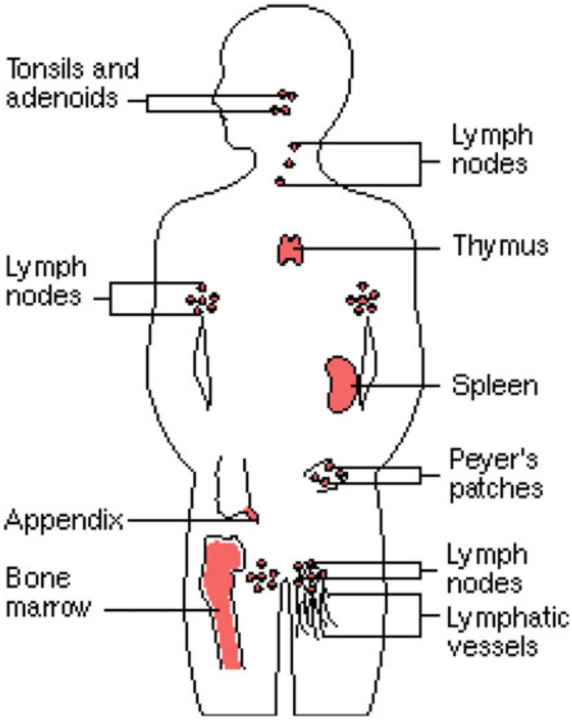

Fig. 1 Anatomy of the immune system [7]

Lymphocyte is classified into two types, B cells and T cells, and they both are responsible for observing and answering antigenic patterns. Receptors in the shape space allow for binding or *matching antigenic* material, composing of higher affinity between the receptor and antigenic material, which indicates strong bond. Several methods can be used to measure affinity such as Euclidean distance, which finds relations between AIS elements.

2.3 Artificial Immune System

Computational immunology and biological theory are quite separate from AIS. They use to mimic immunology using computational and mathematical models to make immune system utilities, even though such models introduce fields of AIS and continue to offer inspiration. Jacob et al. [5] and Jitha et al. [10] introduced AIS as computational programming that performs data manipulation, reasoning and use representation methodologies that are based on mechanism of HIS. Forest et al. [11] has mentioned application areas of artificial immune system like Computer security, Anomaly Detection and Fault Diagnosis, Data Mining and Retrieval, Pattern Recognition, Adaptive Control, Chemical Pattern Recognition, Robotics, Optimization problems, Web Mining, Fault Tolerance, Autonomous Systems, Engineering Design Optimization. Different Computational models are:

(1) Negative selection algorithm
(2) Clonal selection
(3) Immune network model
(4) Danger theory.

3 Proposed Methodology

The field of AIS research has been around for approximately 15 years, and for the majority of its history has been concerned with feature extraction (data clustering), and change or anomaly identification, such as intrusion detection systems. In the proposed method, artificial immune recognition system (AIRS) algorithm will be used for classification problems. Artificial immune recognition system (AIRS) is an original immune stimulated and resource-limited supervised learning algorithm [2]. This algorithm has two major steps:

I. Learning or training phase
II. Classification phase or testing.

3.1 Learning or Training Phase

In this phase, activities like affinity maturation, memory cell formation, clonal selection, and resource competition are used for learning. It includes the following steps:

A. Initialization
B. Selection of memory cell and ARB generation
C. Resources competition and development of ARB pool
D. Identification of candidate memory cell.

A. **Initialization phase**: Data are preprocessed in this phase as:
   (a) All vectors are normalized such that distance between antigens and ARBs or between two ARBs is in the range [0, 1].
   (b) Euclidean distance is used to calculate the affinity and stimulation values as shown in Eq. (1).

$$\text{Euclidean distance} = \sqrt{\sum\nolimits_{i=1}^{n} (x - y)^2} \quad (1)$$

where x and y are feature vectors and is number of attributes in data.

B. **Selection of memory cell and ARB generation**

Here, training antigen is selected to become memory cells and most stimulated memory cell is cloned; this is an iterative process. Stimulation levels are calculated as shown in Eq. (2)

$$\text{Stimulation}(x, y) = \begin{cases} \text{affinity}(x, y), & \text{if class of } x = \text{class of } y \\ 1 - \text{affinity}(x, y), & \text{otherwise} \end{cases} \quad (2)$$

where affinity is given by Eq. (3)

$$\text{affinity}(x, y) = 1 - \text{Euclidean distance}(x, y) \quad (3)$$

C. **Resources competition and development of ARB pool**

Now candidate memory cell is developed by the following method:

i. In ARB pool, all training antigens are exposed to all ARBs and ARB affinity value is used to update resource numbers according to the class.
ii. If required number of resources exceeds the number of resources allowed, in that case, resources with lower affinity values are removed, and this process continues till it satisfies the required number of resources.
iii. All stimulated values of ARBs are used to calculate an average stimulated value of each class. If average values are lower than the stimulated threshold assigned by the user, then mutation is applied on ARBs belonging to the class, and generated ARBs are added to the pool.
iv. This process is performed until average stimulation values of all class exceed the threshold stimulation. Average stimulation is calculated as shown in Eq. (4).

$$\frac{\sum_{j=1}^{|\text{ARB}_i|} \text{arb}_j \, * \, \text{stim}}{|\text{ARB}_i|} = s, \ \text{arb}_j \in \text{ARB}_i \quad (4)$$

Here $i = 1\ldots\ldots n$

$S = (s_1, s_2, s_3, \ldots, s_{\text{nc}}\}$
$|\text{ARB}i|$ = number of ARBs belonging to class ith
abr_j * stim = stimulation level of jth ARB of class ith.

D. **Identification of candidate memory cell ARB generation**

Now for each class, when ARBs reaches at stimulation threshold, then ARB with maximum affinity is identified as candidate memory cell of that class. If the stimulation valve between the training antigen and candidate memory cell is larger than the value between initial memory cell and training antigen, then the selected candidate cell is added to the memory cell pool. The above-mentioned four steps will be executed for each training antigens. Then trained data sets are used for testing and classification.

3.2 *Classification or Testing*

In this phase, the trained data sets are used for testing data; here k nearest neighbor K-NN algorithm will be applied for classification of test data. The class of an antigen is determined by majority voting among the k most stimulated memory cell, i.e., k value under defined parameters.

4 Conclusion

Following outcomes are expected from the proposed research:

(1) Classification performance will be checked on various benchmark data sets, and results will be compared with the previous classification techniques.
(2) Improvements in results will be analyzed for classification accuracy.
(3) Time complexity of the algorithm will be observed.
(4) Overfitting will be tried to reduce.

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Optimization of EHR Data Flow Toward Healthcare Analytics

Vivek Tiwari, Ramjeevan Singh Thakur and Basant Tiwari

Abstract An EHR data warehouse (EDW) is a huge, brought together, standardized, integrated vault of data extricated from one or more administrative and clinical information system (frequently called "operational" or "transaction" frameworks). While operational frameworks are intended to deal with high volumes of exchange procedures, data warehouses incorporate elements to bolster high volumes and varieties of analytic procedures that assist to understand patterns in data. The EDW seems as an analytical system for health care for budgetary, operational, quality, and process enhancement and works as the source framework for populating different databases. By expanding the existing data warehouse to accommodate patterns persistently instead of building new ones, not exclusively is cost of duplicative frameworks and also increase the overall system cost. In this view, the work is presented to explore the applicability and feasibility of such hybrid system for healthcare industry.

Keywords EHR data warehouse · Healthcare analytics · Persistent pattern Clinical data · Pattern · Data preprocessing

V. Tiwari (✉)
DSPM IIIT, Naya Raipur, Chhattisgarh, India
e-mail: vivek@iiitnr.edu.in

R. S. Thakur
Department of Computer Applications, Maulana Azad National Institute of Technology, Bhopal, Madhya Pradesh, India
e-mail: ramthakur2000@yahoo.com

B. Tiwari
Hawassa University, Awassa, Ethiopia
e-mail: basanttiw@gmail.com

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1 Background

In the view that electronic health records (EHRs) have conveyed a few advantages to social insurance, many advantages have not been completely figured it out [1–3]. For instance, EHRs increase the storage capacity of clinical information created every day, but couple of frameworks have possessed the capacity to successfully put those information to use by allowing productive recovery of data in a way that encourages quality, analytics, and security [3, 4]. The EDW utilizes a propelled structure for changing and incorporating information from different source frameworks. It stores information as discrete components and has one picture for each of the accompanying, paying little heed to number of sources [5–8]. An EHR-based clinical data warehouse involves the accompanying benefits:

- A database for organizing and possess raw information
- An integrated and profoundly extensible information model
- Efficient data transformation tool
- Facilitate process to reused processed data
- To remove, change, and load information from different frameworks
- A business knowledge database improved for systematic healthcare analytics
- A healthcare analytics tool that dispenses with the need to compose SQL, empowers publishing of reports
- It is fit for creating an extensive range of visualization (charts, cross-tabs, tables, and graph)

The principle center behind this work is to plan a committed framework which can store EHR information with EHR artifacts together forever. At the end of the day, we can state that framework gives the capacity to recover "ready to use" patterns for prediction, budgeting, optimization, and many more.

2 EHR Pattern-cum-Data Warehouse

The EHR data examination is a pivot point of any patient disease examination [9, 10]. These days, the vast majority of the work focusing just observation of EHR information specifically case by case [11–13]. It will support just only discover and get understanding against specific patient. These days, EHR information is immense and dynamic. Accordingly a variety of and complex EHR artifacts are extracted [14, 15]. In this way, more intricate systems are required keeping in mind the end goal to extract the concealed information and make these patterns profitable to the experts [16, 17]. Information management can be considered in three courses, administration of day-by-day value-based information, administration of historical information, and administration of artifacts. Value-based (operational) information is overseen and kept up by operational databases and is known as database management system (DBMS) [16]. Historical information is overseen by data warehouse, and it is utilized for investigation and analytics. Pattern warehouse center is new ideas, and little accentuation has been given till date. Pattern warehouse is as appealing as information distribution center as the primary storehouse of artifacts and is utilized for reporting and forecasting [16]. By nature, patterns are not diligent, i.e., each time when you require pattern need to execute underlying technique over and over. Pattern warehouse center is an approach to make pattern persevering by putting away them forever.

2.1 Significance of Embedded EHR Pattern Warehouse

We require framework that will allow us to manipulate, extract, transform, and operate on pattern so that knowledge can be presented as per need. Following section focuses on the reasons behind the need to dedicated pattern repository system:

1. Instant access to EHR pattern, trends, and analysis (save time), i.e., patterns are available on demand
2. Convert EHR data into actionable form [18]
3. Decrease computational cost and increase productivity, i.e., provide various kinds of trend reports quickly
4. Maintain the historical EHR patterns even when underline data source not available
5. Integrate EHR patterns from multiple source systems, enabling a central view across the enterprise
6. Provide a single and common platform for as a EHR pattern container regardless of its heterogeneity
7. Compare the EHR patterns that it makes sense to the business users
8. Aggregate the EHR patterns so that it delivers excellent query performance without touching underline data source
9. Make system more independent from other EHR data sources
10. Allow to run complex pattern extraction methods (data mining) once and then make available result forever
11. Make analyst to view trends in multiple way in efficient and effective way
12. Reduce high-cost data preprocessing.
13. Generate a high ROI (return on investment)
14. Support green computing

Figure 1 presents a framework of an EHR pattern-cum-data warehouse that can be used to manipulate, extract, and transform the patterns and as well as EHR and other clinical data.

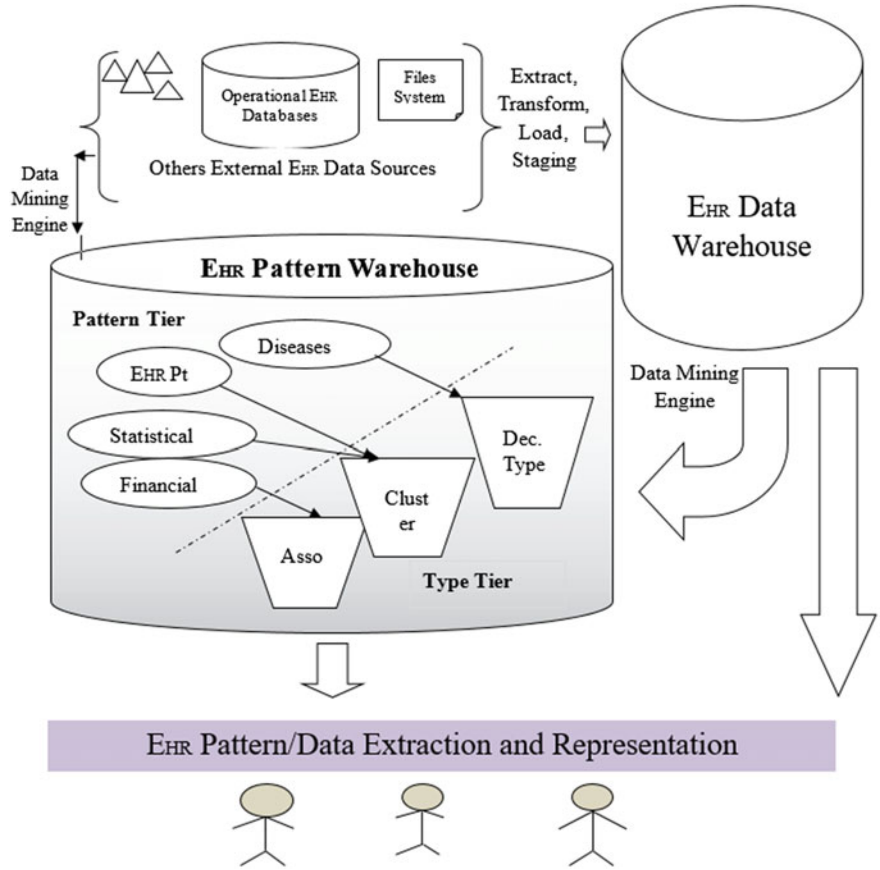

Fig. 1 Framework of an EHR pattern

3 EHR Pattern-cum-Data Warehouse Benefits

A few advantages exist when EHR data warehouses center is implemented. In the first place, data warehouse centers join information from numerous unique sources including legacy and operational systems and reduce the requirement for tedious manual extraction and absorption of information from various frameworks [3, 19, 20]. Moreover, as information is consolidated, they are frequently standardized to enable to manipulate, extract, transform. Second, the connection with tools to execute data mining and statistical analyses permits a wide assortment of exploratory investigations to be quickly performed [19, 21]. Third, since data warehouse centers are separate from the operational frameworks that hold the source information, performing analytics do not bring about extra load and reduce the response time for critical clinical practice. At long last, dissimilar to EHRs that normally store information in a patient-driven way, data warehouse centers store information in an organized way that effortlessly permits cross-patient inquiries [17]. The major applications of such framework are given below:

Criticality of IT Usage

- Data quality issues
- Reporting requirements
- Monthly summaries of their health system's
- Show organizational performance in respect to companions and national benchmarks. National benchmarks
- Automate the integration of disparate data sources
- Tracking outcomes across patient populations (cross-study analysis)
- Improving clinical processes and practices
- Reporting to regulatory bodies
- Quality assurance
- Ongoing medical review
- Single data storage for visualization/analysis tools
- Ensuring consistent data everyone can trust
- Enabling meaningful, targeted quality improvement

Return on Investment

- Financial data comparisons
- Repeatedly and reliably delivered information that combines clinical, financial performance, quality, cost, and patient experience data
- Facilitate analysis on demand rather procuring
- Tracking financial performance
- Clinical research
- Improving business processes and practices

Improvement in Customer Services

- Negotiating with insurance companies
- Tools that effectively extricate basic information at present secured EMRs, claims, and charging frameworks to make information procurement repeatable
- Enabling a more efficient, scalable reporting process

4 Future Research Direction and Conclusion

Future work includes the dynamics of changing, modifying, and updating of EHR patterns in warehouse. We must address the pattern's storage technology and schema toward quantity, quality, and heterogeneity. There are also need to explore about duplication, compression, optimization, and pattern placement. EHR pattern warehouse refreshment problem is very important to handle carefully. There is need to investigate techniques those update the warehouse as underlying source data changed.

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Multiclustered Energy-Efficient Routing Algorithm with Mobile Sink Node Moving in Clockwise Direction

Habila Basumatary and Moirangthem Marjit Singh

Abstract Wireless sensor networks (WSNs) consist of densely deployed small and low-cost sensor nodes which can sense data from the environment and process the same. The focus of the paper is on the communication protocols of wireless sensor network with an emphasis on efficient utilization of energy towards maximization of network lifetime. An algorithm named 'multiclustered energy-efficient routing algorithm with mobile sink node moving in clockwise direction (MERAM-C)' is proposed in the paper. Here, the sink node moves in a clockwise direction with a fixed trajectory across the network area. In this approach, the randomly deployed homogeneous sensor nodes are clustered into several regions each having its own cluster head (CH) nodes. MERAM-C algorithm is implemented and simulated. From the results of simulation, it can be seen that the lifetime of the WSNs using MERAM-C is longer than the lifetime of the WSNs using LEACH (the standard WSN protocol).

Keywords WSN · LEACH · Cluster heads (CHs) · Sink mobility

1 Introduction

The sensor nodes in wireless sensor network (WSN) monitor its surrounding area, gather the information and transmit the gathered information to the sink node where all the forwarded information gets accumulated and then can be accessed by the user. The application areas of wireless sensor network include military, home industry automation, environmental monitoring or health monitoring. The sensor nodes are just dropped randomly to form ad hoc network where the nodes work

H. Basumatary (✉) · M. M. Singh
Department of Computer Science and Engineering, North Eastern Regional Institute of Science and Technology (NERIST), Nirjuli 791109, Arunachal Pradesh, India
e-mail: habilabasumatary6@gmail.com

M. M. Singh
e-mail: marjitm@gmail.com

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automatically [1–4]. The sensor nodes communicate in the peer-to-peer network and transfer the sensed data from one node to another. An in-built source of power supplies the energy required for the node to perform the programmed task. Since the sensor nodes are low battery powered with the on-board power supply, the high energy consumption by the sensor nodes in performing its intended tasks is the main issue in WSN. Generally, the energy consumption in terms of data transmission is comparatively much higher than the data sensing and processing [5].

2 Related Work

A large number of proposals in terms of distributed and centralized algorithms for clustering in WSNs can be found in the literature at present. Clustering in WSN based on coverage area of network helps to achieve better energy efficiency [6, 7]. The WSN area is split up into many clusters depending on some established characteristics. Only the CH (cluster head) node is able to communicate with the sink node, and hence, its role in WSN is significant [8]. Authors in [9] have furnished a routing protocol that can be used for mobile ad hoc networks based on clustering approach that split up the entire network area into many isolated or established multihop clusters. Formation of multiple chains among sensor nodes is found in the protocol proposed by the authors in [10] where every node is connected to one another to form a chain and the sink node is kept stationary. The network area is divided into several clusters based on its distance from sink node. Applying some intermediate procedure, several routes can be produced in order to transmit data so that waiting for a particular route is not required [11]. The flat routing protocols used in WSN are not good for lifetime enhancement even though there is an appropriate criterion taking lesser time. But the multipath routing protocols are suitable for enhancing the lifetime of WSN [12]. Jafri et al. in [13] introduced the mobility of the sink node in an improved version of PEGASIS-based IEEPB protocol, namely MIEEPB. The MIEEPB is based on the concepts of multiclustering and multichain formation with introduction of sink node mobility. The mobility of the sink node affects the lifetime of the WSN to a large extent. In MIEEPB, a $100 \times 100\ m^2$ area of network was considered and divided equally into four different sections.

2.1 LEACH Protocol

The first hierarchical and clustering-based energy-efficient routing protocol for WSN is the LEACH protocol [14]. It was developed to maximize the lifetime of WSN by minimizing energy usage by the sensor nodes. It uses random rotation of local base stations (CHs) by selecting them in a static manner.

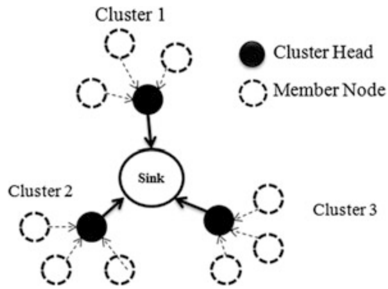


Fig. 1 Scenario of cluster formation in LEACH

The LEACH operation is based on rounds which are performed using the following phases:

(a) Set-up phase: in this phase, CHs are chosen based on a threshold value.
(b) Steady state: clusters are formed, and data is transmitted between nodes.

In LEACH, the energy of the sensor nodes disappears slowly within their clusters. The cluster head consumes more energy if the sink node is positioned at a farther distance from the network area. A scenario of cluster formation in LEACH is shown in Fig. 1.

3 Proposed Work

By dividing the sensor nodes into several clusters through the application of clustering algorithm [14], we propose a multiclustered routing algorithm called as MERAM-C for WSN in this paper. Each cluster has its own local base stations (cluster heads) to which they send their sensed data. The sink node having unlimited power source [13] travels across the whole network area in a clockwise direction in a fixed trajectory, and it collects the aggregated data from CH nodes. To save battery power, basically the following four steps are followed:

I. **Deployment of Sensor Node:**
To achieve efficient communication, random deployment of sensor nodes at fixed positions within the WSN area is adopted in the proposed multiclustered algorithm. Every deployed sensor node is assumed to possess similar properties having limited and equal amount of battery power. There is an uninterrupted flow of information to the mobile sink node that moves continuously at various locations within the entire WSN area in each round.

II. **Clustering:**
To create clusters, each node decides either to become a CH or to remain as the normal node for the round at present [14–16]. Based on a percentage suggested by the user, this decision of the sensor nodes is made. To become a CH, a number (say q whose value is found between 0 and 1) is chosen at random by

every sensor node. Then, $T(n)$ (a threshold value) is calculated using the suggested percentage of becoming CH, P and the current round r. The threshold $T(n)$ calculation is given in Eq. (1) and is taken from the LEACH protocol:

$$T(n) = \begin{cases} \frac{P}{1-P*\left(r\, mod\, \frac{1}{P}\right)} & \text{if } n \text{€} G \\ 0, & \text{else} \end{cases} \tag{1}$$

G represents the list of nodes that were not CHs in the last $\frac{1}{P}$ rounds. Every sensor node will utilize an equal amount of energy in order to become a CH.

III. **Energy Model:**

The radio/energy models discussed in [14] are used in this paper. The energy models are given in Eqs. (2)–(6). To run the trans-receiver process, an amount of 50 nJ/bit (E_{elec}) energy is spent and 100 pJ/bit/m^2 (€$_{\text{amp}}$) energy for running transmitter amplifier. Figure 2 shows the energy model:

$$E_{\text{TRS}}(k,d) = E_{\text{TRS\_elec}}(k) + \text{€}_{\text{amp}}(k,d) \tag{2}$$

$$E_{\text{TRS}}(k,d) = E_{\text{elec}} * k + \text{€}_{\text{amp}} * k * d^2 \tag{3}$$

$$E_{\text{RCV}}(k) = E_{\text{RCV\_elec}}(k) \tag{4}$$

$$E_{\text{RCV}}(k) = E_{\text{elec}} * k \tag{5}$$

$$d_0 = \sqrt{\text{Efs } / \text{Emp}} \tag{6}$$

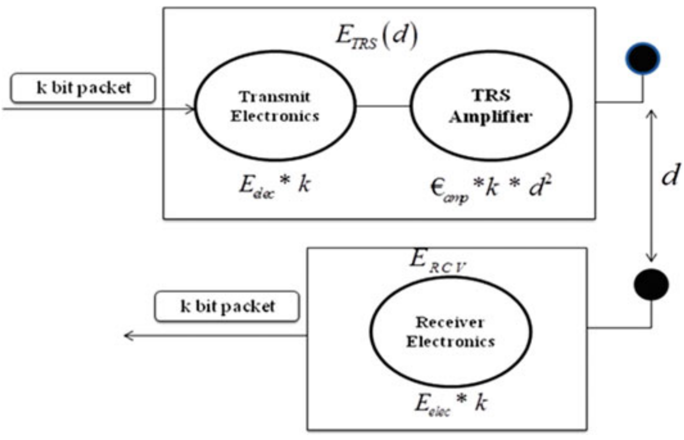
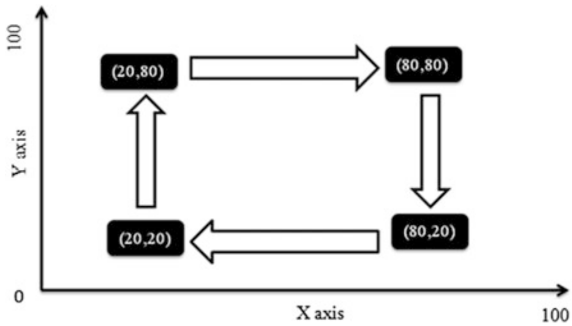


Fig. 2 Utilization of energy for trans-receiver process at "d" distance

Fig. 3 Pre-defined path for the sink node



IV. **Sink Mobility:**
We assumed that the sink node has unlimited power source to complete the programmed task [13]. The performance of WSN is measured in round parameter [14]. When the sensed data is sent to the CH from where it is collected by the sink node, it is considered as the completion of one round. The sink node moves continuously, starting from the location (20, 80) in a clockwise direction with a pre-defined fixed path. The sink node moves into forward, downward, backward and upward directions, respectively, to complete its data collection from the cluster head nodes. Figure 3 shows the pre-defined fixed path of the sink node. This movement of the sink node continues till the simulation reaches to its last round.
Figure 4 shows the movement of the sink node across the whole network area with the above-mentioned pre-defined path during the simulation process. Here, all member nodes are represented by small circle symbols, CHs are represented by star symbols, and the large red circle represents the sink node. As we can see only the location of the sink node and the cluster heads are changed in every round, the coordinates of the other sensor nodes remain same.

V. **Proposed Algorithm:**
The pseudocode of the proposed multiclustered energy-efficient routing algorithm with mobile sink node moving in a clockwise direction (MERAM-C) is given below:

1. Deploy the sensor nodes randomly across the network area.
2. **for** all sensor nodes **do** $i = 1$ to n, $S(i) = (X_i, Y_i)$
3. Randomly establish the sensor nodes.
4. **end for**
5. Elect the cluster heads (CHs) based on $T(n)$.
6. Form the clusters, using elected CH.
7. **for** every cluster

8. Transmit the sensed data to the CH.
9. CH forwards it to the sink node.
10. **end for**
11. Move the sink node to its next location.

4 Simulation and Result Analysis

The proposed protocol MERAM-C is simulated through MATLAB, and its results are compared with the LEACH protocol. The simulation is carried out using fixed parameters which are shown in Table 1. Initializing each sensor nodes with an equal amount of energy (E_0 = 0.5 J), the simulation is started and we noted down the number of rounds the LEACH protocol and MERAM-C reach when 1, 50 and 100% of sensor nodes die. Once a node reaches its residual energy level 0, that node

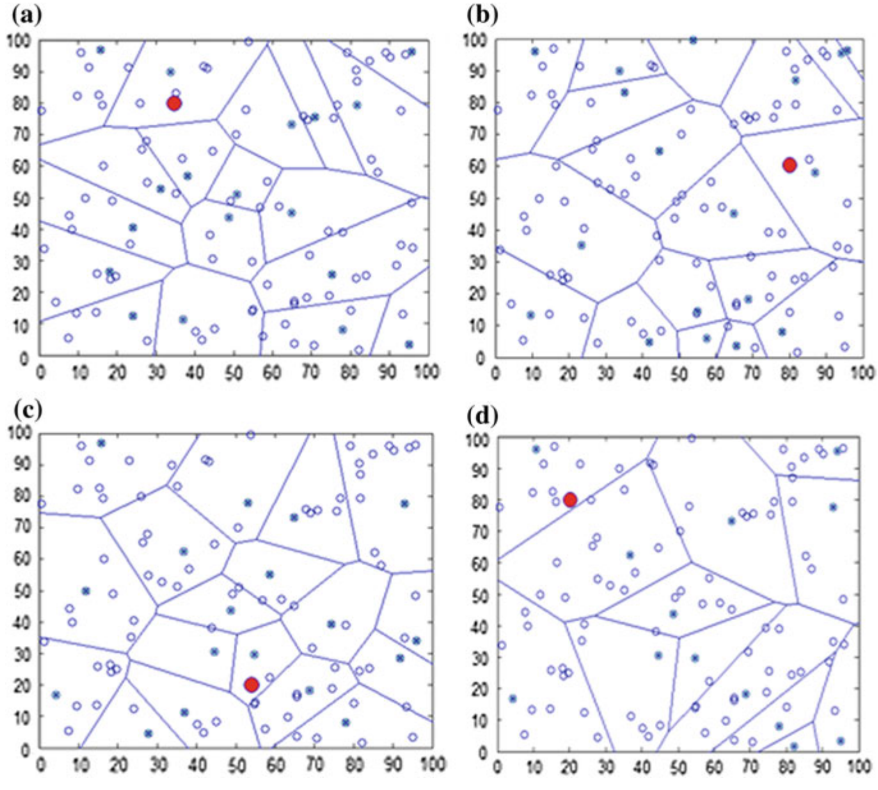


Fig. 4 Sensor node deployment, cluster formation of sensor nodes and movement of sink node

Table 1 Network parameters

SI. No.	Network parameter	Value
1	Network size	$100 \times 100\ m^2$
2	Total number of nodes	$n = 100$
3	Initial energy of sensor nodes	$E_0 = 0.5$ J
4	Packet size	$k = 4000$ bits
5	Data aggregation energy consumption	EDA = 5 nJ/bit
6	Amplification energy ($d > d_0$)	Emp = 10 pJ/bit/m^2
7	Amplification energy ($d \leq d_0$)	Efs = 0.0013 pJ/bit/m^2
8	Transmitter electronics (E_{TRS_elec}) Receiver electronics (E_{RCV_elec})	$E_{elec} = 50\ \mathrm{nJ/bit}$
9	Transmit amplifier ($€_{amp}$)	100 pJ/bit/m^2

Table 2 Total rounds reached when 1, 50 and 100% nodes die during simulation

Protocol	1% (first node died)	50% (half node died)	100% (last node died)
LEACH	795 rounds	976 rounds	1334 rounds
MERAM-C	995 rounds	1226 rounds	1542 rounds

is considered dead for the rest of the simulation. In the LEACH protocol, the sink node is fixed and located at a position which was farther from the network area [14], whereas in MERAM-C, the sink node moves across the network area in a clockwise direction with a fixed trajectory continuously. The total number of alive nodes was collected in each round up to 2000 rounds where 100 alive nodes were considered initially.

Table 2 shows the number of rounds that was reached when 1, 50 and 100% nodes die during the simulation for a $100 \times 100\ m^2$ network area. Figure 5 shows the comparison plot for dead nodes versus number of rounds in LEACH and MERAM-C. In MERAM-C, the first node died at 995th round, but in LEACH, the first node died at 795th round. The last node died at 1334th round in LEACH, and in MERAM-C, the last node died at 1542nd round. Figure 6 shows the comparison plot for alive nodes versus number of rounds that each node completes before reaching to energy level zero. The lifetime of the network reached at 1300th rounds in LEACH, whereas in MERAM-C the network lifetime reached at 1500th rounds. From the figures, it is shown that the lifetime of WSNs using the proposed MERAM-C protocol is longer than using LEACH protocol.

Fig. 5 Comparison plot of number of dead nodes in LEACH and MERAM-C protocols

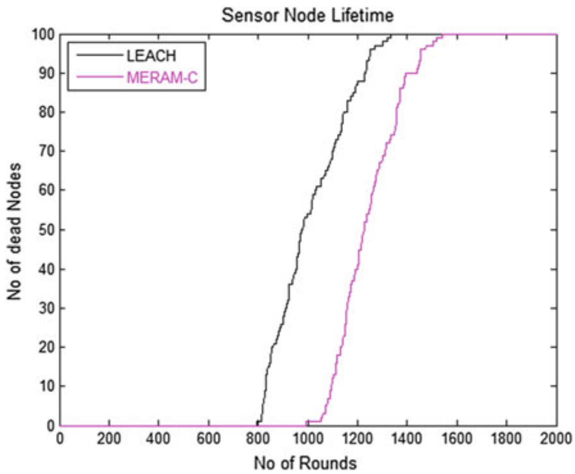


Fig. 6 Plot for WSN lifetime comparison

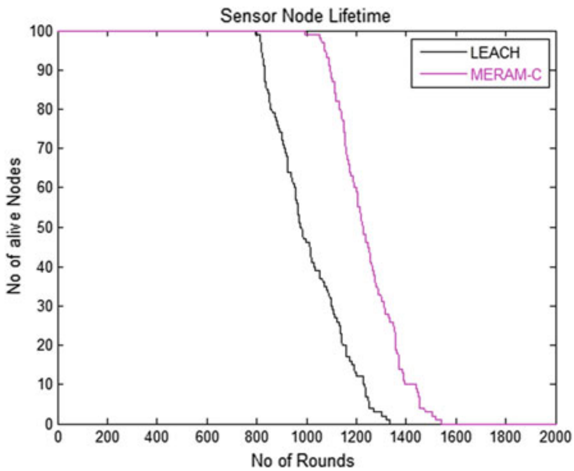


Figure 7 shows the comparison plot for packets sent to the base station versus number of rounds in the MERAM-C and LEACH protocols. The number of packets transmitted in the LEACH protocol was 10,967, whereas in MERAM-C the number of packets transmitted was 27,090 which shows that the results of MERAM-C are better than the LEACH protocol.

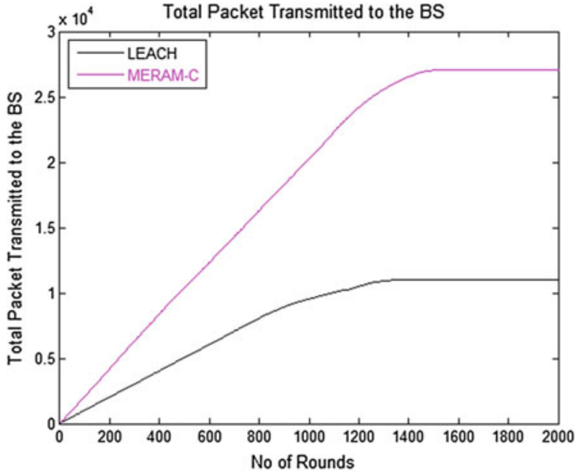


Fig. 7 Comparison plot for total packets transmitted to the BS

5 Conclusion

In this paper, a multiclustered energy-efficient routing algorithm (MERAM-C) was proposed. It was also shown that the lifetime of the WSN using the proposed protocol (MERAM-C) is longer than the lifetime of the WSN using the standard WSN LEACH protocol. It was also observed that the mobility of sink node not only decreases the load on the cluster head but also enhances the network lifetime. Further improvement can be done on the mobility pattern of the sink node considering larger network area for wireless sensor networks.

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A Detection Technique for Overhead Minimization in Tunneling Attack

Sunil Kumar Jangir and Naveen Hemrajani

Abstract Mobile ad hoc networks (MANETs) are wireless infrastructure-less networks. Predefined infrastructure does not exist in this type of network. Thus, a structure is formed on the basis of nodes present at the time whenever a node has a packet to deliver. Because of this property, MANETs are attacked by many intruders. One of the most severe attacks includes wormhole attack. In wormhole attack two wormholes or nodes set up a link, and through this link they can create an illusion of shortest path and in future can work for data dropping. The link they form is also called as tunnel and that is why the other name for this attack is “tunneling attack.” The proposed algorithm works perfectly for the detection of a wormhole and gives minimum overheads. This approach uses the concept of timer and queue.

Keywords MANET · Wormhole · Tunneling attack · Intruders

1 Introduction

A mobile ad hoc network (MANET) is a multi-hop, wireless, infrastructure-less network. This wireless nature of MANETs exposes it to a huge challenge of security issues while system designed Ad hoc networks are generally open to anyone [1]. All mobile hosts in MANET operate without centralized infrastructure. Sometimes due to radio power limitation and channel utilization, host-to-host communication may take place in a multi-hop fashion, where each mobile host acts as a router [2].

S. K. Jangir (✉) · N. Hemrajani
Department of Computer Science & Engineering,
JECRC University, Jaipur, Rajasthan, India
e-mail: sunil.jangir07@gmail.com

N. Hemrajani
e-mail: naven_h@yahoo.com

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Few features of MANET like open medium, dynamic change in topology, lack of central monitoring and management, cooperative algorithm, and no clear defense mechanism make it vulnerable to various security attacks [3].

2 Wormhole Attack

Wormhole attack is one of the most severe attacks on MANET. It cannot be detected easily because in such an attack two malicious or attacker nodes join together and create tunnels between them. The proposed technique discovers an alternative route to the target node since the shortest path might have the malicious attack [4]. In such an attack, each node acts as a sender or a receiver or a router so it is quite difficult to detect whether the data has been sent or received by the true node or the malicious attacker thus increasing chances of loss of data as well as reception of fake data [5]. Since the wormhole attack involves off-channel transmission of data, it is very hard to be detected by the nodes participating in the MANET. Attackers may use high power transmission, packet relay, or encapsulation technique to tunnel packets to colluding nodes. This process creates confusion, for the nodes that are actually multi-hops apart showing them as immediate neighbors. The wormhole nodes can create a tunnel even for the packets not addressed to them. This tunnel creates a route that is much smaller than the original route, and hence nodes pursue the path through these nodes considering it the shortest path. This illusion can be used in future to degrade, disrupt, or analyze the traffic stream in the network [6–10].

A. **Classification of Wormhole Attack**

Wormhole attacks can be classified on a number of bases like in the way these nodes are implemented, the medium chosen by these nodes, in the way they attack, on the basis of their visibility. Depending upon whether wormhole nodes put their identity into packets headers when tunneling (visibility), they are classified as:

1. **Open Wormhole Attack**: Open wormhole attack is also known as exposed attack. In this type of attack, nodes identity is contained in the packet header. Hence, the legitimate nodes are aware of the presence of the wormhole nodes but do not know that they are wormhole nodes.
2. **Closed Wormhole Attack**: Closed attack is also known as hidden attack. It does not affect the packet header at the time of route discovery, and hence legitimate nodes do not know its existence.
3. **Half Open Wormhole Attack**: In this attack, one malicious node is visible to the legitimate nodes as it updates its entries in the packet header and the other node is invisible [11, 12].

3 Detection Techniques

Aarfa et al. proposed a detection technique termed as Normalized Wormhole Local Intrusion Detection Algorithm. It is a modification over Local Intrusion Detection (LID) [13]. Vandana et al. proposed a method that detected wormhole nodes at the early stage of route discovery process in an AODV. This method is known as multilayered detection mechanism. This method consists of four main layers in the architecture, and each layer has a predefined task [14].

Sun et al. suggested a technique called Wormhole Attack Prevention (WAP) based on the use of a timer called Wormhole Prevention Timer (WTP). The technique assumes that the nodes can also listen to the traffic not intended to them; i.e., they can hear the messages even if they are not the recipients. Neighbor node monitoring detects all the neighbors that are not within the transmission range of the node. Transmission range is the one-hop range. The value of Wormhole Prevention Timer (WPT) depends upon whether or not the nodes have mobility. If the nodes are fixed sensor, WPT is given by: WPT = (2 × Transmission Range TR)/*Vp* [15].

4 Proposed Solution

Here, we propose an algorithm which is an extension of the algorithm using Wormhole Prevention Timer. The previous algorithm was for DSR protocol and suffered from the drawback of overheads due to overhearing of messages by all one-hop neighbors. This algorithm detects wormhole attack using a similar concept as the previous one but works for AODV protocol. Since there is no problem of overhearing in AODV protocol, the overheads due to overhearing are avoided by themselves. We assume there is a queue that stores the value of counters. The counter here denotes the number at which the node is in the path. Therefore, the last value of the counter will give the total number of nodes in the path.

The purpose of using the queue is very straightforward, and queue works in FIFO manner. The values in the queue are thus multiplied in reverse order or we can say that is the order in which the node appears while sending RREP. For example, the value of queue after the destination *D* receives the RREQ will be 1 2 3 4.

Steps of the algorithm:

1. for each sender s ε S do
   s ⇒ RREQ
   RRWQ ⇒ HOP_Neighbors;
   Intermediate_Nodes ⇒ HOP_Neighbors;
   Initializes Buffer;
   while timer > 0 && for each RREP
   Buffer <= RREP
   end while

2. Counter is initialized by s to 1
   Counter is stored in Queue by s
   s ⇒ (Counter + RREQ)
   Nodes sending the RREQ increments the Counter and Store in their queue
3. d <= RREQ
   d ⇒ RREP along with queue using reverse path
4. Node after receiving the RREQ calculates the value of its Wormhole Prevention Timer using following formula
   WPT = (n*2*TR)/Vp
   where, n = value at front of the queue
   TR = Transmission range or one hop distance
   Vp = Velocity of Packet
5. The time taken for RREP to reach the node back after sending the RREQ is calculated by:
   Ttaken = TRREP − TRREQ
6. If the time taken exceeds the WPT in the link is suspected to be the wormhole link. The information is broadcasted to the network, The wormhole link is not included in further communications.
7. end for

While calculating WPT, *C* will be the first to receive RREP, and hence value of n for *C* will be 1, *B* will be 2. This value of n therefore is a multiplier to calculate time based on the distance. If the value of WPT is less than the time taken then the link is suspected to be wormhole. While if WPT is greater than the time taken then the link is not a wormhole link and is safe to use for communications (Fig. 1).

The source *A* first starts sending RREQ to its one-hop neighbor *B*. *A* attaches a queue with the RREQ packet to be forwarded. It puts the value 1 in the queue. It also passes a counter initialized to 1 with the packet. The node receiving the RREQ checks if the node itself is the destination node. If it is not the destination node, it forwards the RREQ to its neighbors. It also increments the counter and stores it in the queue. The nodes also keep a record of the time at which they sent the RREQ to their neighbors (Figs. 2 and 3).

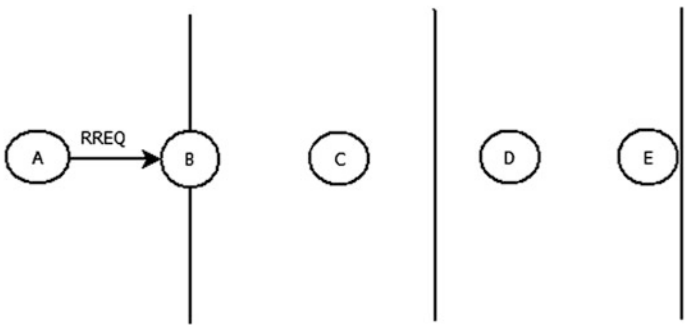

Fig. 1 RREQ from source to neighbor

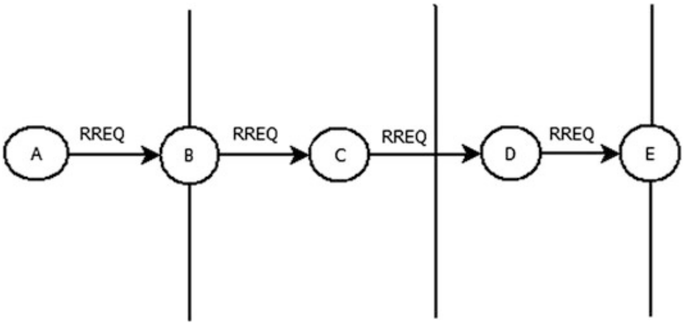

Fig. 2 RREQ reached destination

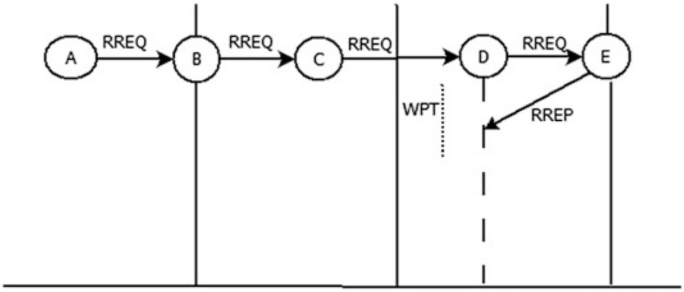

Fig. 3 Destination sends RREP

Once the RREQ reaches the destination *E*, it identifies itself as the destination. Next, it starts sending RREP toward the source A through the same route. Once the neighbor D receives the RREP packet, it calculates time taken by RREQ packet to reach E and then RREP to reach it. Then, E calculates WPT by the value in the queue. It then compares the two values calculated by it. Here WPT is larger than the time taken, and hence the link turns out to be safe. If at any node the value of WPT comes out to be smaller than the time taken, or in other words the RREP packet reaches the node after the expiration of WPT, the link is suspected to be wormhole link. The information about wormhole link is broadcasted to the entire network. Thus, any future communication through this link (*B C*) will be avoided (Figs. 4 and 5).

The same procedure is followed at all nodes receiving the RREP packet.

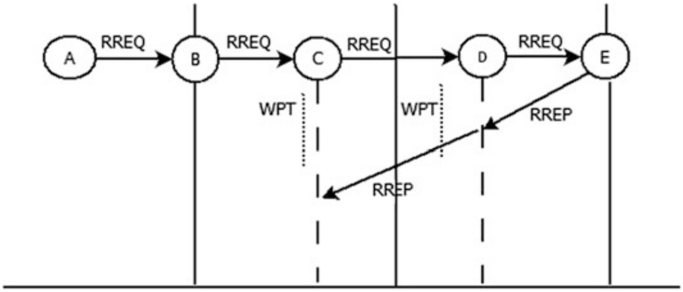

Fig. 4 RREP transmitted further (normal case)

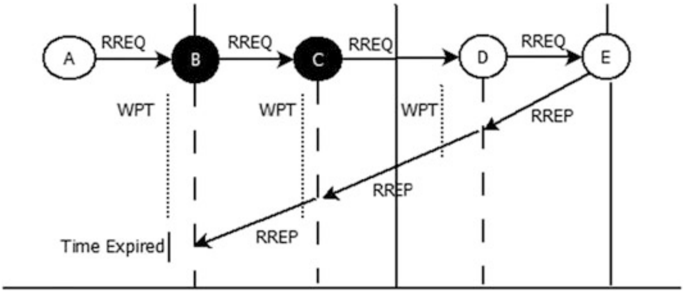

Fig. 5 RREP transmitted further (wormhole detected)

5 Simulation

A. *Simulation Environment*

Wormhole attack and our proposed algorithms are implemented in ns-3. For our simulations, we use Traffic type Constant Bit Rate (CBR) application, UDP/IP, IEEE 802.11b MAC, and wireless channel based on random waypoint mobility model. The simulated network consists of 10–50 randomly allocated wireless nodes in a 1000 by 1000 m^2 flat space. Data rate is 2.0 Mb, and the min speed and max speed of nodes are 0.5 and 1.5 m/s, and the no. of wormhole link kept is 0,1. The selected pause time is 10 s.

B. *Results and Discussion*

Wormhole attack is simulated along with the AODV protocol, and AODV is also simulated without any malicious node, and finally our proposed algorithm is simulated with 0,1 wormhole link in the network, and the performance is measured by performance metrics like average PDR, average EED, normalized routing overhead. As shown in Fig. 6, the Average packet delivery Ratio is highest when

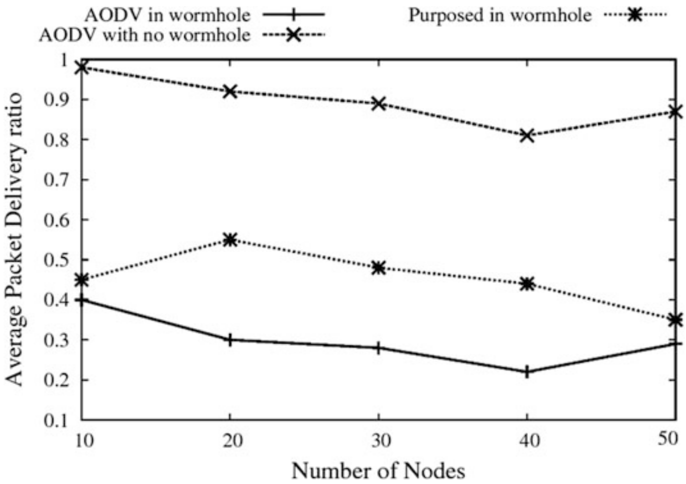

Fig. 6 Average PDR under increasing NON

there is no malicious condition. In our proposed algorithm, the result is slight good as compared with the wormhole attack which occurred in the network.

Packet delivery ratio is defined as the ratio of number of packets sent from the sender side and the number of packets actually received by the receiver. As shown in the diagram when the AODV is in wormhole, the average PDR is constantly decreasing with the increasing number of nodes and vice versa is true when the AODV is not in wormhole. By using the proposed algorithm, the average packet delivery ratio can be increased as wormhole nodes will be detected at initial states; then it would not harm the network and cause less damage.

The source–destination pair ratio is always fixed, and with the increasing number of nodes, only the effect of attackers on network parameters is enhanced. As shown in Fig. 7, the average end-to-end delay of the network increases with the increasing number of nodes because the attackers or wormhole nodes will either drop the packets or they will increase the delay. Thus, the worst case of this situation is shown in the figure when the AODV is in wormhole. By using the proposed algorithm, it can be balanced. In routing, routing overheads contribute the control packets and the route breaks. As per shown in Fig. 8, the normalized routing overheads are increasing with the increasing number of nodes. Therefore the increased number of nodes will result in more number of control packets for their broadcasting and more route breaks. This algorithm can be used to minimize the number of control packets and to control route breaks, thus resulting in lower routing overheads (Figs. 7 and 8).

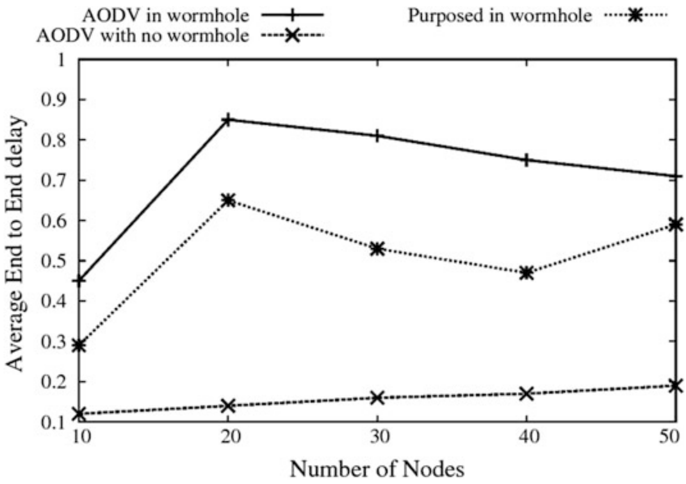

Fig. 7 Average EED under increasing NON

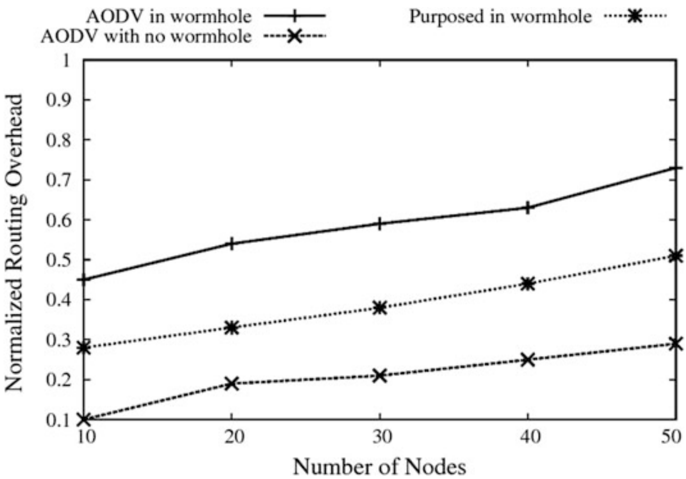

Fig. 8 NRO under increasing NON

6 Conclusion

In this paper, the various aspects and classifications of a wormhole attack are discussed. The proposed algorithm works for the detection of a wormhole in the network and mechanism to diminish the consequences. This approach works equally well with the defined three classifications of a wormhole attack. Two key points of this algorithm are (1) the timer approach and (2) the queue implementation. The use of the timer approach results in minimum number of overheads which is the basis con in every approach, while the queues work in FIFO manner. Thus, we store the node appearing order in it. This results in the identification of the wormhole attack, and the illusion created by the wormhole nodes can be broken. A threshold value, i.e., Wormhole Prevention Timer value, is calculated according to the mentioned formula. Thus, this algorithm works better in the sense of less number of overheads and the time taken in the detection of a wormhole attack.

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A Review of the Quality of Service for Time-Sensitive Applications Through Admission Control in 802.11 WLAN

Dharm Singh Jat, Arun Shejwal, Guy Lusilao and Charu Singh

Abstract Today, the text, voice, and video communications have become the integrated part of our society. All spheres of life, from industry to leisure, now depend upon received data and its reliable and in-time transmission. This paper provides an understanding of the current challenges of Quality of Service (QoS) for real-time application through Admission Control in the network based on IEEE 802.11 WLAN protocol. It explains the gaps in research and limitations that exist in current admission control schemes. The study proposal gives out work method to develop the efficient and effective admission control scheme for 802.11 WLAN and bridge the gap in research.

Keywords QoS · Admission control · Video over IP · Voice over IP (VoIP) Videoconferencing

1 Introduction

In general, the data communication networks can be broad categories as a backbone network and access networks. There are many types of access technologies for deploying access network on campus. Each of these technologies has its own advantages and limitations. In the present and the future scenario, one of the promising candidate access technologies for wireless communication is IEEE

D. S. Jat (✉) · A. Shejwal · G. Lusilao
Namibia University of Science and Technology, Windhoek, Namibia
e-mail: dsingh@nust.na

A. Shejwal
e-mail: arunshejwal@gmail.com

G. Lusilao
e-mail: gzodi@nust.na

C. Singh
VIT University, Vellore, India
e-mail: charusingh2194@gmail.com

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802.11 Wireless Local Area Network (WLAN) standard. Simplicity in deployment and high bandwidth capacity has led to the rapid deployment of WLANs almost everywhere.

In recent years, there has been consistent growth in the use of real-time communications for businesses [1]. The popular real-time applications are a voice over IP (VoIP), video over IP, videoconferencing, instant messaging (IM), networked games, and other time-sensitive critical applications. The real-time communication employs application program that operates in time domain where the user feels the effect as immediate or real time. In this type of communication, the latency parameters are expected to be less than a pre-defined value which is generally measured in microseconds.

The WLAN based on the original 802.11 IEEE standard is capable of provisioning only best-effort services. Many developments have been proposed over vanilla 802.11 WLAN to improve its performance for supporting real-time communication. Most of the improvements are directed toward enhancing the raw data rate supported by the network. Many variations are suggested to original standard incorporating changes in the specification of PHY layer. One of such improvement proposed is 802.11n standard [2]. The standard proposes the concept of multiple inputs multiple outputs (MIMO), using multiple antennas in wireless stations. This standard also incorporates Frame Aggregation technique for higher data rates. The standard is expected to support data rates up to 600 Mbps.

The improvements in data rates have certainly resulted in better performance offered by WLAN to time-sensitive services. However, frequently it has been observed that the high data rate network based on 802.11n fails to provide QoS guarantees under heavy traffic conditions. Hence, it is necessary to design and implement a mechanism to control the admission of flows in the network to ensure below saturation performance of the WLAN [3].

2 QoS Requirements

In last few years, the interactive multimedia services have gained a lot of importance in almost all occupations. It became, even more, buzzword when personal computers were connected via networks. In service Video on Demand, the client can choose a movie that he/she wants to watch. The contents are delivered via network instantly. VoIP telephony, which is highly interactive, is now widely used to exchange information between people. Many servers store set of audio and video streams. In service audio and video streaming, the client can tune into one of the stored streams using a streaming capable application and consume the content. These enhanced services require definite bounds for the Quality of Services (QoS) metrics such as guaranteed bandwidth, delay, jitter, and packet loss. The different types of services have varying QoS requirements [4]. The typical performance requirement for text-, audio-, and video-based services are discussed in Table 1.

Table 1 Performance requirement for text-, audio-, and video-based services

Class	Application	One-way delay	Jitter*	Packet loss rate
Real time	VoIP, videoconferencing	<150 ms	1 ms	1% (Video) 3% (Audio)
Streaming	Streaming video/audio	Up to 10 s	1 ms	1%
Best effort	Browsing, e-mailing, FTP	Minutes	NA	0%

3 Amendments to IEEE 802.11 Standards

The original 802.11 standard specifies the capability of data rates ranging from 2 Mbps extending to few Gbps. It defines the operation of WLAN at 2.4 GHz in unlicensed the industrial, scientific, and medical (ISM) frequency band. WLANs have a limited coverage area and typically cover up to a maximum range of 100 m. In July 2003, yet another amendment to the original standard was ratified as an 802.11 g specification. Similar to 802.11a, it also uses OFDM allowing the maximum theoretical raw data rate of 54 Mbps but in practical maximum network throughput range is 20 Mbps.

3.1 IEEE 802.11e

All of the amendments 802.11a/b/g employ the enhancements in technology at the physical layer to boost the data rate of the channel. Due to higher data rates, these standards do provide better QoS that original 802.11 standard-based WLAN. However, they do not ensure QoS guarantees to different services as they lack differentiation among services. As an enhancement to MAC layer, an amendment IEEE 802.11e standard was defined. This standard proposes new MAC layer function known as hybrid coordination function (HCF) [5]. The enhanced new standard IEEE 802.11e facilitates running QoS-sensitive services over WLAN. Albeit it offers better QoS performance than its predecessor plain MAC standard, it is not self-sufficient to extend guaranteed QoS in network overload environment [6]. It is, therefore, essential to control the volume of traffic in order to assure QoS support to existing flows. If admission restrictions are not in place to control the traffic allowed into the network, an appreciable throughput degradation and high medium access delay result in unacceptable performance to enhanced services.

3.2 IEEE 802.11n

However, provision of different access categories at MAC layer in 802.11e is allowed WLAN to differentiate the traffic flows and provided different priorities; the usable throughput of 802.11e WLAN was limited to 25 Mbps. In order to cater for higher throughput, another standard IEEE had formed a new task group in 2004. New standard 802.11n for wireless local network communications got ratified in 2009. Standard 802.11n employs the PHY layer technology that can achieve raw data rates up to 600 Mbps [2]. The standard employs MAC layer features to record usable throughput up to 400 Mbps. The standard holds the backward compatibility to 802.11 a/g devices. The fundamental requirement considered for development of this standard was incorporating support for at least 100 Mbps MAC throughput, almost four times the throughput of 802.11a/g. In order to achieve this, the specifications are amended at both PHY as well as MAC layer.

4 Admission Control in WLAN

Even though EDCA provides the service differentiation by using ACs, the QoS guarantees for the flows cannot be assured under near full load [6]. This limitation is due to the finite capacity of the channel. It is possible for the new flow to enter the network and jeopardize the QoS received by existing flows. Hence, employing admission control has become imperative to prevent any degradation in guaranteed QoS due to channel overloading [7]. According to the 802.11 WLAN standards, QoS-aware access point should have the Hybrid Coordinator (HC). This coordinator would decide on the admission of data flow at the access point. Traffic Specification (TSPEC) messages were defined by IEEE WLAN 802.11n task group for negotiating admission control in WLAN. Through this message, wireless stations use to inform the access point HC their traffic flow requirements such as packet size, delay, and service interval and data rate. Based on the prevailing loading of the network, the HC would accept or reject a new flow.

4.1 EDCA Admission Control Mechanisms

Most of the suggested admission control schemes for WLAN are based on network parameter measurement and estimation of channel capacity using theoretical network model [6]. In solely measurement-based schemes, the value of the concerned network parameter(s), such as the channel busy time in a specified interval, is monitored continuously and the call admission decision is taken by comparing measured values with a pre-defined threshold value for that parameter. Model-based schemes seek to develop a suitable model for the MAC process at the node and use this model to predict one of the QoS metrics such as the achievable throughput, the MAC service time, or the queuing delay at the time of addition of new flow into the network. Depending on the predicted value of the underlying metric, call admission decision is taken.

4.2 EDCA Distributed Admission Control (DAC)

DAC [8] is proposed initially as a part of the 802.11e standard but dropped subsequently. It is developed to protect existing flows by denying new flows into the network based on transmission budgets allocated for each (AC). The algorithm is executed in the following manner.

- At QAP (QoS enabled access point), the uplink and downlink transmission time for each AC is measured.
- QAP announces budget and utilization per AC in each beacon interval.
- Each QSTA (QoS enabled station) works out availability of transmission opportunity in each AC which equals to difference between budget and utilization.
- Each QSTA determines whether there is a scope of adding new flow or increasing transmission in each AC based on availability calculated above.

4.3 Two-Level Protection Scheme

This scheme [8] is an extension of DAC. At first level, the scheme attempts to protect existing priority flow from other priority flows, both existing and new. At second level, a protection is provided from best-effort traffic. First-level protection is implemented by enhancing the DAC algorithm by adding two new techniques known as early protection and tried and known. With early protection, no new flow is admitted using the same principle of DAC. With tried and known technique, a newly added flow is killed if guarantees of flows cannot be met with. At second level, the best-effort traffic is deferred further and further by increasing initial contention window size and inter-frame spacing. The main issues of the implementation are same as DAC scheme.

4.4 Admission Control Based on Threshold

In this scheme, each wireless station measures the traffic on the channel. Two different ways are proposed for admission control. One is based on relative occupied bandwidth and other is based on collision experienced by stations.

- In relative occupied bandwidth scheme, each station measures the busy time of the channel over a sample window period and calculate occupied bandwidth (B_{occu}) as the ratio of busy time to window time. Two different threshold values, T_{high} and T_{low}, are defined. When current B_{occu} is lower than T_{low}, then inactive AC is activated. If B_{occu} is more than T_{high}, then low priority AC is deactivated.
- In collision-based admission control, all stations calculate average collision as the ratio of a number of collisions occurred and the number of transmissions made over sample window period. Again, two thresholds are defined for making a decision in a similar way as done in the technique described above.

When the channel traffic is between the threshold values, the admission control schemes do not kick in any action. When the network load goes above the higher threshold, admission control scheme stops the transmission from the lowest priority active AC for the next beacon period. When the network load goes below the lower threshold value, the highest priority inactive AC resumes the process during the next beacon period. The implementation of this admission control scheme is very easy on both infrastructure and ad hoc WLAN mode. However, the challenge is to set appropriate threshold values. Also, the low priority data flows are stopped and started intermittently degrading service to flows in those access categories.

4.5 Model-Based Admission Control

In IEEE 802.11 WLAN admission control scheme, most of the proposed schemes are based on two-state Markov chain model in the literature [9]. The method tries to estimate the achievable bandwidth by the existing data flows if a new flow with certain parameters is admitted. On calculation, if it is found that the new flow can meet its own QoS requirements without threatening the QoS guarantees for all other existing flows; then only new data flow is permitted in the network. In the literature [10], the proposed model considered the EDCA parameters, i.e., transmission opportunity (TXOP), contention window minimum CW_{min} and measured collisions in the network. Bianchi Model for DCF and Extension of Bianchi Model for EDCA are two main schemes for measurement of available bandwidth in a WLAN [9, 11].

5 Research Gaps

The study presents the aim and design criteria of 802.11ax protocol for QoS provision in WLAN [12]. The study concludes that a design of perfect PHY and MAC layer protocols for advanced WLAN is a daunting task. The research further emphasized upon the need of appropriate admission scheme for ensuring the QoS for the video traffic. Mansoor et al. (2017) proposed feedback admission control in order to ensure maximum utilization of a channel capacity [13]. The scheme utilizes the piggyback information for decision making. For testing, performance study used MPEG4 video traffic and considers the end-to-end delay and unutilised time of the channel for IEEE 802.11e WLAN. A fuzzy-based admission control system (FACS) to estimate the performance of the FACS suggested a system for 803.11e WLAN [14]. There is a need to develop an improved admission control for more advanced protocols like 802.11n.

The authors showed the concept of dynamically adapting the contention window has been presented to optimise the network performance in IEEE 802.11e wireless networks [15]. The study considers the various network parameters for resetting contention window. The study has considered the standard 802.11e. There is need to extend the work to the newer protocol to evaluate the strategy proposed for network optimisation for QoS. This study presents the aspects related to the performance degradation in WLAN [16]. It also proposed a mechanism for improving the QoS in 802.11e WLAN. The scheme proposes adjusting the contention window backoff timing based on active wireless stations. The scheme measures the delay, throughput, and collision rate for different traffic scenarios. The scheme needs to be extended to the 802.11n by improving the model developed for measuring collision rate in 802.11e. The focus has been on adjusting two MAC layer parameters related to the transmission timing control in 802.11e WLAN [17]. The study proposes a throughput control scheme based on the queue length and virtual collision rate. The scheme results are validated for 802.11e WLAN and need to be confirmed for newer WLAN standard such as 802.11n.

6 Conclusions and Recommendations

In this paper legacy, IEEE 802.11 MAC layer QoS limitation is discussed [18] and the review explained added features of the IEEE 802.11e standard that support QoS features for time-sensitive applications in WLANs. QoS support limitation of 802.11e under heavy load provoked many to research into the field of admission control. The good admission control mechanism is to protect admitted flow in WLAN from the new request and allowing the maximum traffic flow according to the capacity of networks. Furthermore, this review looked at the literature on modeling the bandwidth availability and delay analysis for WLANs using analytical models. Hence, it necessary to present a model based on measurement of network parameters to reduce computation complexity, for throughput and delay estimation in WLAN.

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Internet Victimization Patterns Over Mobile Phone in Namibia

Husin Jazri, Elizabeth Paulus, Dharm Singh Jat and Durgesh Kumar Mishra

Abstract The growing evidences are suggesting that Internet victimization patterns are increasing as smartphone technology and mobile phone applications evolve. This research examines mobile phone-based Internet victimization in the 14 regions across Namibia. This research uses samples of 232 participants across Namibia with a 26-question-based survey. The survey explains in some detail the behavior of online victims and possible perpetrators. The survey also outlines different types of Internet victimizations over mobile phone. Based on the Internet victimizations scorecard, males are found to experience more instances of victimization than women in Namibia. Social networking, forum, and blog use predicted Internet victimization more than any other means. This research finding revealed that this country is in need of specific measures to curb the increase of Internet victimization and educate its citizen on this issue urgently.

Keywords Internet victimization · Mobile phone risks · Cyber-attacks Internet security

H. Jazri (✉) · E. Paulus · D. S. Jat · D. K. Mishra
Namibia University of Science and Technology, Windhoek, Namibia
e-mail: hjazri@nust.na

E. Paulus
e-mail: queenpaulus@gmail.com

D. S. Jat
e-mail: dsingh@nust.na

D. K. Mishra
e-mail: durgeshmishra@ieee.org

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1 Introduction

Mobile phone usage such as text messaging, emails, voice calls, and social networking interactions has taken over as the principal means of communication on a daily basis in Namibia. Smartphones also are becoming trends of social status in addition to tool for communication channel.

Internet victimization refers to any malicious intent translated into some kind of actions that can make victims feel so uneasy, unsecure, and harmful in whatever form in digital space intentionally placing them in a reasonable fear of harm or perceived danger [1]. Internet victimization may include, but not limited to, sending angry, rude, or vulgar messages online over mobile phone, computers, and other digital communication media. Aggressive acts like sexually harassing someone, requesting pornographic pictures, monitoring specific activities with intention to gain access to private data are among those acts that lead to the Internet victimizations. Excessive behaviors like threatening, teasing, stalking, harassing, blackmailing are also common symptoms of Internet victimization, which are happening on a daily basis. Victimizer sometimes pretends to be someone else and sends specific materials to make the victim look bad or to get the victim into trouble by posting information that is against the law or personal in nature. Serious crimes like identity theft, money laundering and blackmailing individuals for prostitution, drug trafficking activities, and other illegal activities are also on the rise and if committed online can be included as part of Internet victimization cases [2].

Namibia is still at its infancy of systematic recording and tracking of these mentioned issues. Victims of Internet victimization were reported to experience many different effects which include anger and sadness [3], emotional distress [4], low self-esteem [5], high levels of depression and social anxiety [4], academic problems in universities and schools, and low productivity at workplace [3, 6]. Youth who are being cyber victimized are reported to have feeling of emotionally distressed and afraid [6]. In one study, adolescents being cyber bullied were reported to be feeling sad, hopeless, and powerless [7]. Relationship between psychological vulnerability and Internet victimization existed [8] which tends to support the argument of [9] that Internet victimization interrupts and affects many aspects of the victims' lives.

The main problem that exists in Namibia is that not everyone is aware of Internet victimization issues and worst still many do not know what to do about it once hit. Thus, this paper intends to highlight the urgency to have appropriate measures to protect Namibian Internet and mobile phone users from online predators. With this in view, this research attempts to highlight how serious the problems are and to understand the common actions of the attackers and reaction of victims empirically, so that we can protect ourselves better.

1.1 Mobile Phones Vulnerabilities

Mobile phone stores sensitive information such as contact details and passwords. Mobile phone also enables users to conduct online transactions, such as Internet banking, buying products or services, and processing point-of-sale payments. There are an increasing number of Internet activities on mobile phone nowadays, and this makes them attractive targets for attackers.

Security solutions specifically designed for mobile phones cannot ensure security in all aspects. Technical measures such as personal firewalls, antivirus, and encryption lead to inconveniences to mobile phones. Countless users fail to enable their mobile phone security features as advised, or they just simply ignore it due to complexities and limited memory space in the phone. The very portability features of mobile phone make them easy target and can be misplaced and stolen away. Sophisticated attacker can wipe the phone memory and gain access to any data stored in the phone [10] and worst still anyone can download freely available mobile forensic tools from the Internet and use it to extract any data they like despite password protection offers by the phone security.

1.2 Impact of Internet Victimization

The study on the impact and consequences of Internet victimization in Namibia is still at its infancy. According to DePaolis and Williford [11], majority of youth victimized on the Internet experienced negative psychological problems such as lose focus, lower self-esteem, higher levels of depression, social anxiety, dropped in school grades, increased tardiness, and skipping classes. Youth who had been cyber bullied were reported to experience emotional distress, anger, and frustrations.

1.3 Response to Internet Victimization

Having a better understanding as how victims respond to Internet victimization experiences and its behavioral effects on mobile phone can help to develop better efforts to protect individuals from harmful acts over the Internet [12]. Victims are encouraged to seek social support to protect them from continuous harm and share those traumatic emotions. Deleting the message or completely blocking the perpetrators sometimes may not be the best way to remedy the situation as it may destroy traces of digital evidences that lead to the prosecution of the culprit.

2 Research Methodology and Design

2.1 Survey Participants

The analysis sample consists of 232 mobile Internet users, who answered 35 question items Web-based survey. Qualitative methodology is used. Survey results are shown using tables, graphs, and pie charts as a summary data from the respondents. The samplings are selected using Convenience Sampling Approach.

2.2 Data Collection Tool

Survey questions designs were to find more about online participants' experiences and to investigate common Internet victimization patterns in Namibia. Consequences of Internet victimizations were a particular focus. The frequency of victimization instances was investigated on 5 category of Likert Scale, ranges from 1 to 5 where 1 represents Strongly Disagree, 2 represents Disagree, 3 represents Undecided, 4 represents Agree and 5 represents Strongly Agree.

The Structured Exploratory Factor Analysis was employed which provides a YES or NO answer in order to eliminate complex or ambiguity answers items. An Assenting Factor Analysis was conducted on more than four-category items scale, where participants select the best answer.

3 Data Analysis and Results

The bulk data derived from the study was qualitative research in focus. The samples included 232 individuals ranging from various regions in Namibia using convenient sampling method. The respondents who answered the questionnaire comprised of 111 females and 121 males, aged between 18 and 75. Representation of qualitative statistics used in this research includes use of graphs and pie charts to summarize survey data collected from the respondents. This research survey was deployed using surveyplanet.com as an online tool to assist in presentation and collation of research findings.

Out of 232 participants surveyed, 59.9% used mobile phones on a daily basis to access the Internet (Fig. 1); 74% of the respondents claimed that they have been victimized at least once (Fig. 2); 68.25% of participants claimed not to have experience any Internet victimization over mobile phone; and 31.75% of the participants have been victimized more than twice a month. It was found that 39.2% stated never experienced any Internet victimization (Fig. 3), 12.5% experienced it through text messages, 15.5% through emails, 15.5% through chat rooms, 11.2% through social networking, 3.4% through Web site, and 2.6% through blogs

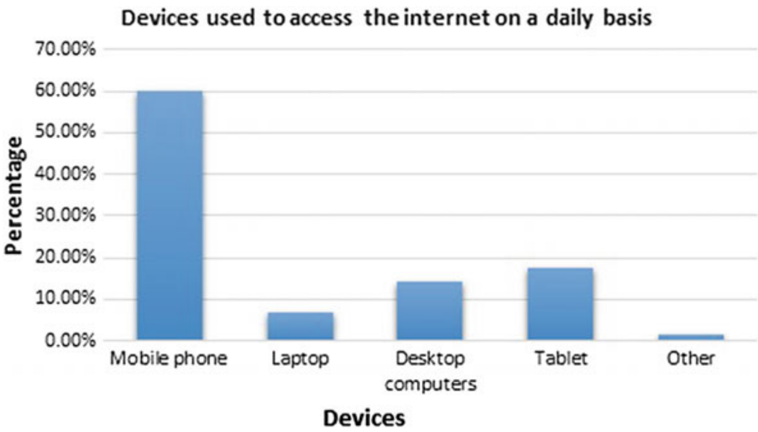

Fig. 1 Devices used to access the Internet on a daily basis

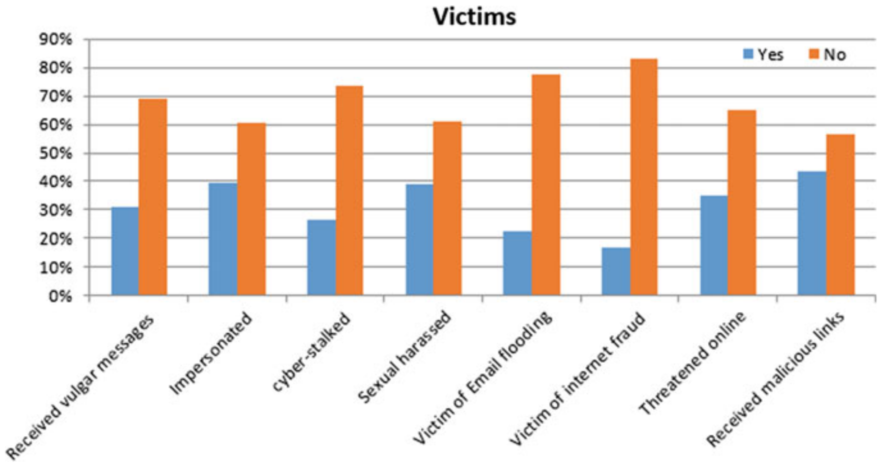

Fig. 2 Internet victimization over mobile phone

(Fig. 4). Victims of Internet fraud ranged from non-delivery of merchandise (12.5%), Internet auction (9.1%), identity theft (7.8%), and credit card cloning (6%). Those who were threatened online reported that socioeconomic status (16.4%) played a major role in the victim being victimized online, followed by the way you look/dress (8.6%), race and religious beliefs (6.9%). Internet victimization occurs across a diverse range of media, with the most common being the use of a blogs (20.3%), social networking (19.4%), Web sites (19%), chat rooms (11.6%), and receiving harassing emails (8.6%). Many of those victimized were left feeling stressed and depressed (28%), afraid and scared (18.5%), alone and isolated (15.5%), defenseless (15.1%), embarrassed (5.2%), and worried (3.9%).

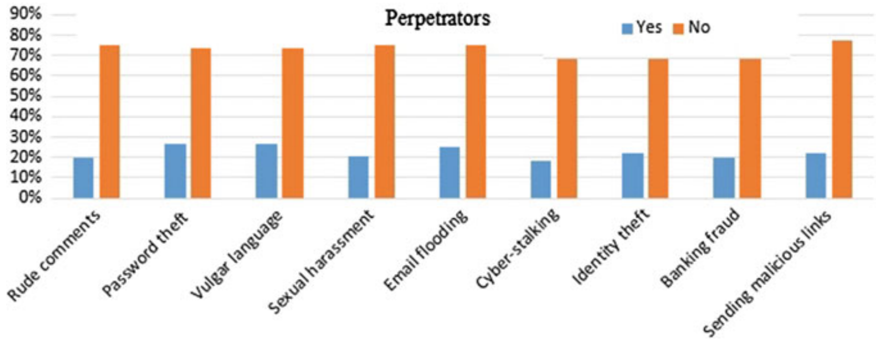

Fig. 3 Internet perpetrator over mobile phone

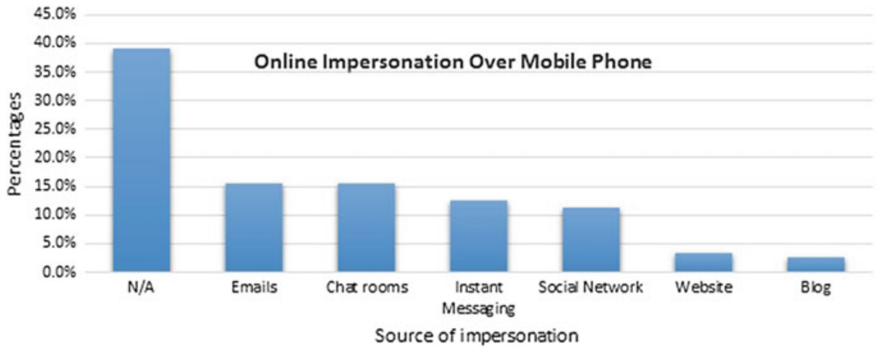

Fig. 4 Online impersonation over mobile phone

Our findings also show that 30.2% of those surveyed used someone else's password without permission to access others mobile phone data. 29.3% have used bad language on the Internet via mobile phone to show or vent their anger and frustration. In addition, a staggering 18.5% have sexually harassed an individual online, 20.7% have requested sexy or nude pictures from a stranger online. The results obtained highlight that 20.7% have participated in teasing, threatening, or cyber stalking someone online over mobile phone; 19% have impersonated someone online; 21.6% have forwarded malicious links via email enticing individuals to enter their bank details.

Three critical variables such as age, educational level, and frequent Internet user did not have a direct relationship with Internet victimization scores. Average Internet victimization score of males was significantly higher than that of females suggesting that males experienced more instances of victimization as they have the tendency to go into a much riskier Internet sites.

4 Discussions

This research indicates that about 74% of participants surveyed experienced at least one type of Internet victimization pattern within past three months. The ratio is found to be very high and should raise concern to many. This research findings also support the notion that Internet victimization also occurs at an increasing trend on every newly introduced mobile devices with no exception [13–15].

Our findings indicate that male mobile users are more likely to be victims than female mobile users because of their Internet usage pattern and the Web site they choose to visit. This research has also established a relationship between the use of social media and Internet victimization. Namibians need to be more careful particularly when they use online forums and blogs. Internet victimization patterns could be reduced by educating Namibians to have some control over their behavioral pattern when using mobile phone. Educating users means that Namibian should have more discussions, participations, and research on this topic focusing on local context and cases.

Further research should be done to scrutinize different variables that cause Internet victimization and measures to stop it. We are also proposing that more participatory research are forthcoming to share experiences, administers and publish more information surrounding many issues of Internet victimization so that it can reach out to the larger population of Namibia effectively. Finally, deeper research about the nature of Internet victimization along with the potential extent of emotional damage should be initiated so that we can get to the root cause of these issues. It is in our view that specific institutions should be established urgently in Namibia looking after Internet victimization pattern so that citizen can be better protected from these abuses and misuse of mobile technology.

5 Conclusions and Recommendations

This research provides an overview of Internet victimization pattern based on the Namibian context. One of the most harmful aspects of the Internet is that people can remain anonymous and thus increase the motivation of Internet perpetrators to intimidate victims thinking that they can get away with it. The fact that 74% of respondents have experienced at least once in the last three months and 25% of respondents had been victimized more than twice in a month indicates that the problem is more serious than we initially thought. Even the least popular Internet victimization pattern, which occurred to participants at least once, had a proportion over 23% in the current study. This is such a big ratio to be ignored by authorities and service providers without urgent and concrete actions to address it.

Another important finding of this research is that the line between perpetrators and victims is blurring. Most participants surveyed accessed someone else’s password without owner’s permission. This is a huge risk, as it invades privacy and leads to fraud-related crimes. The survey focused exclusively on different patterns of Internet victimization with no in-depth questions asked about victims' perception of Internet victimization to maintain simplicity. Despite these limitations, the current study provides a good insight into the profiles of victims and perpetrators, and it pinpoints the relationship between Internet victimization and other part of mobile online risk behaviors.

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