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Preface

International Conference on Cyber-Technologies and Emerging Sciences (ICCTES-2021) depicted an authentic reflection of the colossal research drive. The conference was organized by the School of Computing, Graphic Era Hill University, Bhimtal Campus, Uttarakhand, on hybrid mode (Offline and virtual platform) during December 17–18, 2021. The theme of this conference was appropriately devised on the prevailing requirements of the scientific and technological arena. The two-day colosseum offered a perfect plinth for intellectuals from both India and abroad to confer their ideas on cyber-technologies and emerging sciences. Potential researchers, industry persons, and authors were invited to submit their novel, unpublished papers of significant research quality that addressed the advances and challenges in the interdisciplinary areas in both system theories and applications.

We received 263 research submissions that focused on cyber-security, computing, real-world applications, artificial intelligence, Internet of things, machine learning, blockchain, communication system, and other emerging technologies in the area of computer science. The submissions solicited state-of-the-art applications, innovative methods, and unsolved challenges to establish the relative solutions to advance the existing applications and theories of cyber-technologies and emerging sciences.

Overall, after the successful presentation of papers under six different sessions, this volume is an outstanding collection of 49 quality research papers on varied facets related to the theme of the conference which were presented at the conference.

December 2021

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A Novel Meta-Classifier Framework Approach for Land Use Land Cover Classification

Jaishankar Bhatt, Rahul Nijhawan, Durgaprasad Gangodkar, and Amit Kumar Singh

Abstract Land covers only 29% of the total earth's surface, the remaining 71% is covered by ocean. 7.7 billion people live on this 29% of the earth's surface. Humans will be able to maintain a balance between human activities and the natural conditions of the earth through wise land use/land cover. Also, the earth's development will be continual and sustainable. A machine learning model that allows humans to assort the land use/land cover will greatly assist humans in keeping track of changes in land use as a resource. This paper, present a new meta-classifier framework that incorporates state-of-the-art algorithms such as support vector machine (SVM), K-Nearest Neighbors (KNN), Tree, AdaBoost, Artificial Neural Network (NN), and Random Forest (RF) for land use land cover classification. This is the first meta-classifier approach for LULC that we are aware of. The algorithms in the first layer of the architecture are given a variety of multi-spectral and geographic satellite bands provided by Sentinel-2 satellite images. The proposed architectures organize satellite images into subcategories such as water bodies, forests, slums, parking lots, airports, and buildings. With a classification accuracy of 91.3%, our proposed framework outperformed modern algorithms (SVM, Tree, KNN, AdaBoost, RF and NN). Statistical measurements are used to examine accuracy further.

Keywords Land use land cover · SVM · Tree · Machine learning model · KNN RF · ROC · Sentinel-2

1 Introduction

Land use/land cover classification has become more relevant in recent years due to the rapid rise of the world's population. When the human population was less, 29% of the earth's surface as land was more than enough to sustain it, and no one cared

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about land use or land cover. However, since the world's population has grown to 7.7 billion people, scientists have realized that scarcity will soon be a problem [1]. The realization that land is a finite, essential, and required natural resource for the survival of life on Earth has occurred [2]. As a result, in today's world, it is vital to classify land use/land cover in order to keep track of land consumption as a resource. Actually, the various land portions can be used for a variety of reasons, including the construction of buildings, airports, car parks, slums, forests, and water bodies. So maintaining a balance between human-made structures (such as buildings, slums, and airports) and natural bodies (such as forests and water bodies) is critical because natural bodies maintain the ecosystem's equilibrium, which supports life on Earth and classification of land use/land cover helps us to preserve that balance [3]. Using a big amount of the land resource for the construction of buildings, airports, and automobile parking for an extended length of time can deteriorate the land's condition and have an impact on other natural resources.

We have introduced a new stacking-based ensemble framework for land use/land cover classification. The ensemble technique uses numerous machine learning algorithms to make more accurate predictions than any single algorithm [4, 5, 6]. Currently, there are two types of ensemble methods: bagging and boosting. These ensemble methods simply take a group of low-performing learners and combine them into a single, strong learner[13, 14, 15]. Super learning or stacked regression are two terms for ensemble/stacking. Our framework uses an ensemble of several algorithms that inputs Sentinel-2 satellite images as an input to the first layer consisting of KNN, AdaBoost, SVM, Tree, and NN models. Next, the features extracted from the first layer acts as input to the aggregator consisting RF model. The ultimate output or prediction is provided by RF.

2 Literature Review

Previously, researchers have proposed the techniques for classification of land use/land cover. Kaul, and Sopan have used supervised classification technique for land use land cover classification and change detection on satellite data [7]. Niu, song, and Su, Zhang have used faster R- CNN inception v2 model for extracting navigation area using CAD blueprints [8]. Cheruto, Kauti have also used supervised classification technique for assessment of land use and land cover using the satellite images of Landsat 7 [9]. Patidar and Sankhla have employed unsupervised classification technique for change detection of land use and land cover of Dehradun City using images of LISS-III and Landsat-8 [10]. Li, Zhang have used systematic pixel-wise and scene-wise remote sensing image classification approach which is based on deep learning [11]. Rahman has employed the ISODATA classification method to classify Landsat TM data for detection of land use/ land cover changes [12].

3 Data Collection

We developed the data set of about 400 images as shown in Table 1, which belong to the following 6 classes: Water bodies, Slums, Parking areas, Airports, Buildings, Forests. These Sentinel 2 satellite images are acquired from the United States of Geographical Survey (USGS). The developed dataset's representative images are shown in Fig. 1. The distribution of the dataset during the training and validation phase was considered in a 1:4 ratio.

Table 1 Size of the dataset

Class	Number of images
Slum	63
Buildings	112
Parking area	60
Forests	101
Airports	9
Water bodies	55
Total	400

Fig. 1 Dataset of 6 classes containing images obtained from Sentinel 2 satellite

4 Methodology

4.1 Support Vector Machine (SVM)

Support vector machine belongs to the category of supervised machine learning algorithm which works both for classification and regression[16, 17]. It makes use of a tree as a model for decisions and their consequences. The decision tree employs a variety of algorithms to determine if a node should be split into two or more sub-nodes [18, 19].

4.2 Tree

A Tree or Decision tree (DT) is type of a supervised machine algorithm, which works both for classification and regression. It makes use of a tree as a model for decisions and their consequences. Both classification and regression have different.

4.3 Neural Network (NN)

The neural network is a deep learning model that functions similarly to our brain's neurons. A neural network can be formed by combining layers of perceptron, resulting in a multi-layer perceptron model of a NN [20, 21]. It has two layers: an input layer that accepts feature inputs and an output layer that predicts the output. The layers that appear between the input and output layers are referred as hidden layers [22, 23].

4.4 AdaBoost

AdaBoost is a machine learning framework that helps other machine learning techniques perform better. It can be incorporated to any machine learning method to increase its performance, but it is most productive when used with a weak learner. It is most effective with the weak learner. AdaBoost can also help with binary classification problems in decision trees. The ensemble technique is used by AdaBoost [24].

4.5 Random Forest

The random forest belongs to supervised machine learning algorithms which can work both as for classification and regression purposes [25]. RF is based on the ensemble learning technique. RF combines multiple decision trees. Due to the presence of multiple decision trees, the RF algorithm is near about bias-free [26, 27].

4.6 K-Nearest Neighbors (KNN)

KNN belong to the supervised machine learning algorithms. It works by calculating the Euclidean or Manhattan distance of new data points to all training data points. It picks the K-nearest values (where K is an integer value). Finally, it allocates a class to the new data point based on the distance between it and the majority of the other data points. It employs the entire data set for training when classifying a new data point [28].

5 Proposed Approach

Our study proposes a novel hybrid framework approach that employs an ensemble of different algorithms such as SVM, KNN, Tree, AdaBoost, ANN, and RF. Various combinations of multi-spectral satellite bands provided by Sentinel-2 satellite imagery is fed to the architecture in the first layer of the framework. The first layer of architecture consists of KNN, SVM, AdaBoost, Tree, and NN. The output from the first layer is now converted to a 1-D vector which is fed to RF as shown in Fig. 2. The final prediction is done by RF. By going through a different experimental scenario we find out that Random forest works better as an aggregator or meta-learner compared to other models.

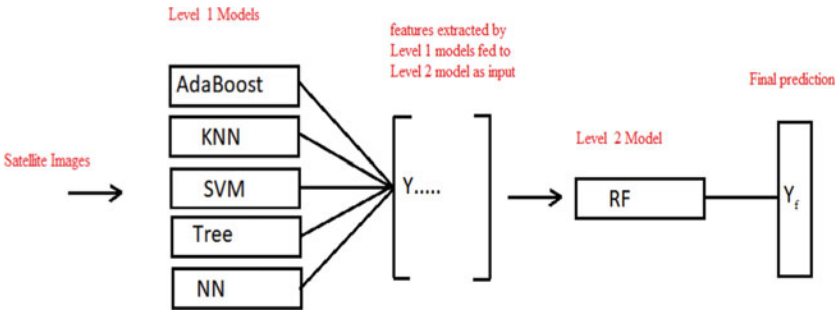

Fig. 2 Framework of proposed architecture

Our model outscored current techniques such as KNN, Tree, AdaBoost, SVM, and NN by a considerable difference. The statistical measures of our proposed model are AUC: 97.5%, classification accuracy (CA): 91.3%, F1 score: 90.3%, Precision: 89.4%, Recall: 91.3%.

6 Result and Discussions

6.1 Experimental Scenario 1 ((Tree, KNN, SVM, NN, RF) + AdaBoost)

In the first case we added Tree, KNN, SVM, NN, and RF Models to the first layer. The first layer receives images from the Sentinel 2 satellite as input. The final feature vector is formed by combining the features extracted by all the models in the first layer. The AdaBoost model, which forms the second layer, receives this final feature vector as input. The AdaBoost model makes the final prediction, and the final accuracy is 86.8%, as shown in Table 2.

6.2 Experimental Scenario 2 ((Tree, AdaBoost, SVM, NN, RF) + KNN)

In the second scenario, we've added Tree, AdaBoost, SVM, NN, and RF Models for the first layer. Images of the Sentinel 2 satellite are given as input to the first layer.

Table 2 Accuracy assessment

Classification	Area under curve (%)	Classification accuracy (%)	F1 score (%)	Precision (%)	Recall (%)
AdaBoost [24]	82.4	71.8	72.0	72.6	71.8
KNN [25]	98.6	78.4	75.4	83.0	78.4
Tree [26]	85.6	78.9	78.2	77.8	78.9
RF [27]	96.9	82.7	81.9	81.2	82.8
NN [28]	95.7	83.0	82.8	84.4	83.0
SVM [29]	50.0	84.2	82.8	82.5	84.2
Scenario 1	92.8	86.8	86.6	86.7	86.5
Scenario 2	95.0	81.7	79.7	79.7	81.9
Scenario 3	95.6	70.7	68.5	74.4	72.8
Scenario 4	59.2	24.7	24.9	29.7	24.7
Scenario5 (PA)	97.5	91.3	90.3	89.4	91.3

Now final feature vector is formed by combining the output from the first layer. This final feature vector is now fed as input to the KNN model, which form the second layer. Final prediction is done by the KNN model and the accuracy is 81.7% as shown in Table 2.

6.3 Experimental Scenario 3 ((Tree, AdaBoost, KNN, NN, RF) + SVM)

In the third case, we've added Tree, AdaBoost, KNN, NN, and RF Models for the first layer. Images of the Sentinel 2 satellite are supplied into the first layer as input. Features extracted by all the models in the first layer are now put together into a final feature vector. The SVM model, which forms the second layer, receives this final feature vector as input. The SVM model makes the final prediction, with a final accuracy of 70.7% (see Table 2).

6.4 Experimental Scenario 4 ((Tree, AdaBoost, KNN, SVM, RF) + NN)

In the fourth scenario, we've added Tree, AdaBoost, KNN, SVM, and RF Models to the first layer. Images of the Sentinel 2 satellite are given as input to the first layer. The NN model, which forms the second layer, receives this final feature vector as input. The NN model makes the final prediction, and its accuracy is 24.4%. Because the final accuracy (24.4%) is poor in this case, we concluded that NN is ineffective as an aggregator.

6.5 Experimental Scenario 5 ((Tree, AdaBoost, KNN, SVM, NN) + RF)

The fifth scenario depicts our proposed architecture, which includes Tree, AdaBoost, KNN, SVM, and NN models for the first layer and RF for the second layer. Sentinel 2 satellite images are now given to the first layer as input. The output from the first layer is now combined to generate the final feature vector. The RF model now takes this final feature vector as input. The RF model makes the final forecast, which has 91.3% accuracy. In this scenario, we can observe that the accuracy (91.3%) is significantly higher than the prior models. As a result, we came to the conclusion that RF is more effective as an aggregator (Table 2). As a result, we concluded that RF is more effective as an aggregator (Table 2).

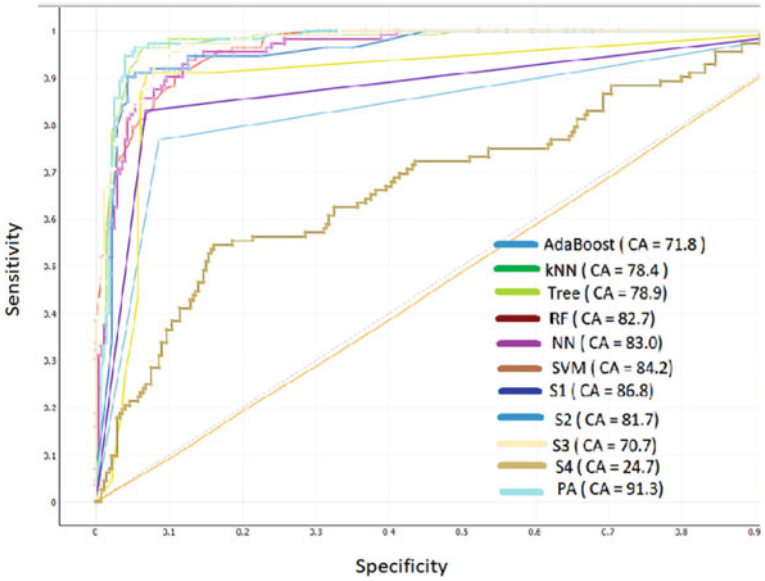

Fig. 3 ROC curve

The proposed ensemble framework's performance is estimated using the ROC curve (see Fig. 3). The performance of the proposed models is depicted by the area under curve value, which portrays the region under the ROC curve [19]. The AUC value's proximity to 1 represents the model's level of perfection [29].

As per the ROC curve, our proposed method outperformed the other modern methods: PA (AUC = 97.5) is far better than AdaBoost (AUC = 82.4%), SVM (AUC = 50.05), Tree (AUC = 85.6%), NN (AUC = 95.7%). This is because the ensemble frameworks learn the behavior of each classifier and identify the weights based on an error made by each classifier on the feature space. Less weight is given to the classifier which makes more errors and vice versa.

7 Conclusion

We employed a hybrid ensemble framework that employs the integration of different individual algorithms. As indicated in Fig. 1, we used data from Sentinel-2 satellite images, we obtained a remarkable accuracy of 91.3% which outperformed the other state-of-art algorithms. We also concluded that random forest works better as a meta-learner compared to other algorithms. Further, the study also concludes that an ensemble of classifiers produces better results compared to an individual classifier due to the unique capability to realize the behavior information of each model.

Our framework can also be applied to other multi-class classifications, such as the classification of many kinds of celestial bodies using satellite photos, and so on.

References

1. Gilland B, Higgins G, Kassam A, Naike L, Fischer G, Shah M, Harrison P (1984) Population supporting capacities of lands in the developing world. Population and Development Review
2. Louisa J, Antonio D (2005) Land cover classification system: classification concepts and user manual: LCCS. Food and Agriculture Organization of the United Nations, 8
3. Sims D (1997) Negotiating a sustainable future for or land-Structural and institutional guidelines for land resource management in the 21st century. Food and Agriculture Organization of the United Nations
4. Dietterich TG (2000) Ensemble methods in machine learning. In: Multiple classifier systems. MCS 2000. Lecture notes in computer science, vol 1857. Springer, Berlin, Heidelberg
5. Nijhawan R, Raman B, Das J (2018) Proposed hybrid-classifier ensemble algorithm to map snow cover area. J Appl Remote Sens 12:016003
6. Nijhawan R, Joshi D, Narang N, Mittal A, Mittal A (2019) A futuristic deep learning framework approach for land use-land cover classification using remote sensing imagery. In: Advanced computing and communication technologies. Springer, pp 87–96
7. Kaul H, Sopan I (2012) Land use land cover classification and change detection using high resolution temporal satellite data. J Environ 1:146–152
8. Niu L, Song Y, Su J, Zhang H (2018) A deep learning study of extracting navigation area from CAD blueprints. In: ISPRS annals of the photogrammetry, remote sensing and spatial information sciences, IV-4, pp 155–162
9. Cheruto MC, Kauti MK, Kisangau PD, Kariuki PC (2016) Assessment of land use and land cover change using GIS and remote sensing techniques: a case study of Makueni County, Kenya
10. Patidar S, Sankhla V (2015) Change detection of land-use and land-cover of Dehradun city: a spatio-temporal analysis. Int J Adv Remote Sens GIS 4:1170–1180
11. Li Y, Zhang H, Shen Q (2017) Spectral-spatial classification of hyperspectral imagery with 3d convolutional neural network. Remote Sens 9:67
12. Rahman MT (2016) Detection of land use/land cover changes and urban sprawl in Al-Khobar, Saudi Arabia. ISPRS Int J Geo-Inf 5:15
13. Nijhawan R, Sharma H, Sahni H, Batra A (2017) A deep learning hybrid CNN framework approach for vegetation cover mapping using deep features. In: 2017 13th International conference on signal-image technology and internet-based systems (SITIS). IEEE, pp 192–196
14. Nijhawan R, Rishi M, Tiwari A, Dua R (2019) A novel deep learning framework approach for natural calamities detection. In: Information and communication technology for competitive strategies 2019. Springer, Singapore, pp 561–569
15. Nijhawan R, Raman B, Das J (2017) Meta-classifier approach with ANN, SVM, rotation forest, and random forest for snow cover mapping. In: Proceedings of 2nd international conference on computer vision and image processing 2018. Springer, Singapore, pp 279–287
16. Suykens JA, Vandewalle J (1999) Least squares support vector machine classifiers. Neural Process Lett 9:293–300
17. Hsu CW, Lin CJ (2002) A comparison of methods for multiclass support vector machines. IEEE Trans Neural Networks 9:293–300
18. Safavian SR, Landgrebe D (1991) A survey of decision tree classifier methodology. IEEE Trans Syst Man Cybern 21:660–674
19. Magerman DM (1995) Statistical decision-tree models for parsing. arXiv preprint cmp-lg/9504030
20. Nijhawan R, Das J, Raman B (2019) A hybrid of deep learning and hand-crafted features based approach for snow cover mapping. Int J Remote Sens 40:759–773

21. Nijahwan R, Verma R, Bhusan S, Dua R, Mittal A (2017) An integrated deep learning framework approach for nail disease identification. In: 2017 13th International conference on signal-image technology and internet-based systems (SITIS), pp 197–202
22. Hagan MT, Demuth HB, Beale M (1917) Neural network design. PWS Publishing Co
23. Rowley HA, Baluja S, Kanade T (1998) Neural network-based face detection. IEEE Trans Pattern Anal Mach Intell 20:23–38
24. Hastie T, Rosset S, Zhu J, Zou H (2009) Multi-class adaboost. Stat Interf 2:349–660
25. Nijhawan R, Das J, Balasubramanian R (2018) A hybrid CNN+ random forest approach to delineate debris covered glaciers using deep features. J Indian Soc Rem Sens 46:981–989
26. Liaw A, Wiener M (2002) Classification and regression by randomForest. R News 2:18–22
27. Strobl C, Boulesteix AL, Zeileis A, Hothorn T (2007) Bias in random forest variable importance measures: illustrations, sources and a solution. BMC Bioinform 8:1–21
28. Dudani SA (1976) The distance-weighted k-nearest-neighbor rule. IEEE Trans Syst Man Cybern 4:325–327
29. Bradley AP (1997) The use of the area under the ROC curve in the evaluation of machine learning algorithms. Pattern Recogn 30:1145–1159

Survey of Surveillance of Suspicious Behavior from CCTV Video Recording

Mohammed Mahmood Ali, Mohammed S. Qaseem, and Mohammed Hassan Shaji Khan

Abstract Many of crimes that are executed through online-mode are un-identified. Currently, most of crimes are explicitly executed in front of surveillance cameras which are implicitly recorded through CCTV cameras. The surveillance systems recording failed to catch those culprits from recorded videos spontaneously. No doubt, the strategies were developed where the culprit's photos are captured and criminal department start hunting for those culprits for days, months or years. Unfortunately, in most of cases, searching for culprits is prolonged for short span of time and later the hunting task may be stopped or closed, due to many reasons such as delay in searching process or permission restrictions or insufficient proofs or change of detective officers. Innumerable works exists in the market that monitors the suspicious behavior analysis of persons, but fails to catch them on the spot at the offence location. To resolve this critical issue, we need to make use of these recorded stored videos for catching the culprits on the spot at run-time by implementing an alerting strategy via an automated alarming system at run-time during the crime scenario itself. This survey emphasizes on various video surveillance systems that were developed earlier for catching the culprits. Many of the state-of-art systems lack the ability to surveillance such suspicious videos at run-time. Many of the existing surveillance systems fail to generate an alert or alarms during the execution of crime which are video recorded implicitly.

Keywords Surveillance · CCTV · Security · Behavior analysis · Video surveillance systems

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1 Introduction

Now-a-days, the Surveillance cameras are increasingly being used in public areas that play an important role in the society and have been installed everywhere. Surveillance and Monitoring system is broad area that can be used efficiently for spying and detecting suspicious activities to mitigate criminal offences in the society [1]. To identify and responding to such suspicious behavior dynamically from CCTV footages is a very challenging task. The developments of automated spying system is not yet mature, that needs to have the capability to capture any unusual activities which happens at any point of time and immediately response to such suspicious behavior from CCTV footages would have taken-up; which assists in reducing the criminal offence before it gets executed. The ultimate goal of saving lives can be achieved if automated CCTV spying system with alarming is implemented in real-time scenario. Monitoring capability of security agencies has not kept pace in surveillance system with the technological advancements of CCTV. Most of the existing CCTV security system fails to stop the crime and do not control the disturbances generated in the disciplined environment of the society. Goal is to identify the anomalies from surveillance videos and stop crime by proposing an intelligent model that alleviates the security personal and reduces time. Surveillance systems needs to be well designed such that it can keep an spying eye with the efficient usage of technological advancements of IP surveillance, video recorder (DVR) with IR day/night cameras that generates high alert security alarms. Most of video recorders i.e., DVR is deployed at the heart of the CCTV for receiving, managing, storing and recording of videos that are captured by cameras [1]. Real–time suspicious detection surveillance module needs to have the capability which can capture faces in real-time scenario whenever suspicious criminal activities are found around the society. Further, this system should mark the red-bounding box around a moving criminal person and at the same time a warning is also sent to the security authorities so that they can locate and trace the criminal. We will provide a variety of applications that can be categorized at different levels like public health surveillance system, road accidents, robbery, shoplifting, fighting and loitering in public areas. Major advantage is to prevent and deter crime by generating alarming system to the nearest security authorities to stop crimes happening at a particular location. Earlier system were not able to do so, due to too much data to monitor manually and humans cannot effectively watch surveillance videos they just see the video recording and try to find out the culprit if any anomaly activity happens which is like a postmortem kind of work is going on in the present surveillance system. The video object representation is done just like segmentation, moving object detection and tracking, sudden illumination change, trajectory filtering which are currently has capabilities and good systems are available till date and also very few research work exists for behavioral understanding and prediction which are incapable to identify suspicious behavior of the humans before the occurrence of the event or even at the time when the partial event is being taking place in a real time environment [2]. The objective is to develop an efficient video surveillance solution integrated with emergency alarms during the happening

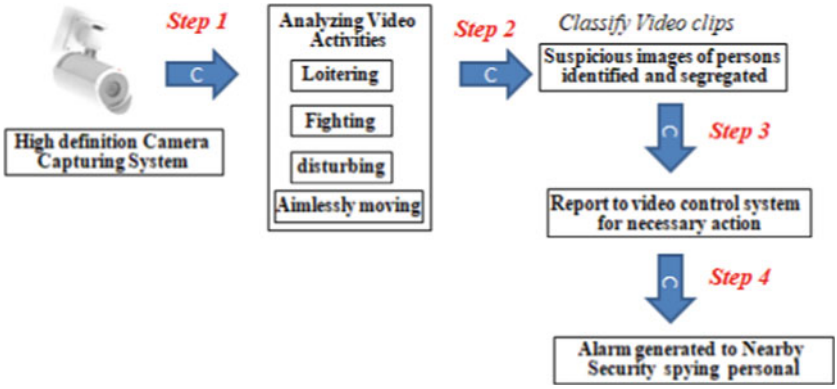

Fig. 1 Basic model of video surveillance system

of suspicious crime scene and stopping them. Few studies convey that identifying the person's behavior, using parameters such as temperature of faces which varies from the normal person's temperature [3]. As temperature increases very small sensors needs to be embedded which identifies visual information then note the intention of the person whether it is normal or anomaly behavior. Further, psychological experiments have also proven that if we can identify the behavioral aspects of the person by certain change in the body temperature the signals are generated which needs to be captured which may assist in identifying the person's intention.

The Fig. 1, shows generalized model of surveillance system with a centralized system that captures still images from video by applying the filtering techniques from multimedia data. Usually, multimedia data constitutes of running text, images, animations, short clips and voice from which images/frames are extracted and spied for identifying the suspicious behavior. Applying data mining techniques on multimedia discovers implicit patterns from this bulk of multimedia data from which suspicious behaviors needs to be extracted which is currently a new research is initiated in research community [1].

This section describes importance and necessity of surveillance system from CCTV recordings which needs to be equipped with alarming system through which alerts are generated, instead of dumb CCTV recording system. Section 2, elaborates the previous works that carried in the field of video surveillance systems using computer vision and video processing aspects for detecting suspicious behavior of persons from CCTV recordings. In Sect. 3 we picked the related papers and the models specifically on surveillance from Video recordings and Facial behaviors that tried to generate alarms or alerts when suspicious activities or behavior are found in shops, shopping malls, crowded areas, ATM machines, Restricted and prohibited areas. Finally, the Sect. 4 concludes that for efficient automated video surveillance system can be better implemented by applying succinct deep learning, data mining or

machine learning algorithms that supports alert generation strategy to nearby security control department that reduces the manual human work of continuous video monitoring.

2 Literature Survey

Surveillance system is an upcoming domain in multiple disciplines of different domains of surveillance system which provides a huge demand and the cameras and CCTVs are increasingly being used in public areas. Many papers have shown the intelligent algorithms for video anomaly detection to alleviate the human resource and their precious time. A few papers on the survey of strategies for surveillance of suspicious behavior from videos are discussed in this section.

Amrutha et al. [3] proposed a methodology to check the suspicion activities of campus with the use of CCTV footages and gives the alarm of suspicious event to the security personal. This model identifies the suspected behavior of a person if he is suspicious or normal in the domain of academic using deep learning techniques. This model can be utilized in circumstances and needs to be trained by giving specific set of suspicious activity for a specific scenario. This model fails to identify suspicion persons from the suspicious activity when multiple suspicious activities happens at the same time.

Ayed et al. [4], proposed a strategy that uses face features to identify the emotions on faces pertaining to fearful expressions just like a suspected behavior. Accordingly, the psychologist says such fearful act of suspected person's behavior may force the person to commit a crime after a particular span of time is lapsed. In this system they used distributed cameras fixed along with contactless frequency sensors embedded along the face based-video equipment which predicts the heart-beat rate by using fusion technology. By the heart rate detection their model could able to identify the instances of motivated factors that pushes a person to commit a crime as well as abnormal behavior of such persons.

Lee et al. [5] proposed ArchCam that detects suspicious behavior's by utilizing two algorithms that attempts to destroy or remove the ATM machines from its original location by generating instant warnings to the authorized video surveillance team. ArchCam uses embedded kit along with GPU. In this model first algorithms detects climbing activity around the ATM regions where as the second algorithm detects any of the objects or humans destroying the ATM machine components. This model is proposed for specific one ATM machine centre. This, Model has captured such test videos for a mock scenario of ATM setup which could able to identify the various suspicious behaviors of persons. They also stated that it can be possible to develop such models for suspicious human behavior detection for various shops and government organizations.

Gorave et al. [6] proposed a theoretical model which detects and defines the type of suspicious activities executed in the environment and consecutively, provides alerts to the particular security authorities (violence, misbehaving, fighting, throwing,

damaging objects or humans). Their system has ability to automate the whole process and analyzes the running video streams, thus it does not need consistent human monitoring the cameras in video streams. This model used the YOLO (You Only Look Once) for accomplishing most of classification and detection tasks of moving objects as well as humans. Along with YOLO, additional classifier is also used namely LBPH classifier. LBPH classifier is activated automatically at a particular scenario that is, once the person's suspicious activity is detected immediately in the next time slice. Apart from that different cameras are installed which can identify and detect any kind of weapons by the classifier model. Thus, the suspicious activity alerting will be initialed for immediate action and get hold of the culprit. Their proposed model demonstrated a scenario of installing three cameras and identifying the culprit with the help of algorithms which gave the precision accuracy of 74%. This model is not well-suited for massively small area with limited objects and no new event are detected whose behavior is not trained to the classifier model resulting in poor performance.

The survey of techniques used in detecting of suspicion behavior of persons from CCTV footages recorded in videos is elaborated in Table 1.

3 Comparative Analysis

This section depicts the various frameworks proposed to identify suspicious behavior of a person. The importance of Surveillance system becomes an essential requirement in our daily life which is in use everywhere in the society and evolved rapidly within a short period of time. The surveillance system plays an important role in different domains and can be a broadly defined with number of categories like health system, home security, ATM machines, shopping areas, Traffic signals and everywhere in the world where security is needed. Many of the research works is done on the surveillance system in various domains but the focus is on suspicious behavior of a person which has now become as a part of work in daily routine. The basic need of todays is providing automated security system that watches or keeps an eye in the working environment. Identifying a Suspicious behavior of person in a video system is a challenging task as it constitutes of various parameters to be brought into consideration such as video data quality, Timeliness, strength of sensitivity which might have positive or negative impact by using a systematic semantic approach, body actions and trajectory of body parts and many more basic things in the video frame to be considered. All these attributes or parameters needs to be well segregated and stored in the video surveillance databases for detecting a suspicious person and create their individual video database and compare with normal video frame database by assigning the threshold value. But, the major problem is preventing the crime on the spot which is our major concern which causes the main challenge of assurance. To tackle with the problem of suspicious detection in video frame many researchers have been done as discussed in Table 1.

Table 1 Techniques for identifying suspicious activity behavior of persons

Reference paper	Objective	Methodology used	Suggestion
[3]	Deep learning techniques were used for identifying suspicion activity and generates an alarm to security personal when abnormal change in the behavior of a person is estimated by the system	Methodology involves extraction of various features from captured videos of suspicion persons by CNN and LSTM architecture	Deployed in academic institution. The accuracy obtained by training the model is 76% for 10 epochs
[2]	Suspicion activities are identified with the aid of semantic approach for identifying movement of living persons at the indoor and outdoor gates and restrict persons from entry into the area	semantics-based approach uses background subtraction technique for identifying the objects specifically living things, further it keeps the object tracking in the history which distinguishes motion features in a particular area by comparing with predefined conditions, for defined activities of interest	Fails to detect complex scenes due to lighting effect, placement of the cameras angle etc.
[7]	In public transport areas the fighting and misbehaving activities like stealing the people luggage at Bus stops, Trains, Airports are identified	Dislocation of objects are identified by using background segmentation process and 3-D motion cameras which are converted into semantic features from the scene	It requires excessive interfacing of human and excessive training is required by machine-learning
[8]	Proposed a technique to identify trending rumors, that are called to be the disputed factual claims	Performs four important tasks: (i) detects tweets which has Questions, (ii) clusters are generation for such questions, (iii) annotates the rumor for such tweets, (iv) Ranking for identified clusters is done by using statistics	Raised questions raised are verified and if alteration is required it will be corrected based on the identified expressions. Updating of patterns in real time scenarios needs to be inculcated to overcome spam

(continued)

Table 1 (continued)

Reference paper	Objective	Methodology used	Suggestion
[5]	A proposal is given prepared to identify suspiciousness activities performed in ATM's using image processing	ArchCam is implemented using embedded system with GPU platform. Two algorithms with low computational complexity are proposed that captures suspicious anomalies such as squatting and climbing around the ATM machine	This method is restricted to ATM machine and also shows crime happening in the machine and provide alert to the security person after ATM machine is destruction is done. Needs manual monitoring. Supports a single ATM machine, unable to give alert system to the crime department to stop the crime, but records the crime
[9]	Developed a deep learning-method that predicts the involvement of abnormal anomaly with the use of CCTV footages grasped from networked surveillance systems and intimates users of those anomalies in a smart Internet of Things (IoT) environment Specifically, assists parents for personal monitoring the activities of children's in institutions or clubs	It uses Revolution method with kernel density (RFKD) assisted by ReHAR method along with ML techniques method for prompt decisions of abnormal events are notified through smart IoT devices for prompt monitoring	This is done using random forest classifier for a suspicious activity, difficult to collect data, requires manual monitoring and catching the culprit by watching the activities, and automated alert generation for suspicious activity is not supported

Similarly, a novel model to sense and trace the images from a video frame which is useful for video surveillance system is proposed [10]. Gorave et al. [6], developed a model for detecting the suspicious object and tracking the trajectory, restricted to shops by using the train dataset. But, the major concern is that when multiple suspicious actions executed rapidly in short span of time their system fails to initiate an alert to prevent the crime. Lee et al. [5], proposed a model for ATM machine but requires continuous manual monitoring and unable to give alarm to the security department. Arroyo et al. [11], developed a strategy of alarming system which uses web based communication, but its drawback is its poor efficiency of hardware configuration and depends on bandwidth. Further, it does not have a central authority to prevent the crime. Ayed et al., works attempted to capture suspicious behavior based on feelings of fearful faces with the use of face-video sensor technology. This has

been classified in two methods (1) Facial expression method (2) Heart rate estimation method based on the type methods used. Hence, it provides many parameters like (a) Body temperature (b) Body sensitivity (c) Pulse rate these can be implemented by hardware using Raspberry board [4]. Restricted area video surveillance system was proposed by Chen et al. [12] where the images information is stored who are permitted and not permitted into the restricted areas inside the database and the data is preserved along with monitoring system raises alarm when an unknown person enter into a specific prohibited area when there is a mismatch with the face database using (PIR-sensor). The image of the persons captured and compared with the faces in the database if the match fails then alarm system is activated and an email alert is sent to its lawful persons of the concerned department. The proposed method engages the passive infrared sensor for identifying the movements and viola jones for recognizing the faces and KNN assists in classifying among the authorized and the unauthorized areas. Bhagya Divya et al. [13], proposed a model that detect suspicious person i.e. unauthorized entry in a restricted place in a video by motion detection algorithm and start tracking if the person is suspicious on the display. Major intention is to provide efficient background subtraction method to generate clear background model and improve the detection of moving objects. The camera has been connected to the monitoring room and alert messages are generated if any suspicious activity is identified. In another model focuses on detection of the pixel and the moving object with the study of their behaviors using the implicit algorithms with limited coverage of area by capturing of videos in the surveillance areas. Niu et al. [14] proposed robust model for activity recognition in different interaction patterns among a group of people with certain algorithm using real-world video data unable to prevent the crimes. Mudgal et al. [1] proposed a model for violence activities like hitting, slapping, punching etc., using Gaussian mixture model that learns all precautionary attributes of violence from different violence dataset and detect the abnormal activities. But, defining multiple abnormal activities is conflicting and overlapping with other surplus violent actions which are not so efficient to detect a particular suspicious behavior in real time environment of video surveillance system.

4 Conclusion

In this paper, we have presented a survey on suspicious behavior analysis from video and various datasets used in the survey papers are depicted in Table 2.

Video surveillance is a fast-growing research area. Video surveillance have many applications which plays a significant role in smart cities, farms, educational institutions, Government organizations and even in smart homes. Video surveillance is a critical component of security that can be used for investigation purpose to know the ground truth of the facts. In this paper we have surveyed the abnormal behavior of person's from videos and gone through the various research works that are carried out till date to prevent the crime which is a major challenging task in the current era. The overall survey through which doubtful activities can be identified is depicted

Table 2 Suspicious scene grouping with different types of abnormal activities

Type of work/scene	References
Monitoring the suspicious activities in campus	[3]
Detection human activities in real-time video	[4, 13–15]
Face detection	[12]
Loitering at ATM and abandoned bag detection	[2, 5, 15]
Track moving objects from video	[6, 9, 10]
Behavior of pick pockets in a shopping mall	[16]
Monitoring to protect children in a daycares, crèches	[17]
Heart-beat rate prediction on facial expressions	[4]
Cheating activities in the examination hall	[18]
Vigilance detection frame work	[1]

in Table 2. The focus of this survey is to pick any one of the issue that classifies the suspicious behavior from video datasets to surveillance sensitive aspects. The theoretical improvised approach is suggested for extraction of suspicious activities from video embedded with alarming system which is shown in Fig. 1. We have gone through the various research works to check the suspicious behavior of the persons from CCTV footages. But, main problem is they are deficient to stop the crime before it happens or starts. The objective of this survey is to improve the security system by adding alarming component in the CCTV footages which are recorded in the video database, making a proactive video surveillance system that has the capability to prevent the worst criminal cases in our daily life.

In Sect. 2, we have discussed different studies that are carried to improve video surveillance system that generates alerts to the security guards when any of the suspicion occurs by checking the features from the image frames using CNN by classifying the normal or suspicious behavior [3]. The main difficulties arise in collecting of suspicious video datasets that distinguishes normal or suspicious activities are discussed [2].

Apart from predicting of normal or suspicious features from CCTV footages, the challenge is to quickly detect the suspicion behavior so that we can decrease the rate of crimes from the society [1]. The next step is to apply succinct deep learning, data mining or machine learning algorithms for alert generation at the crime spot to nearby security control department [19, 20]. Usually in mob gathering areas, Festivals, Holy places, Traffic congestions, ATM machines needs to be put under surveillance systems which are equipped to generate alert alarms to the security department to stop crime before it occurs [10]. In future work, we planned to develop an Automatic alarming model for video surveillance system using Predefined extracted suspicious activities from video by classifying multimedia data using intelligent data mining and video filtering techniques [6].

References

1. Ali MM, Qaseem MS (2022) Strategies and tools for effective suspicious event detection-from video: a survey perspective (Covid-19), contactless healthcare facilitation and commodity delivery management during COVID 19 pandemic. Springer
2. Kamthe UM, Patil CG Dr (2018) Suspicious activity recognition in video surveillance system. In: IEEE fourth international conference on computing communication control and automation
3. Amrutha CV, Jyotsna C, Amudha J, Vishwa A (2020) Deep learning approach for suspicious activity detection from surveillance video. In: IEEE international conference on innovative mechanisms for industry applications
4. Ayed MB, Elkosantini S, Abid M (2019) Suspicious behavior recognition based on face features. IEEE
5. Lee W-K, Leong C-F (2018) ArchCam: real time expert system for suspicious behaviour detection in ATM site. In: Expert systems with applications. Elsevier, pp 12–24
6. Gorave A, Misra S (2020) Suspicious activity detection using live video analysis. In: Proceeding of international conference on computational science and applications, algorithms for intelligent systems. Springer
7. Elhamod M, Martin D (2013) Automated real-time detection of potentially suspicious behavior in public transport areas. IEEE Trans Intell Transp Syst 14(2)
8. Popoola OP, Wang K (2012) Video-based abnormal human behavior recognition—a review. IEEE Trans Syst Man Cybern—Part C: Appl Rev 42(6)
9. Janakiramaiah B, Kalyani G, Jayalakshmi A (2020) Automatic alert generation in a surveillance systems for smart city environment using deep learning algorithm. In: Evolutionary intelligence. Springer Nature
10. Elhoseny M (2019) Multi-object detection and tracking (MODT) machine learning model for real-time video surveillance systems. Springer Nature
11. Arroyo R, Javier Yebes J, Bergasa LM, Daza IG, Almazán J (2015) Expert video-surveillance system for real-time detection of suspicious behaviors in shopping malls. In: Expert systems with applications. Elsevier
12. Chen JIZ Dr (2020) Smart security system for suspicious activity detection in volatile areas. J Inf Technol Digit World 2(1):64–72
13. Bhagya Divya P, Shalini S (2017) Inspection of suspicious human activity in the crowdsourced areas captured in surveillance cameras. Int Res J Eng Technol (IRJET) 4(12). e-ISSN: 2395-0056
14. Niu W, Long J, Han D (2004) Human activity detection and recognition for video surveillance. In: Proceedings of 2004 IEEE international conference on multimedia and expo (ICME) (IEEE Cat. No.04TH8763)
15. Ouivirach K, Gharti S (2012) Incremental behavior modeling and suspicious activity detection. Elsevier J
16. Bouma H, Baan J (2014) Automatic detection of suspicious behavior of pickpockets with track-based features in a shopping mall. In: Proceedings of SPIE—the international society for optical engineering
17. Vallathan G, John A (2020) Suspicious activity detection using deep learning in secure assisted living IoT environments. J Supercomputing. Springer Nature 2020, Springer
18. Musa ASB, Singh SK, Agrawal P (2014) Suspicious human activity recognition for video surveillance system. In: IEEE proceedings of 2014 international conference on control, instrumentation, communication and computational technologies
19. Ali MM (2021) Automated details retrieval system for victims of incidents and accidents using fingerprint. Int J Comput Digit Syst. Elsevier
20. Ali MM, Qaseem MS, Rasheed MA, Khan MKA (2020) ESMD: enhanced suspicious message detection framework in instant messaging applications. In: 2020 Fourth international conference on inventive systems and control (ICISC). IEEE, pp 777–784

21. Niu W, Long J (2014) Human activity detection and recognition for video surveillance. In: Proceedings of IEEE international conference on multimedia and expo
22. Mudgal M, Punj D, Pillai A (2017) Suspicious action detection in intelligent surveillance system using action attribute modelling. J Web Eng 20(1):129–146. https://doi.org/10.13052/jwe1540-9589.2017

Security Attacks, Requirements and Simulative Analysis of QoS in WSN

Praveen Kumar Rai, Arun Kumar Rai, Vipin Rai, and Shashi Bhushan

Abstract The objective of a routing protocol for wireless sensor network is to ensure availability of messages, authentication and integrity. Most of the existing secure routing algorithms for Wireless Sensor Networks are based on symmetric analysis of transmission and packet analysis. Security is always a concerning area in the field of Wireless Sensor Network and it is necessary to understand the security requirements. This paper explored the Wireless Sensor Network basic with existing secure routing algorithms along with the clustering-based Genetic Algorithm and test over the Wireless Sensor Network. Genetic algorithms are components of random algorithms. In order to construct the answer, this approach requires a precious volume of determinism embedded to genetic variables. The simulation covers most concerning areas of energy and packet transmission analysis. This paper covers to comprehend the security attacks, security requirements and the proposed algorithm that performs better result in terms of energy dissipation, dead nodes and throughput as compare to other protocols after certain comparisons at MATLAB-2013 platform.

Keywords Quality of services (QoS) · Wireless sensor network (WSN) · Cluster head (CH) · Genetic algorithm (GA) · Dead nodes

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1 Introduction

In the LEACH, the cluster head selection is performed randomly and cluster heads are rotated or decided within each round of data processing. Due to the arbitrary preference of a cluster head, the cluster head energy will be well dispersed within each node of the sensor network. In SEP, the nodes having high energy are referred as advanced node and the chance of advanced nodes to turn out to be Cluster Head is high as compared to the normal nodes. Threshold Sensitive Energy Efficient Sensor Network Protocol (TEEN) is mainly used for optimizing use of energy for communication in Wireless Sensor Network. The circular point represents communication node and dark node represents local base station. Cluster head sends a hard threshold to intact sensor node within the cluster; it understands the attribute for the sensed data.

1.1 Security Attacks

There are numerals of possible attacks in wireless sensor network. Security Attacks can be mainly classified into two parts Active Attacks and Passive Attacks.

Active Attacks—are categories into numeral parts like Routing Attacks, Denial of services, Fabrication, Modification, and Lack of cooperation, Impersonation, Eavesdropping and many more. Active attacks are directly performed on the network.
Passive Attacks—This attack is not directly done on sensor node. It can be categories into parts like Monitoring, traffic analysis, Camouflages Adversaries (Fig. 1).

1.2 Security Requirements

Data Confidentiality, Availability, Secure Localization, Data freshness, Authentication etc. these are the security requirements of Wireless Sensor Network.

Data confidentiality: By the use of Data Confidentiality, data is protected from illegal user so that it cannot be read or analyzed. Confidentiality can be maintained by few steps:
a—Only the intended receiver can receive the data.
b—Distribution of key should be finished secretly.
c—Strong and enough key distribution should be used.
d—Find out the secure channel generation t.
Data Integrity: Data integrity ensures the reliability that data is not customized by any illegal third party. Data should not be customized or altered by attackers during the transmission. Now the question is the how can we maintain integrity,

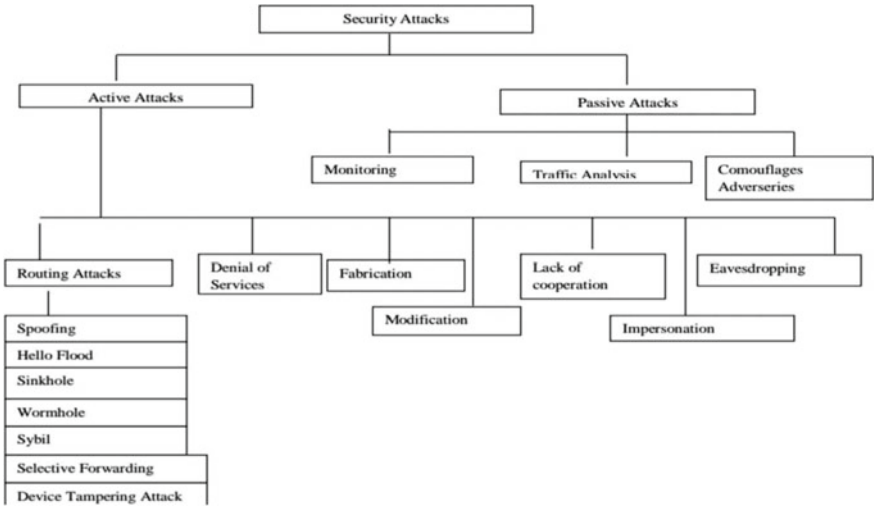

Fig. 1 Security attacks

this is the big question. Now one solution may possible by time to time verification of the data.

Self Organization: Sensor Nodes are flexible and self organizing. So it is difficult to implement traditional cryptographic algorithm (Like RSA etc.) due to fix topology approach.

Data Newness: The old data should not be sending over and over again. Use of old data repeatedly causes replay attack.

Authentication: To find out the data from authentic source is very important.

Time Synchronization: Due to participation different entities in security mechanism, time synchronization is very necessary. It desires a critical time.

Secure Localization: Sensor nodes in Wireless Sensor Network should be confined to a small area in secured manner in any environment. Attacker can send false messages and position if sensor nodes will be less secured.

Availability: Data availability ensures that the authorized user is not prohibited to access services. To overcome this problem common technique is provide more communication among nodes.

2 Related Work

A low cost network with self-regulating nodes and monitoring nodes is the Wireless Surveillance Network (WSN) [1]. Because of the limits in resource capacity, WSNs are highly susceptible to different forms of physical attack and are analyzed for external data distribution. Alternative key attack on WSN is a fake capture attack where the suspicious directly imprisonments the node and reliefs private information from the node memory.

Wormhole attacks will weaken wireless sensor networks or throw them off practice [2]. Throughout the standard wormhole attack, an intruder accepts a packet at one point in the network and transfers it to another point in the network over a wired or wireless network with less latencies than a network link. The following article outlines a wireless sensor network wormhole detection algorithm. This detects wormholes on the basis of the network distortion. As the wormhole attacks are passive, the algorithm is used as a search technique with the hop counts method, the local map at each node is modified, and irregularities that trigger wormholes are observed using diameter components.

Hamidouche et al. [3], in this paper they suggest genetic methodologies focused on computations for pooling and mentoring in WSN. The purpose of this tool is to extract the sensor existence and increase the management quality. They render detailed copies of the existing accounts, and then equate the re-encoding findings with the actual accounts data. The results show that the calculations proposed exceed the current calculations as the implementing measures differs, including the use of dynamism and the number of beams that the base station has obtained.

Jamshidi et al. [4] proposed algorithm based on the detection mechanism that is applied over the WSN, and its performance is evaluated through a set of tests in terms of true detection rate, false detection rate, and overhead contact. Tests of the experiments indicate that the proposed algorithm can identify 99.8% of Sybil nodes with a false detection rate of 0.008% (in average).

The IoT wireless sensor network is being used because of advanced packet failure during transmission [5]. They must develop a traffic protocol, which improves network efficiency and also improves QoS, to overcome these problems. The proposed protocol considers the option of the optimum route, i.e. lifespan, efficiency, and traffic strength at the next-hop node to be three-factor.

3 Methodology and Process

Genetic algorithms are a component of (evolutionary) random algorithms. In reality, they base a large portion of their activities on randomness. The valuation method, however, leads to this possibility. In order to construct the answer, this approach requires a precious volume of determinism embedded to genetic variables. This

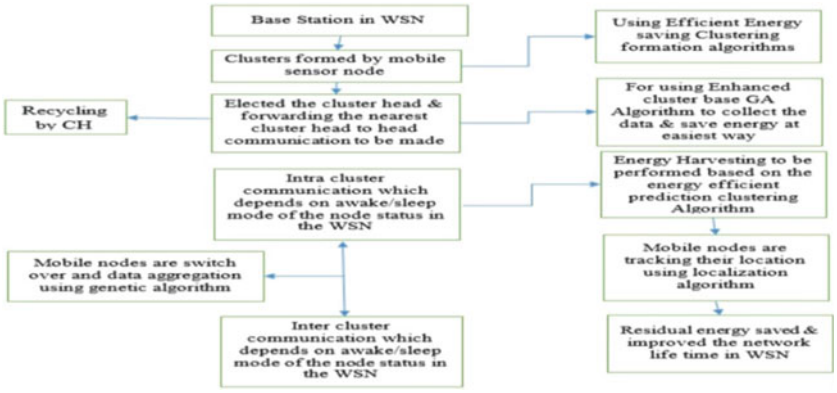

Fig. 2 Cluster concept along with genetic algorithm

research mythology is integration of the cluster concept along with genetic algorithm as presented in the below flow chart (Fig. 2).

3.1 Principle Operations

- The Genetic Algorithms' overall structure is comprised of six key elements:
- An original interface population
- A feature of chromosome in coding/decoding;
- The operators of genes (mutation, crossover)
- An evaluation feature (Fitness)
- Selection algorithm (Tournament, roulette).

3.2 Proposed Model

See Fig. 3.

Fig. 3 Proposed model

4 Simulation and Result

In this section, the simulation is performed through MATLAB. Energy dissipation, dead nodes and throughput are estimated by comparing different algorithm (Fig. 4).

Figure 5 present the comparison of proposed (Cluster based GA) with the CBCR and Simple Leach for Dissipation of Energy. This simply found that the proposed algorithm has taking very high number of communication round as it compare to the rest. Comparing with the three protocol (LEACH, CBCR and Proposed),we found after the number of rounds, the energy dissipation of proposed algorithm is better as compared to the other.

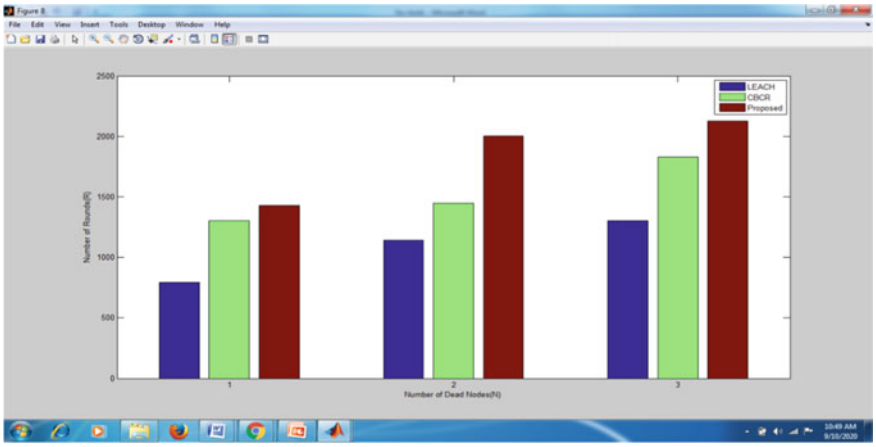

Fig. 4 Estimation of dead nodes

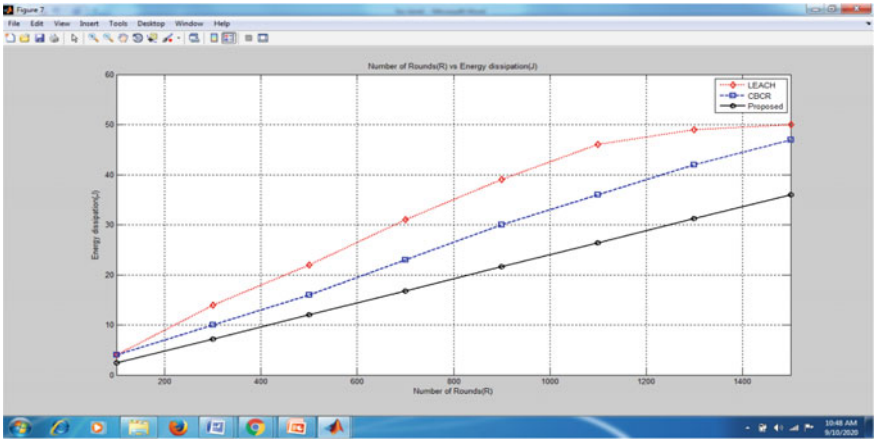

Fig. 5 Estimation of energy dissipation

4.1 Throughput Evaluation

(a) Packet delivery ratio—It reflects the ratio of the total number of presented messages that each subscriber node collects to the total number of published messages that all publisher nodes turn out for the subscriber node events.

(b) Throughput—Throughput is the number of packet that is fleeting through the channel in a particular unit of time. The number of samples generated by the network as reply to a given query is equal to the number of sensors, k, that are presented and active when the query is received. The formula is given below (Figs. 6, 7 and 8).

Test	Packet	Packet Drop	PDR	E2E-delay	Throughput
Test 1	160	6	99.96	0.17	941.18
Test 2	160	9	99.94	0.197	812.18
Test 3	200	9	99.95	0.123	1626.02
Test 4	150	0	100	0.068	2205.88
Test 5	160	10.5	99.93	0.168	952.38
Test 6	180	7.5	99.96	0.12	1500.00
Test 7	200	9	99.95	0.12	1666.67

Fig. 6 Result come out by GA based WSN

Test	Packet	Packet	PDR	E2Edelay	Throughput
Test 1	180	24	99.87	0.170	1058.82
Test 2	190	15	99.92	0.122	1557.38
Test 3	150	0	100	0.072	2083.33
Test 4	170	9	99.95	0.12	1416.67
Test 5	180	30	99.84	0.168	1071.43
Test 6	180	18	99.9	0.171	1052.63
Test 7	170	9	99.95	0.125	1360.00

Fig. 7 Result come out by earlier based algorithm based on neural network

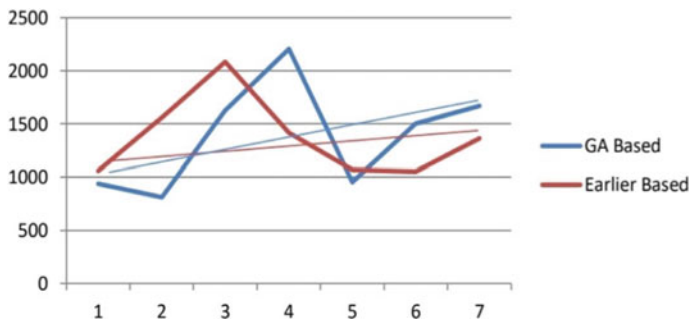

Fig. 8 Comparetive study of GA based and earlier based

$$\text{Throughput} = \text{total packets}/\text{End2EndDelay}$$

5 Conclusion

The estimation of quality in Wireless Sensor Network reflects the communication reliability. As the communication need energy among node to node and node to base station. This energy in time domain degraded as ultimately loss of entire energy in certain time. In our simulation, it is found that dead nodes increases and energy degraded after no. of rounds. In this paper, the proposed algorithm perform better result in term of energy dissipation, dead node and better throughput as compare to other protocols. The recent advances have embedded in wide range of application of wireless sensor network use in military, traffic surveillance, target tracking, environment monitoring, medical, and commercial applications will be subject to our future studies. In this paper with GA evolutionary algorithm for neural network is used for picking best fit nodes. In the next paper better result can be generated by the use of Convolution Neural Network.

References

1. Bhatt R, Maheshwary P, Shukla P, Shukla P, Shrivastava M, Changlani S (2020) Implementation of fruit fly optimization algorithm (FFOA) to escalate the attacking efficiency of node capture attack in wireless sensor networks (WSN). Comput Commun 149:134–145
2. Yadav B, Tiwari S (2019) Review of worm whole attack in WSN. Int J Sci Res Eng Trends (IJSERT) 5(6):1934–1936
3. Hamidouche R, Aliouat Z, Gueroui AM (2018) Genetic algorithm for improving the lifetime and QoS of wireless sensor networks. Wirel Pers Commun 101(4):2313–2348
4. Jamshidi M, Poor SSA, Qader NN, Esnaashari M, Meybodi MR (2019) A lightweight algorithm against replica node attack in mobile wireless sensor networks using learning agents. IEIE Trans Smart Process Comput 8(1):58–70
5. Jaiswal K, Anand V (2019) EOMR: an energy-efficient optimal multi-path routing protocol to improve QoS in wireless sensor network for IoT applications. Wirel Pers Commun:1–23
6. Rezaeipanah A, Nazari H, Ahmadi G (2019) A hybrid approach for prolonging lifetime of wireless sensor networks using genetic algorithm and online clustering. J Comput Sci Eng 13(4):163–174
7. Pandey AK, Srivastava S (2016) Study and analysis of energy efficient cluster based routing protocol. Int J Comp Appl 148(2):0975–8887
8. Wang N, Zhu H (2012) An energy efficient algorithm based on LEACH protocol. In: International conference on computer science and electronics engineering (ICCSEE), pp 339–342
9. Islam MM, Matin MA, Mondol TK (2012) Extended stable election protocol (SEP) for three-level hierarchical clustered heterogeneous WSN. In: IET conference on wireless sensor systems, pp 1–49
10. Pandey AK, Srivastava S (2016) Survey on wireless sensor routing protocols. Int J Sci Res 5(5):1145–1149

11. Zaman N, Abdullah A (2011) Different techniques towards enhancing wireless sensor network (WSN) routing energy efficiency and quality of service (QoS). World Appl Sci J (WASJ) 13(4):798–805
12. Zhang Q, Zhang W (2019) Accurate detection of selective forwarding attack in wireless sensor networks. Int J Distrib Sens Netw 15(1):1550147718824008
13. Zhang W, Liu Y, Han G, Feng Y, Zhao Y (2018) An energy efficient and QoS aware routing algorithm based on data classification for industrial wireless sensor net works. IEEE Access 6:46495–46504
14. Samara G, Aljaidi M (2019) Efficient energy, cost reduction, and QoS based routing protocol for wireless sensor networks. arXiv preprint arXiv: 1903.09636
15. Alwan H, Agarwal A (2013) Multi-objective QoS routing for wireless sensor networks. In: 2013 International conference on computing, networking and communications (ICNC), pp 1074–1079
16. Amjad M, Afzal MK, Umer T, Kim BS (2017) QoS-aware and heterogeneously clus tered routing protocol for wireless sensor networks. IEEE Access 5:10250–10262

Breast Cancer Prediction Using Greedy Optimization and Enlarge C4.5

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Abstract Detecting Breast Cancer in the early step is significant to minimize the death rate by enhancing the available treatments. As there exists no definitive treatment for Breast Cancer detection, early detection is significant. Hence, this study employs Machine Learning (ML) methods for expecting Breast Cancer effectively with efficiently. In this study, novelty is given in the feature selection and classification process. This study intends to perform relevant feature selection through the proposed Greedy Optimization (GO) method. In addition, it aims to perform a classification of the relevant features by the use of the newly introduced Enlarge C4.5 algorithm (Ext.-C4.5). At first, Breast Cancer dataset is loaded. Then, pre-processing is performed. The pre-processed data is obtained through data reduction and dimensionality reduction. Here, data reduction is performed using the Block Level Deduplication, dimensionality reduction is performed using C-Isomap. This pre-processed data is considered for feature selection. This feature selection is given for train and test split. This is followed by classification. Lastly, the prediction is performed by the trained model. The experimental implementation and performance analysis of the planned system is undertaken. It is performed by comparing the proposed system with the existing systems (Naïve Bayes (NB), Decision Tree (DT), Nearest Neighbour (NN), Multilayer Perceptron (MLP), Artificial Neural Network (ANN), Extreme Learning Machine, K-Nearest Neighbour (KNN) and Support Vector Machine (SVM)) in terms of correctness, accuracy, specificity, sensitivity, f1-score and Completing Time. The results revealed that the proposed GO and E-C4.5 performs efficiently than the existing methodology.

Keywords Breast cancer prediction · Block level deduplication · C-Isomap · Greedy optimization · Enlarge C4.5 algorithm

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1 Introduction

Breast Cancer is one among many malignant diseases that leads to high mortality, particularly in women. In recent years, it has become a global problem. Yet, it is diagnosed only in its advanced stages as women neglect clinical examination as well as self-inspection of breast [1]. This paper [2] customized two Machine Learning (ML) methodologies for Breast Cancer classification. This study employed Wisconsin Breast Cancer Database. This study aimed to develop efficient ML strategies for classifying cancer by utilizing two classifiers. The performance of the classifiers has been evaluated with respect to accuracy, training and testing process. The outcomes exhibited that K-Nearest Neighbour (KNN) accomplished high efficiency compared to Naïve Bayes (NB). But, when large datasets are employed, the execution time of KNN will enhance. In addition, this study [3] intended to find the significant prediction factors that impact the Breast Cancer patient's survival rate by utilizing common ML methodologies to build interpretable prediction models. The evaluation of this model by utilizing Random Forest (RF) affords better accuracy in comparison to supplementary algorithms. However, the accuracies exhibited by every algorithms have been found to be close. This study identified the most significant variables such as classification of cancer stage, positive lymph nodes, diagnosis method, the total count of the removed axillary lymph nodes, type of primary treatment and tumour size. Moreover, this article [4] intended to examine large Breast Cancer datasets by utilizing three classification methodologies for predicting cancer occurrence. This study utilized Apache Spark as Big Data (BD) framework. This study examined two additional BD types, namely combined dataset and DM that consists of DNA Methylation as well as Gene Expression, to examine the possible merits of utilizing them in classifying Breast Cancer. The outcomes explored that Gene Expression performed effectively than DNA Methylation for the classification of Breast Cancer. Further research must be undertaken to enhance these classification methods in terms of result by the use of Feature Selections and methods of Balanced Dataset [5]. Hence, the present study recommends ML techniques to efficiently perform feature selection to enhance the accuracy of classification to predict Breast Cancer. In this review, originality is given in the feature selection and classification process for enhancing system efficiency.

The major impacts of this study are listed below.

1. To select relevant features from the Breast Cancer dataset using the proposed Greedy Optimization (GO) methodology.
2. To classify the relevant features obtained from the train and test split using the proposed Enlarge C4.5 algorithm.
3. To undertake a performance analysis by comparing the proposed and existing methods in terms of correctness, accuracy, sensitivity, f1-score, specificity and accuracy so as to validate the efficiency of the introduced methodologies.

1.1 Paper Organization

This research paper is prepared in the following way. Section 1 describes the fundamental concepts related to Breast Cancer Prediction. Paper Sect. 2 enhances the review of various existing researches associated with this context. Subsequently, Sect. 3 briefly explains the proposed methodology. Followed by third section, Sect. 4 discusses the experimental outputs obtained from the proposed model. Finally, the conclusion of the overall proposed system is concluded in Sect. 5.

2 Review of Present Work

Current section discusses the review of multiple feature learning and classification methods used in the existing systems for the breast cancer prediction.

Breast Cancer seems to be the typical kind of cancer. Most of the women struggle from this type of cancer throughout the world. Breast cancer must be predicted earlier to reduce the mortality rates. Feature Selection is an important process for Breast cancer prediction as it selects only relevant features, thereby eliminating irrelevant features. This enhances the classifier's accuracy level. Feature selection has been effectively utilized in medical applications. This process aids in recognizing the reasons for a particular disease. This process has also confirmed to be an effective pre-processing tool for issues of Machine Learning (ML). Thus, this study [6] presented a study about various feature selection methodologies in medical applications. These feature selection methodologies include Consistency Based Filter (CBF), Information Gain, Correlation Based feature selection, ReliefF, INTERACT, Recursive Feature Elimination (RFE) for Lasso Regularization (LR) and Support Vector Machines (SVM). In the first case, the outcomes explored that the feature selection performed better than traditional classification methods. In the next case, feature selection minimized the execution time needed for Feature Extraction (FE). This study also found that most of these techniques failed to handle huge datasets. Hence, there occurs a need to introduce high sophisticated feature selection methods to handle large data. In accordance with this, a feature selection with traditional feature selection methodologies on the basis of the embedded, wrapper, filter as well as hybrid models have been introduced in this paper [7]. In addition, this paper also afforded the classification of Fuzzy Logic (FL) based feature selection and Dimensionality Reduction methodologies in a comprehensive way. Moreover, Breast Cancer is a severe health problem as it causes about 1.6% and above deaths (female) worldwide. Early Prediction of Breast Cancer supports in planning and providing relevant treatments. Similarly, this article [8] intended to perform a comparison of a few conventional Data Mining (DM) concepts in terms of correctness in predicting the recurrence of Breast Cancer. This study embedded a Particle Swarm Optimization (PSO) as feature selection into three well-known classifiers such as fast Decision Tree (DT) learner, Naïve Bayes and K-Nearest Neighbour (KNN) with the

aim of enhancing the prediction model's accuracy level. The outcomes revealed that Naïve Bayes performed effectively without and with PSO than the supplementary two methods. Whereas the supplementary techniques enhanced when utilized with PSO. This study has to be enhanced by incorporating new methodologies with other feature selection methodologies [9]. This study will research ensemble algorithms and cluster methodologies.

On the other hand, this paper [10] intended to validate anthropometric and clinical measurements for predicting the occurrence of Breast Cancer through the use of a hundred and sixteen examples. Numerous analysis and feature selection techniques have been utilized to find the relevant features. This study employed various renowned classifiers, namely Naïve Bayes, SVM, Logistic Regression (LR), Quadratic Discriminant (QD), K-Nearest Neighbour (KNN), Random Forest (RF), and Linear Discriminant (LD). Later, these classifiers have been evaluated. This study also examined the efficiency of the medical features that have been recorded during periodic blood analysis to predict Breast Cancer by the use of ML techniques [11]. In addition, this study deliberated the role of several ML modules like classification, biomarker selection and data-division protocols. This study considered nine biomarkers. The outcomes of the feature selection methodologies represent that age, resistin and glucose were the highly relevant as well as efficient biomarkers to predict Breast Cancer. Moreover, the KNN classifier accomplished high accuracy in classification when considering these features. Followed by this, the Gaussian SVM accomplished high classification accuracy. However, the performance of these methodologies utilized in this article has to be compared with the advanced classification methodology performance in the near future. Likewise, this study [12] examined the Genetic Algorithm (GA) for feature selection and varied DM methodologies like LR, RF, DT, SVM, Multi-Layer Perceptron (MLP), Rotation Forest and Bayesian Network to build an automated system for classifying amongst malign and benign tumour cells. The results revealed the effectiveness of Rotation Forest with GA accomplished high accuracy for Breast Cancer classification [13]. Additionally, this paper [14] explored a case study that examines the insecticide levels of organochlorine in women who are suffering from benign and malignant Breast Cancer growth. The feature selection has been executed in the proposed framework. The process has been included with filters of pre-processing. The proposed framework to predict breast cancer accomplished accuracy at a rate of ninety percent. This accuracy level has been discovered to be effective than the typical classifiers as a neural network, SVM and so on [15].

Various classification methodologies for Breast Cancer Prediction is discussed here. This study [16] considered Average Classification Accuracy and Average Misclassification costs of varied classes. This study also presented an efficient Cost-Sensitive SVM (CS-SVM) for classifying the malignant as well as the benign breast tumours effectively. This study employed SVM for accomplishing classification. Additionally, a comparative analysis has been executed to validate the efficacy of the proposed methodology. The analytical outcomes explored that the proposed technique achieved superior result than the other methods considered for comparison. In addition, this paper [17] aimed to predict the recurrence of Breast Cancer accurately and reliably by utilizing the patient's demographic and pathological features. This

study involved a hybrid methodology that incorporated statistical ensemble learning, feature selection and optimization on the basis of the meta-heuristic population to predict the reappearance of Breast Cancer in the initial five years after diagnosis. This was a retrospective study which is a drawback. The outcomes have been inclined based on the accessible specimen and referral patterns to the clinic. This study revealed that the size of the sample has to be enhanced for improvising the statistical ability in the prediction system. It will also be effective to incorporate risk valuation into the methodology as well as report the recurrence risk. This is yet to be implemented, which is a drawback [18]. Similarly, this paper [19] recommended a Nested Ensemble methodology to develop an automatic and accurate prediction model to detect malignant and benign tumour cells. Thus, the aim of these methodologies has been to classify the patients into malignant and benign categories for permitting people with non-threatening Breast Cancers for minimizing or avoiding the invasive procedure extent they have to experience—the proposed strategy permitted to employ various ensemble techniques concurrently to enhance the prediction system performance. The outcomes revealed that the usage of the recommended methodology would enhance the performance of Naïve Bayes and BayesNet algorithms for Breast Cancer detection. This study has to be further extended with several classification and ensemble methodologies. Likewise, this paper [20] explored a Multimodal Deep Neural Network through the incorporation of Multi-dimensional Data (MDNMD) for predicting the survival rate of the Breast Cancer affected humans. The outcomes of the study explored better outcomes. It is probable that the proposed method's performance would be improved when many samples become accessible in the near future. Moreover, this study [21] initially employed an SVM—ML model with multiple parameters like Polynomial Kernel Function, Gamma and Regularization Parameter (C) to accurately detect Breast Cancer. This research employed the Wisconsin Breast Cancer Dataset. This study utilized two renowned techniques, namely ANN and SVM [22]. The outcomes explored that the recommended technique permits to attain accuracy. This study also helped in accomplishing efficient prediction of Breast Cancer. This study can be tested on varied kinds of medical data.

Furthermore, this article [23] validated the performance of two classical and six ML methodologies for predicting the metastasis occurrence and survival rate of Breast Cancer affected patients. The results exhibited the efficiency of LDA and SVM to predict the rate of survival with respect to various criteria. Moreover, LDA has been an efficient methodology to predict metastasis among Breast Cancer patients. This study requires further extension by utilizing huge datasets for introducing a valuable tool for survival of BC as well as metastasis prediction. In addition, this study [24] recommended a tumour classification technique for a small sample and high dimensional tumour datasets. This study used relaxed Lasso-Gen SVM (rL-Gen SVM) as a classification technique. Then, this study attained classification accuracy through cross-validation of ten-fold on each sample of the individual records. The outcomes represent that the introduced technique in this study utilized regularization parameters for avoiding overfitting. It can utilize minimum feature genes to attain high accuracy in classification. This can efficiently handle small sample and high-dimensional data. Moreover, this paper [25] recommended a CAD system to

exhibit combinations of varied deep feature and selected the efficient algorithm that enhances the accuracy of classification. Additionally, this study reviews the process of minimizing the cost of computation for classification. This was undertaken by building four varied experiments. Validation has been carried out on two datasets. The empirical outcomes represented that the recommended CAD system has the ability to accomplish the classification of Breast Cancer. The results also explored that it has a high ability to classify malignant and benign cases in comparison to manual diagnosis through mammogram images. The radiologists might utilize this proposed system as a support for optimal diagnosis of Breast Cancer. This study will also minimize the time as well as the effort during the investigation. Yet, this study has to further examine the new DCNN in the near future.

3 Proposed Methodology

In this study, novelty is given in Feature Selection and classification process. The Breast Cancer prediction is performed using feature selection and classification techniques. The proposed Greedy Optimization (GO) is used for feature selection, and the introduced Enlarge C4.5 (E-C4.5) algorithm is used to perform classification for predicting breast cancer. The overall model of the proposed methodology is given in the Fig. 1.

Initially, the Breast Cancer dataset is loaded. Then, pre-processing is performed by data reduction and dimensionality reduction. Block-level Deduplication is used for performing data reduction. Subsequently, C-Isomap is used for dimensionality reduction. After this, the pre-processed data is obtained and given for feature selection. This is later considered for train and test split. Followed by this, classification is performed. Here, feature selection is performed through the proposed GO algorithm and classification is performed by the proposed E-C4.5 algorithm. Finally, the trained model is used for prediction, and the proposed system is evaluated through performance analysis.

3.1 Pre-processing

The Pre-processing is the preliminary data processing stage to make it ready for further analysis. It involves certain techniques. In this study, data reduction and dimensionality reduction is performed to attain the pre-processed data. It is briefly discussed below.

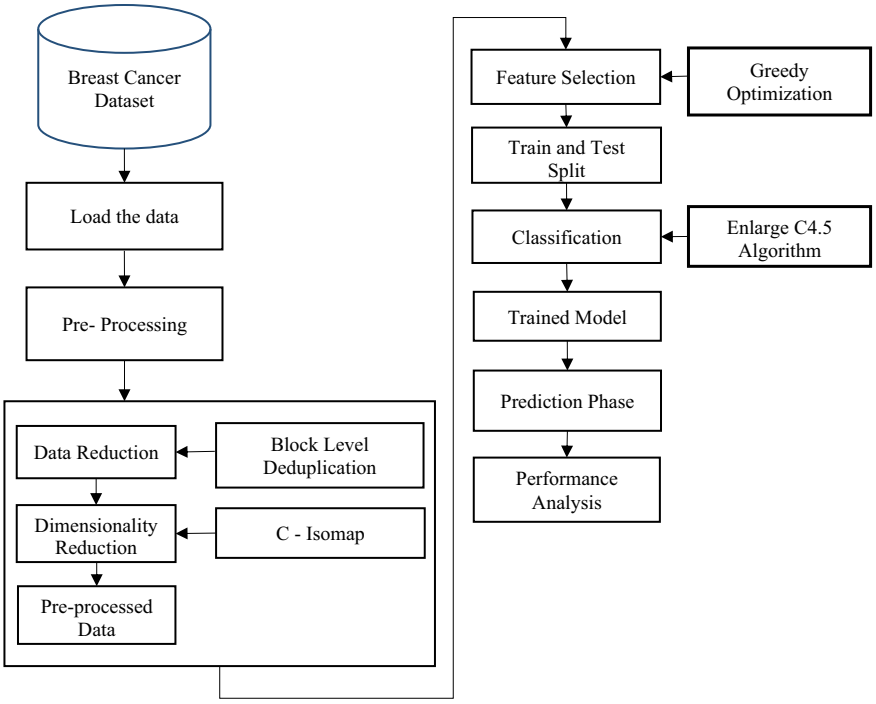

Fig. 1 Completer model of the proposed system

3.2 Data Reduction—Block Level Deduplication

The Block Level Deduplication is employed in the data stream, which is partitioned into blocks and check to find if there is a repetition in the blocks. When a unique block is found, it is written to the disk along with its identifier stored in the corresponding index. Hence, this prevents storing the duplicate data blocks again, thereby minimizing the storage space. In this study, data reduction is performed through the Block Level Deduplication. This technique finds duplicate data and eliminates redundancy. This is also known as sub-file deduplication. Hence, this methodology is efficient as it avoids data block duplication and reduces the storage space.

3.3 Dimensionality Reduction—C-Isomap

C-Isomap is a Dimensionality Reduction (Non-linear) technique. It is a widely utilized embedding technique of low-dimension. It is utilized to compute a Low Dimensional Embedding (LDE) and Quasi-isometric of high dimension oriented data points. This algorithm affords a simple technique to estimate the data's intrinsic

geometry on the basis of the individual neighbour of the data points. It is highly effective, and it can be generally employed to a big range of data dimensionalities as well as their sources.

3.4 Feature Selection

This is performed to select significant features to perform efficient classification. This process is significant to increase classification accuracy. The proposed Greedy Optimization (GO) approach is used to perform feature selection. It is briefly discussed here.

3.5 Greedy Optimization (GO)

A greedy technique is a simple and intuitive methodology utilized in optimization issues. This methodology makes an optimal decision at each stage as it tried to determine the overall optimal path to solve the overall problem. The GO is an efficient technique for choosing the optimized features. This study utilizes GO for feature selection as it removes noise and selects the relevant features in minimum time. Additionally, this technique can handle the attributes in an effective way. This technique uses five components during the feature selection process. They are Candidate Set (CS), Selection Function (SF), Feasibility Function (FF), Objective Function (OF) and the Solution Function (SF). At first, a Candidate Function (CF) is produced that consists of a set of sentimental attributes. The best attributes are then selected from the gathered candidate set, which is estimated by the below Eqs. 1–3.

$$\text{Greedy} = \sum_{b=1}^{c} \sum_{a=1}^{n} \mu_{ba}^{2} x_a - v_b^2 \tag{1}$$

$$v_b = \frac{\sum_{a=1}^{n} \mu_{ba}^{2} x_a}{\sum_{b=1}^{n} \mu_{ba}^{2}} \quad b = 1, \ldots c, \; a = 1, \ldots n \tag{2}$$

$$\mu_{ba} = \mu_b(x) = \left(\sum_{k=1}^{c} \frac{x_a - v_b^2}{x_a - v_k^2} \right)^{-1} \tag{3}$$

In the above equations, μ_{ba} denotes the mean value, v_b denotes the attribute variance and x_a denotes the dataset attribute.

Subsequently, the initial population is obtained. Then, two individuals ($X1$, $X2$) are selected in this population. Followed by this, a crossover operator is employed to generate a child (X3). A replacement of any one individual ($X1$, $X2$) is made among the two individual by (X3) and immigration is performed occasionally till

this population converges. The obtained population is given by the below Eq. 4.

$$\rho(r) = \rho 0 e^{-\gamma d^m} \tag{4}$$

Here ρ denotes the population, $\rho 0$ denotes the population iteration and d denotes the individual distance.

As mentioned earlier, this methodology is the best approach to make the efficient optimal decision at individual steps. In the below Eq. 5, the steps are taken as positions.

$$x_a(t+1) = x_a(t) + \frac{\beta_0}{1+\gamma r^m}[x_b(t) - x_a(t)] + R(\alpha) \tag{5}$$

Here $x_a(t)$ denotes the current position, $x_a(t+1)$ denotes the subsequent position and $R(\alpha)$ denotes the local search.

Finally, the best fitness value is retrieved as per the above Eq. 5.

3.6 Classification

In ML, classification is a predictive modelling issue. Here prediction of the class label is performed for a given input data. In this research, classification is performed through the proposed Enlarge C4.5 (Ext-C4.5) algorithm.

3.7 Enlarge C4.5 (Ext-C4.5) Algorithm

Enlarge C4.5 (E-C4.5) constructs Decision Trees (DT) from training data that is of a set using the information entropy concept. This training data comprises samples that are already classified. At each tree node, this algorithm selects the data attribute that efficiently splits its sample sets into subsets augmented in a class or other. Moreover, the splitting criteria are the normalized information gain (NIG). The attribute that has the maximum NIG is selected for making decisions. Then, this algorithm recurses on the segregated sub-lists.

Assume the information volume of counterexamples (n) and positive examples (p) is given by the below Eqs. 6 and 7.

$$\text{Info}(s) = \sum_{j=1}^{m} \frac{q_j + m_j}{q+m} J\left(m_j, q_j\right) \tag{6}$$

$$J\left(m_j, q_j\right) = -\frac{m_j}{q_j + m_j} \log_2 \frac{m_j}{m_j + q_j} - \frac{q_j}{q_j + m_j} \log_2 \frac{q_j}{m_j + q_j} \tag{7}$$

This technique is simplified and merged as per the below Eq. 8.

$$\text{Info(s)} = \frac{1}{(m+q)} \sum_{j=1}^{m} \left(-m_j \log_2 \frac{m_j}{m_j + q_j} - q_j \log_2 \frac{q_j}{m_j + q_j} \right) \tag{8}$$

Based on the above equation, the attribute entropy is selected for the nodal point. This equation persists to be simplified to the below Eq. 9.

$$\text{Info(s)} = \frac{1}{(m+q)\text{Jn2}} \sum_{j=1}^{m} \left(-m_j \text{Jn} \frac{m_j}{m_j + q_j} - q_j \text{Jn} \frac{q_j}{m_j + q_j} \right) \tag{9}$$

In accordance with the mathematical theory of equivalent infinitesimal, the below Eqs. 10 and 11 are obtained.

$$\text{Jn} \frac{m_j}{m_j + q_j} = \text{Jn} \left(1 - \frac{q_j}{m_j + q_j} \right) \approx - \frac{q_j}{m_j + q_j} \tag{10}$$

$$\text{Jn} \frac{q_j}{m_j + q_j} = \text{Jn} \left(1 - \frac{m_j}{m_j + q_j} \right) \approx - \frac{m_j}{m_j + q_j} \tag{11}$$

Thus, this could simplify the computation of the attribute entropy of the nodal point. It is given by the below Eq. 12.

$$\text{Info(s)} \approx \frac{1}{m + q\text{Jn2}} \sum_{j=1}^{m} \frac{2 m_j q_j}{m_j + q_j} \tag{12}$$

Thus, this minimizes the calculation complexity.

Finally, the Breast cancer prediction is performed through the trained model, which classifies Breast Cancer as malignant or benign in an effective way.

4 Results and Discussion

The result obtained through the implementation of this proposed methodology is reviewed in this part. In addition, the performance analysis of the proposed system is also discussed in this section which is accomplished by comparing it with the existing system in terms of various performance metrics. The performance metrics are also discussed in this section.

4.1 Data Description

Wisconsin Diagnostic Breast Cancer dataset is utilized in this study. This dataset consists of thirty-two features of five hundred and sixty-nine subjects. The thirty-two features comprise thirty real tumour features, ID number as well as the class label. This represents that the individual subject possesses a malignant or benign tumour. In this research implementation, the dataset is improved.

The dataset is obtained from Breast Cancer Wisconsin (Diagnostic) Data Set, General Surgery Dept.

University of Wisconsin, Clinical Sciences Centre, Madison [26].

4.2 Performance Metrics

The proposed system is analysed with respect to various metrics, precision, sensitivity, namely accuracy, specificity, F1-score and execution time. Each of these metrics is explained below.

A. **Accuracy**

This is a measure of evaluating the system's ability to properly classify Breast Cancer as malignant or benign. It is given by the below Eq. 13.

$$\text{Accuracy} = \frac{\text{True Negative} + \text{True Positive}}{\text{True Negative} + \text{False Negative} + \text{True Positive} + \text{False Positive}} \tag{13}$$

B. **Precision**

It describes the degree to which a specific process will duplicate similar values. It is expressed by the below Eq. 14.

$$\text{Precision} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}} \tag{14}$$

C. **Sensitivity**

It denotes the suitably recognized positive segments. It is given by the below Eq. 15.

$$\text{Sensitivity} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}} \tag{15}$$

D. **Specificity**

It refers to the state of being specific to a group or individuals. It is given by the below Eq. 16.

$$\text{Specificity} = \frac{\text{True Negative}}{\text{True Negative} + \text{False Negative}} \tag{16}$$

E. **F1-score**

It is also known as F-Measure metrics. It is defined in from of the Harmonic Mean (HM) of accuracy and recall. It provides efficient measurement. It is given by the below Eq. 17.

$$\text{F1 - Score} = \frac{2 * (\text{Recall} * \text{Precision})}{\text{Recall} + \text{Precision}} \tag{17}$$

F. **Execution Time**

In this paper, execution time is the measure of the minimum time consumed by an ML technique to accomplish the Breast Cancer classification.

4.3 Experimental Results

The proposed GO and E-C4.5 algorithm is implemented and histogram, correlation map, confusion matrix, malignant as well as the benign count is obtained. It is briefly discussed here. Figure 2 is showing the histogram for malignant and benign tumours.

As per the implementation of the proposed system, the benign values are found to more than the malignant values, which is shown clearly in Fig. 2. Moreover, the malignant, as well as the benign count is shown in Fig. 3.

The accomplishment of the proposed system reveals that the malignant count is found to be above 200 and the benign count is found to be above 350. Additionally, a confusion matrix is obtained, as shown in Fig. 4.

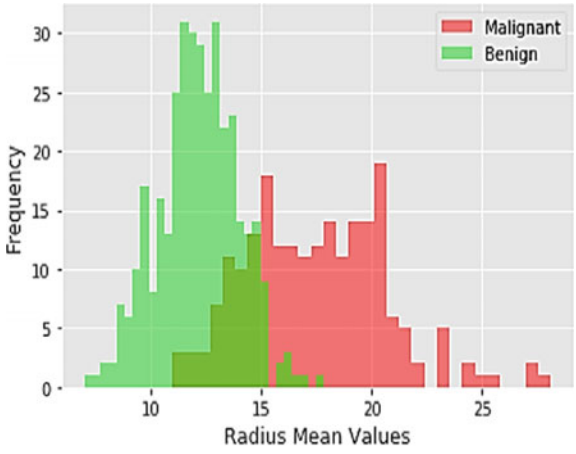

Fig. 2 Histogram-radius mean for malignant and benign values

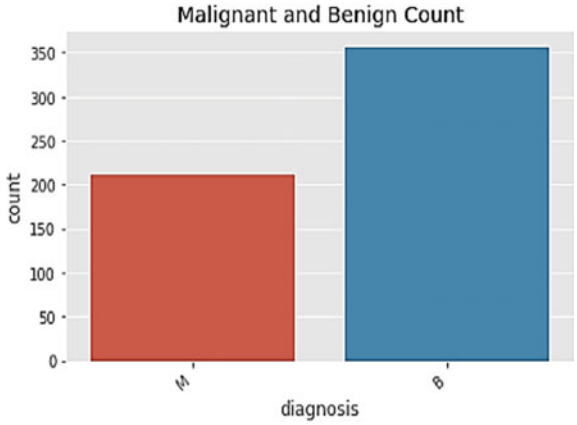

Fig. 3 Malignant and benign count

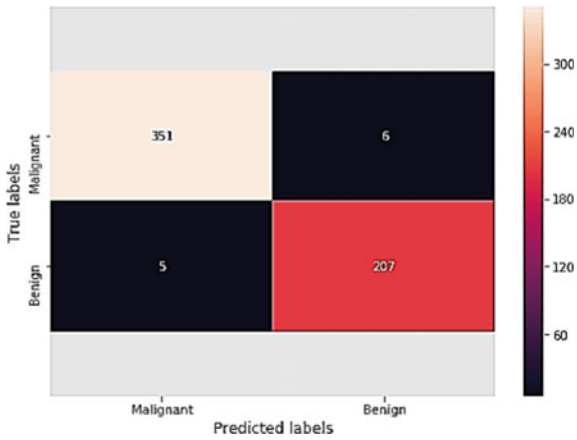

Fig. 4 Confusion matrix

In Fig. 4, 351 cases are correctly identified as malignant, whereas 6 cases are misinterpreted. On the other hand, 5 cases are misinterpreted as benign and 207 cases are correctly predicted as benign. Here, as the correctly interpreted values are higher than the misinterpreted values, the proposed method is found to be optimal in Breast Cancer classification and prediction. Moreover, a correlation map is obtained, as shown in Fig. 5. In this correlation map, the light colours denote positive correlation and dark colours denote negative correlations. Here, the numbers of features are taken in the X and Y-axis. This helps to exhibit efficient features.

From Fig. 5, the light colours in the diagonal represent a positive correlation which denotes the efficient feature selection. Thus, the proposed method shows effective

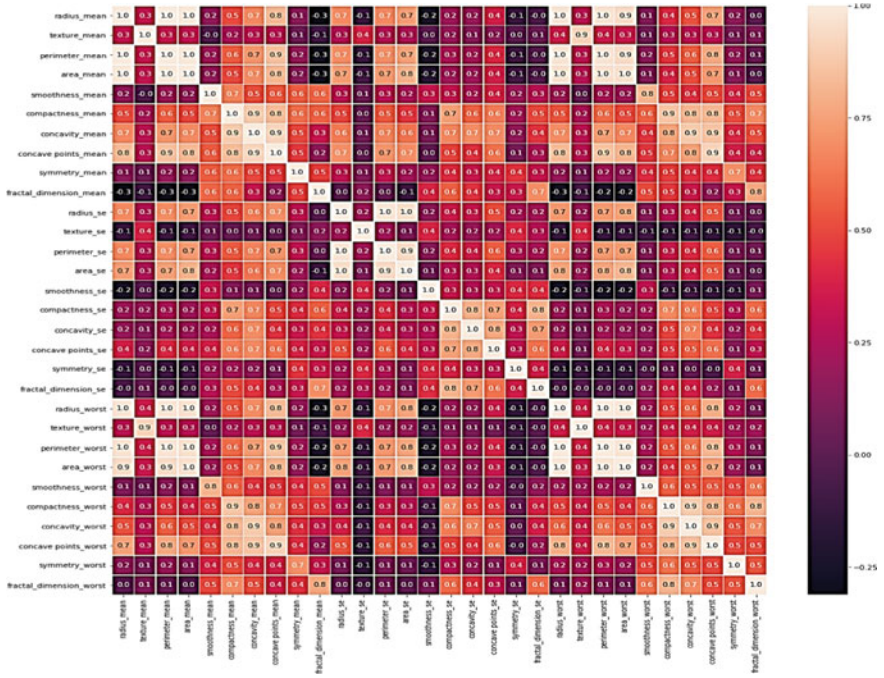

Fig. 5 Correlation map

outcomes on implementation to correctly classify and predict Breast Cancer with minimum misinterpretation.

4.4 Performance Analysis

As mentioned earlier, the future system is analysed by comparing it with the available methods with respect to the accuracy, precision, sensitivity, specificity, F1-score and execution time. This helps to find the extent to which the proposed methodologies are better than the existing techniques. In this study, the existing techniques that are considered for comparison include Naïve Bayes (NB), Multi-Layer Perceptron (MLP), Nearest Neighbour (NN), Decision Tree (DT), Extreme Learning Machine (ELM), Artificial Neural Network (ANN), Support Vector Machine (SVM) and K-Nearest Neighbour (KNN). The results obtained through the performance analysis are briefly discussed here.

The results obtained by the analysis of the proposed method with the existing system with respect to precision, specificity, sensitivity and F1-Score is given in the Table 1.

Table 1 Analysis of the proposed system in comparison with the existing system [27] in terms of precision, specificity sensitivity and F1-Score

Algorithm	Precision	Sensitivity	Specificity	F1-Score
Naïve Bayes	0.919	0.899	0.967	0.908
Decision Tree	0.925	0.925	0.97	0.925
Nearest Neighbour	0.949	0.952	0.975	0.949
MLP	0.967	0.968	0.975	0.67
Proposed	0.99	0.98	0.99	0.98

From Table 1, it is clear that the proposed system shows a high percentage of precision, sensitivity, specificity and F1-Score when compared to the available systems. The precision rate of the proposed Model is found to be 0.99, the sensitivity rate is found to be 0.98, specificity is found to be 0.99 and F1-Score is found to be 0.98. The existing methods also show better outcomes. However, the proposed system outperforms these existing methods for the mentioned metrics. It is graphically shown in Fig. 6.

The above Fig. 6 clearly shows the increase in the rate of precision, sensitivity, specificity and F1-Score in comparison to the existing methods (NB, DT, NN and MLP). Thus, these results reveal the efficiency of the proposed system than the existing systems.

In addition, the accuracy of the proposed methods is analysed by comparing it with the existing methods. It is shown in the below Table 2.

From Table 2, it is clear that the proposed methods shows maximum accuracy than the existing NB, DT, NN and MLP. The accuracy rate of the proposed model

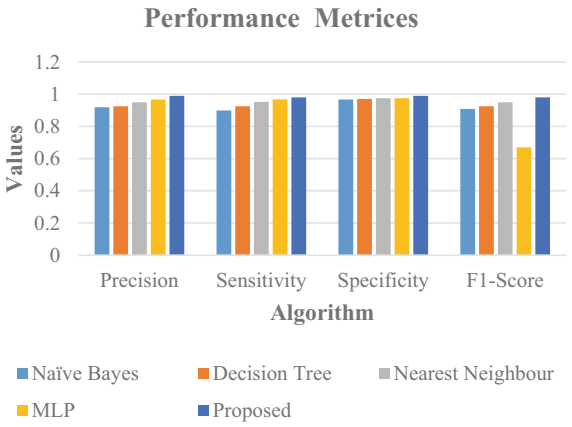

Fig. 6 Analysis of the proposed system in comparison with the existing system [27] with respect to precision, specificity, sensitivity and F1-score

Table 2 Analysis of the proposed methods in comparison with the existing methods [27] in terms of accuracy

Algorithm	Accuracy (%)
Naïve Bayes	87
Decision Tree	89
Nearest Neighbour	89.5
MLP	95
Proposed	98.06

is found to be 98.06 percent. Thus, this result indicates that the use of the proposed system enhances system accuracy. It is graphically shown in Fig. 7.

From Fig. 7, it is clear that the proposed system shows high accuracy than the existing methods, which explores the outstanding result of the proposed methods in terms of accuracy.

Additionally, various other existing algorithms such as ANN, ELM, KNN and SVM are compared with the proposed system and the obtained results are shown in Table 3.

From Table 3, it is prove that the proposed system shows high accuracy than the existing methods. The accuracy rate is found to be 98.06 percent. This reveals that the proposed system shows high accuracy when compared to the existing ANN, ELM, KNN and SVM. It is graphically shown in Fig. 8.

From Fig. 8, it is clear that the proposed system shows high accuracy than the existing ANN, ELM, KNN and SVM. In addition, the proposed system is compared with the existing ANN, ELM, KNN and SVM in terms of execution time. It is available in Table 4.

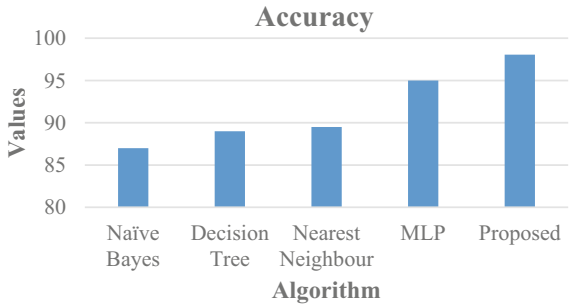

Fig. 7 Analysis of the proposed system in comparison with the existing system [27] with respect to the accuracy

Table 3 Analysis of the proposed system in comparison with the existing system [28] in terms of accuracy

Algorithm	ANN	ELM	KNN	SVM	Proposed
Accuracy (%)	79.034	80	77.5	73.5	98.06

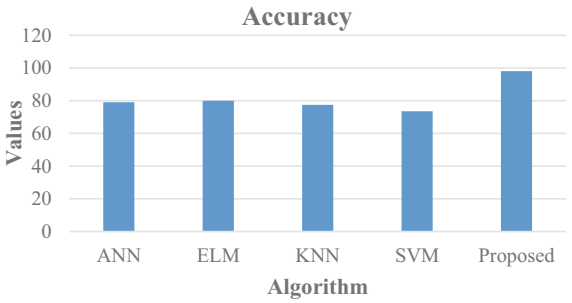

Fig. 8 Analysis of the proposed system in comparison with the existing system [28] with respect to the accuracy

Table 4 Analysis of the proposed system in comparison with the existing system [28] in terms of execution time

Algorithm	ANN	ELM	KNN	SVM	Proposed
Execution time (s)	0.4282	0.075	0.15781	0.1866	0.0025

From Table 4, it is found that the proposed system takes minimum time for execution at a rate of 0.0025 s in comparison to the existing methods (ELM, ANN, KNN and SVM). It is graphically shown in Fig. 9.

From Fig. 9, it is clear that the proposed system takes a minimum Execution Time than the existing ANN, ELM, KNN and SVM. This reveals the efficiency of the proposed system in terms of Execution Time.

Thus the analytical results enhance that the proposed system is efficient than the existing NB, DT, NN, MLP, ANN, ELM, KNN and SVM in terms of precision, accuracy, specificity, sensitivity, Execution Time and F1-Score.

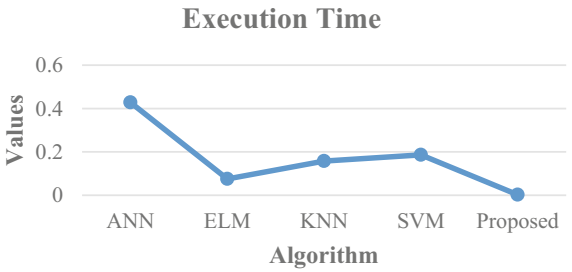

Fig. 9 Analysis of the proposed system in comparison with the existing system [28] with respect to execution time

5 Conclusion

In this study, Breast Cancer prediction has been performed on the basis of ML techniques. This prediction has been accomplished by a series of steps that include pre-processing, Feature Selection and classification. This study provided novelty in the feature selection and classification process. Feature selection has been performed through the proposed Greedy Optimization (GO) technique. Followed by this, classification has been performed using the introduced Enlarge C4.5 Algorithm. The proposed system has been analysed by a correlation map, confusion matrix, histogram and malignant and benign count. This exhibited efficient breast cancer classification that is proved through the experimental results. The proposed system has also been analysed to evaluate its efficiency through a comparison with the existing systems. Various performance metrics (precision, accuracy, specificity, sensitivity, Execution Time and F1-Score) have been taken for this analysis. The analytical results revealed that the proposed system increased the precision, accuracy, specificity, sensitivity and F1-Score, thereby minimizing the Execution Time in comparison to other existing models (considered in this study). Hence, the proposed system is more efficient than the existing system that is confirmed through the analytical results. This study will assist the medical practitioners to make correct decisions and provide treatments accordingly. Consequently, this study helps to minimize misdiagnosis of humans that might happen due to fatigue.

References

1. Akram M, Iqbal M, Daniyal M, Khan AU (2017) Awareness and current knowledge of breast cancer. Biol Res 50:1–23
2. Amrane M, Oukid S, Gagaoua I, Ensari T (2018) Breast cancer classification using machine learning. In: 2018 Electric electronics, computer science, biomedical engineering's meeting (EBBT), pp 1–4
3. Ganggayah MD, Taib NA, Har YC, Lio P, Dhillon SK (2019) Predicting factors for survival of breast cancer patients using machine learning techniques. BMC Med Inform Decis Mak 19:1–17
4. Alghunaim S, Al-Baity HH (2019) On the scalability of machine-learning algorithms for breast cancer prediction in big data context. IEEE Access 7:91535–91546
5. Turgut S, Dağtekin M, Ensari T (2018) Microarray breast cancer data classification using machine learning methods. In: 2018 Electric electronics, computer science, biomedical engineering's meeting (EBBT), pp 1–3
6. Remeseiro B, Bolon-Canedo V (2019) A review of feature selection methods in medical applications. Comput Biol Med 112:103375
7. Manikandan G, Abirami S (2021) Feature selection is important: state-of-the-art methods and application domains of feature selection on high-dimensional data. In: Applications in ubiquitous computing. Springer, pp 177–196
8. Sakri SB, Rashid NBA, Zain ZM (2018) Particle swarm optimization feature selection for breast cancer recurrence prediction. IEEE Access 6:29637–29647
9. Jain I, Jain VK, Jain R (2018) Correlation feature selection based improved-binary particle swarm optimization for gene selection and cancer classification. Appl Soft Comput 62:203–215

10. Singh BK (2019) Determining relevant biomarkers for prediction of breast cancer using anthropometric and clinical features: a comparative investigation in machine learning paradigm. Biocybern Biomed Eng 39:393–409
11. Cain EH, Saha A, Harowicz MR, Marks JR, Marcom PK, Mazurowski MA (2019) Multivariate machine learning models for prediction of pathologic response to neoadjuvant therapy in breast cancer using MRI features: a study using an independent validation set. Breast Cancer Res Treat 173:455–463
12. Aličković E, Subasi A (2017) Breast cancer diagnosis using GA feature selection and rotation forest. Neural Comput Appl 28:753–763
13. Sayed S, Nassef M, Badr A, Farag I (2019) A nested genetic algorithm for feature selection in high-dimensional cancer microarray datasets. Expert Syst Appl 121:233–243
14. Sharma A, Hooda N, Gupta NR (2021) Breast cancer recurrence prediction in biopsy using machine learning framework. In: Advances in communication and computational technology. Springer, pp 347–357
15. Moturi S, Rao ST, Vemuru S (2019) Optimized feature extraction and hybrid classification model for heart disease and breast cancer prediction. Int J Recent Technol Eng 7:1754–1772
16. Liu N, Qi E-S, Xu M, Gao B, Liu G-Q (2019) A novel intelligent classification model for breast cancer diagnosis. Inf Process Manage 56:609–623
17. Mohebian MR, Marateb HR, Mansourian M, Mañanas MA, Mokarian F (2017) A hybrid computer-aided-diagnosis system for prediction of breast cancer recurrence (HPBCR) using optimized ensemble learning. Comput Struct Biotechnol J 15:75–85
18. Zhao D, Liu H, Zheng Y, He Y, Lu D, Lyu C (2019) A reliable method for colorectal cancer prediction based on feature selection and support vector machine. Med Biol Eng Compu 57:901–912
19. Abdar M, Zomorodi-Moghadam M, Zhou X, Gururajan R, Tao X, Barua PD et al (2020) A new nested ensemble technique for automated diagnosis of breast cancer. Pattern Recogn Lett 132:123–131
20. Sun D, Wang M, Li A (2018) A multimodal deep neural network for human breast cancer prognosis prediction by integrating multi-dimensional data. IEEE/ACM Trans Comput Biol Bioinf 16:841–850
21. Abdar M, Makarenkov V (2019) CWV-BANN-SVM ensemble learning classifier for an accurate diagnosis of breast cancer. Measurement 146:557–570
22. Nilashi M, Ibrahim O, Ahmadi H, Shahmoradi L (2017) A knowledge-based system for breast cancer classification using fuzzy logic method. Telematics Inform 34:133–144
23. Tapak L, Shirmohammadi-Khorram N, Amini P, Alafchi B, Hamidi O, Poorolajal J (2019) Prediction of survival and metastasis in breast cancer patients using machine learning classifiers. Clin Epidemiol Glob Health 7:293–299
24. Kang C, Huo Y, Xin L, Tian B, Yu B (2019) Feature selection and tumor classification for microarray data using relaxed Lasso and generalized multi-class support vector machine. J Theor Biol 463:77–91
25. Ragab DA, Attallah O, Sharkas M, Ren J, Marshall S (2021) A framework for breast cancer classification using Multi-DCNNs. Comput Biol Med 131:104245
26. Wolberg WH Dr, Street WN, Mangasarian OL. University of Wisconsin, Clinical sciences center, 1210 West Dayton St., Madison "Breast Cancer Wisconsin (Diagnostic) Data Set creators". https://archive.ics.uci.edu/ml/datasets/Breast+Cancer+Wisconsin+(Diagnostic)
27. Alimardani M, Almasi M (2020) Investigating the application of particle swarm optimization algorithm in the neural network to increase the accuracy of breast cancer prediction. Int J Comp Trends Technol 68:65–72
28. Aslan MF, Celik Y, Sabanci K, Durdu A (2018) Breast cancer diagnosis by different machine learning methods using blood analysis data. Int J Intell Syst Appl Eng 6:289–293

Meta-Analysis of Nature Inspired Hybrid Cuckoo Algorithm

Shruti Aggarwal and Vijay Kumar Sinha

Abstract Diving deep into nature makes us understand it better. Nature inspires researchers world-wide to design technology based upon natural phenomenon. There are various birds such as migrating birds, cranes, and cuckoo which are used as inspiration to design algorithms. In this paper, the nature-inspired Cuckoo Algorithm, which is based on brood parasitism reproductive strategy, is discussed in detail. The Cuckoo Algorithm has various hybrids which are used in numerous applications; all these hybrids are reviewed and discussed in this paper. Meta-analysis is conducted using WoS and Scopus databases to study its variants and application domains, analyze the research trend for these hybrid algorithms and predict the future for these nature-inspired algorithms. Numerous experiments based upon correlation of related terms, year-wise analysis, article growth, etc. are conducted and described in this paper.

Keywords Cuckoo algorithm · Hybrid nature-inspired algorithms · Ecology based · Optimization

1 Introduction

Reproduction is the essence of evolution and is a herculean task for humans and animal species alike. But Cuculidae commonly called Cuckoo is one such bird, which lays its eggs in other birds' nest and throws away their eggs to avoid the hatching task. This task makes Cuculidae an obligate brood parasite [1]. Based upon this phenomenon, Nature Inspired Cuckoo Algorithm (NICA) [2] is designed which is used for optimization and application in various domains. Cuckoo is a part of nature inspired algorithms family. The nature-inspired techniques [3] are categorized

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into evolutionary [4], ecology-based and population-based Algorithms [5]. Various hybrids of Cuculidae are discussed and analyzed in this work. Meta-analysis of research trends is also conducted to predict future research trends in this domain.

2 Hybrid NICA

NICA uses Levy Flight principle as given by French mathematician [6]. It has been used and implemented in various domains and especially for optimization [2]. There are various hybrids of NICA. CuckooK [7] is one such hybrid nature inspire algorithms that is based on the k-means clustering technique. Various hybrids of k-means clustering are also used to optimize NICA [8]. CuckooK++ [9] is a hybrid nature-inspired algorithm using k-means++ and NICA. Then there is Improved Discrete Cuckoo Algorithm [10] which is used for scheduling problems. Reducing unit production cost is one such application where cos of production is optimized using NICA [11]. NICA is also used for software fault prediction [12]. Hybrid NICA has application in software fault prediction and optimization of various clustering techniques [13]. Global optimization is effectively achieved using hybrid Cuckoo Search Algorithm [14]. Cuckoo search, cuckoo optimization and various hybrids of NICA are used in various domains to solve real-world problems.

3 Application Areas of NICA

NICA is used for optimization. It is also used for hybrid power management using fuzzy controllers [15]. The application domain ranges from software cost estimation [16] to gene selection for [17] minimum redundancy and maximum relevance. As is evident from Fig. 1, NICA is widely used for parameter estimation, bioluminescence, machine learning, energy utilization, artificial intelligence and integral programming. It also has some application in image segmentation, scheduling, network security, feature selection and support vector machines.

Hybrid accelerated Cuckoo Particle Swarm Optimization is used for training neural networks [18]. Twitter sentiment analysis [19] can also be done using this meta-heuristic technique. Studying weather conditions, crop planning is also done using hybrid NICA [20]. All these hybrid variants have varied applications and can be implemented for domains varying from medicine to technology optimization.

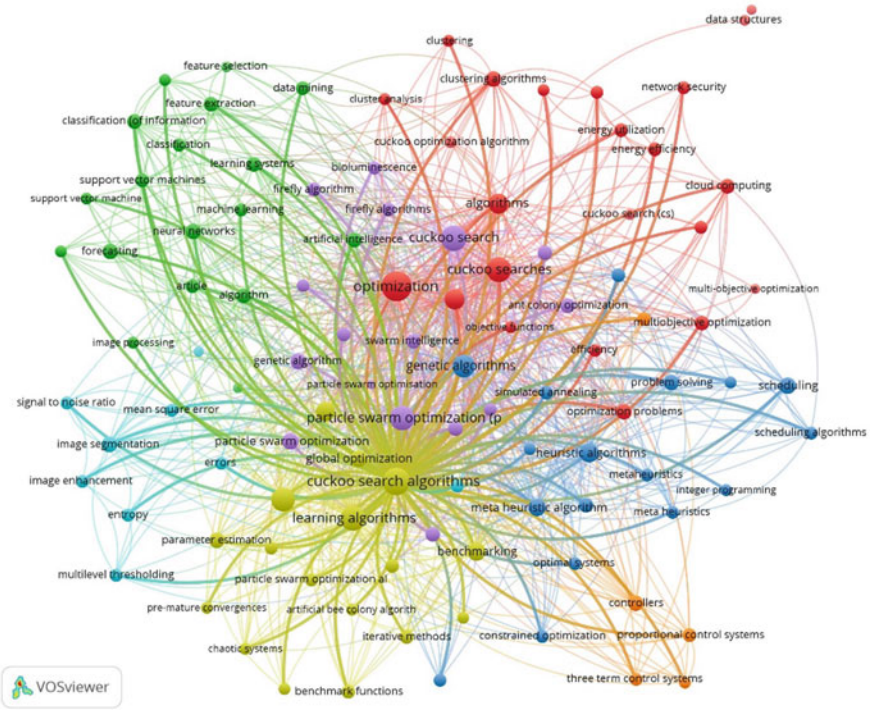

Fig. 1 Applications of NICA

4 Global Research Pattern for NICA

NICA is globally implemented by researchers. Table 1 describes in detail the countries, the number of research documents related to NICA in these countries, and their relative link strength along with citations. This data is extracted from the Scopus database, which shows India, China, and Iran are the top three countries respectively, where research on NICA is highest and the total link strength is as high as 367 which gives a clear picture of how the related research is co-related. South Africa, Brazil, France are among the few countries where lesser researchers have worked in the domain of Nature Inspired Algorithm using Cuckoo optimization or searching algorithms.

NICA can be used to solve various fuzzy [21] and hybrid numerical problems. Popular Taguchi technique is also used to hybrid Cuckoo Algorithm. Researchers have worked globally in implementing various hybrids of NICA as also shown in Fig. 2.

Table 1 Link strength and global occurrence analysis

Sr. No.	Country	Documents	Citations	Total link strength
1	India	643	8325	331
2	China	377	4668	367
3	Iran	123	3920	158
4	Malaysia	74	1427	79
5	United States	68	1395	96
6	United Kingdom	62	3818	157
7	Egypt	55	780	96
8	Saudi Arabia	42	578	49
9	Viet Nam	40	591	44
10	Turkey	36	1333	38
11	Australia	31	1062	76
12	Algeria	30	645	37
13	Mexico	30	411	23
14	South Korea	29	331	15
15	Pakistan	27	240	5
16	Iraq	26	217	26
17	Spain	26	213	9
18	Taiwan	21	432	29
19	Canada	20	314	6
20	Thailand	18	68	7
21	Italy	17	162	5
22	Jordan	15	209	42
23	Morocco	14	383	43
24	Germany	13	242	8
25	Nigeria	13	66	15
26	Romania	12	155	0
27	Japan	11	50	4
28	South Africa	11	92	1
29	Brazil	10	152	1
30	France	10	86	9

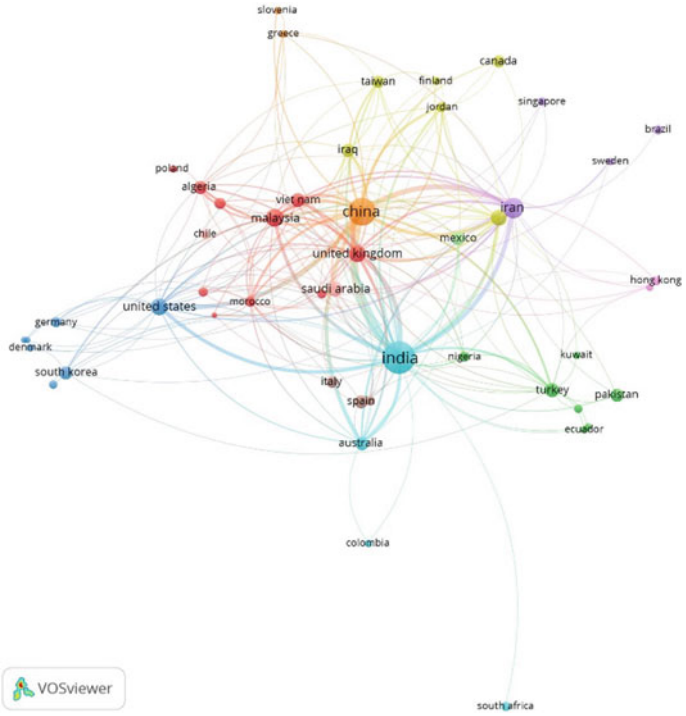

Fig. 2 Global research pattern for NICA

5 Research Trend in Web of Science Database for Cuckoo Nature Inspired Technique

Though major researchers are from India and China, a lot of research potential lies in countries like Malaysia, Algeria, and Iran with high link strength.

The experiment was conducted on the Web of Sciences database for NICAs. Figure 3 describes in detail, that Cuckoo related work started majorly in 2003.Uptill a decade there was were slow increase in this type of research but post 2011–12, there was sharp rise in research in this domain. Exponential increase in research trends can be seen in NICA related research since 2013. Various researchers collaborated and nature-inspired techniques became the epicenter for research based on optimization. As per the trend analysis, there is very high potential of research in this domain, as is shown by the cumulative rising pattern of research for hybrid NICAs.

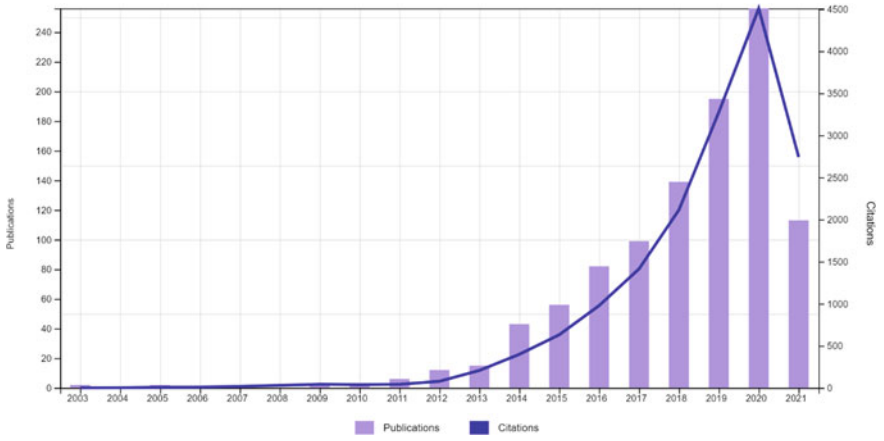

Fig. 3 Research trends of publications. *Source* Web of Science

6 Prominent Researchers for NICA

Xin-She Yang has done a lot of research for NICA and its variants [22]. Iztok Fister has also worked with Xin She Yang on its hybrid variants [23]. Gandomi has also designed various hybrid Cuckoo Algorithms like Chaotic Cuckoo [24], Cuckoo

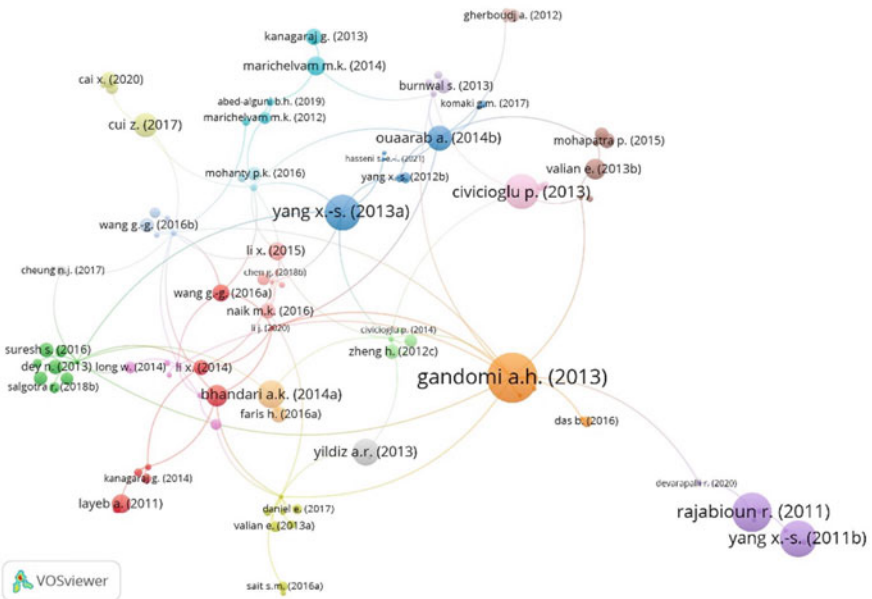

Fig. 4 Author wise research analysis

search optimization [25] etc. Though there is world-wide research going on, still maximum research is done in the Indian, Chinese and Iranian fraternity (Fig. 4).

7 Source-Wise Analysis of Cuckoo Related Articles

Applied soft computing journals, IEEE Access, neural computing, and expert systems with applications and IEEE Access are popular sources of research publications for NICA and its hybrids in various domains as shown in Fig. 5. As there are varied applications of NICA, some research papers can also be seen in journals like Journal of Intelligent Systems, Applied Sciences Journal, Indonesian Journal, etc.

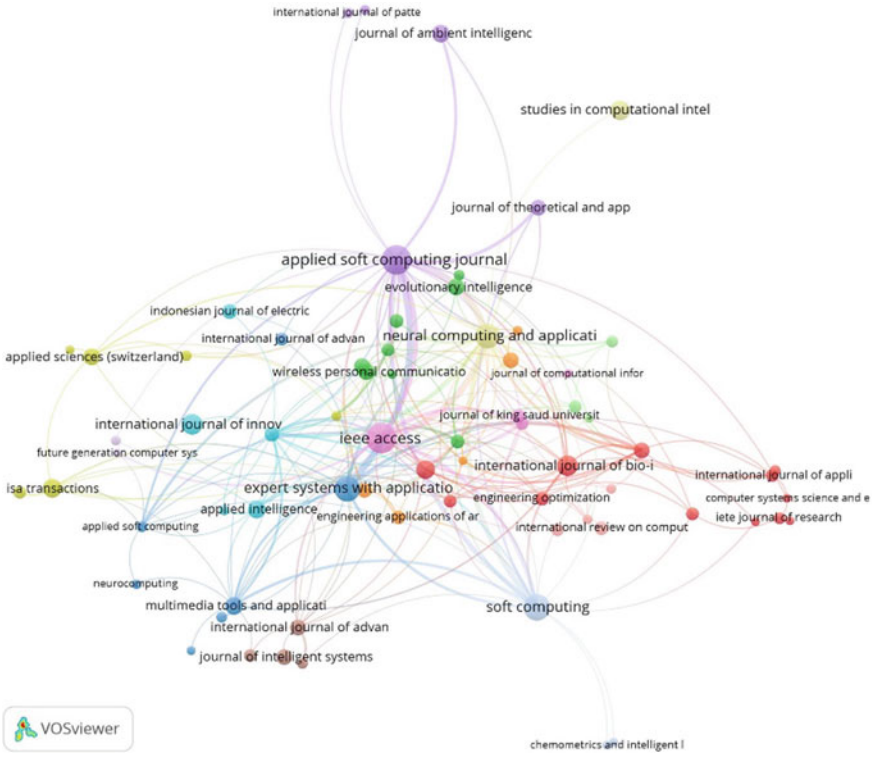

Fig. 5 Source-wise analysis of cuckoo related articles

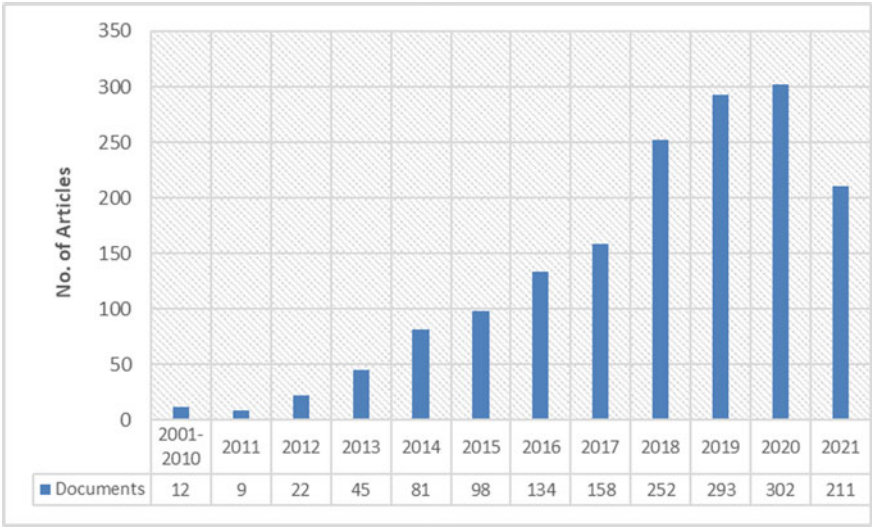

Fig. 6 Year-wise analysis of publication data

8 Analysis of Year-Wise Growth in Publication Data

Experiment is conducted taking data for analysis from the Scopus database for the computer science field. From 2001 up till 2010, the research using Cuculidae just started to emerge. Post 2012, there was sharp rise in NICA related research and various domains were explored to solve real-time problems using Cuckoo optimization and search techniques. Looking at the last five-year trend, it can be conveniently predicted that there would be exponential growth in coming time where various hybrids of Cuckoo Algorithm would be used in conjunction with other techniques in varied domains (Fig. 6).

9 Conclusion

Cuckoo is a nature inspired technique which is widely used for optimization and has wide application. In this work, various hybrids of Cuckoo Algorithm such as Chaotic Cuckoo, CuckooK++ and other hybrids are discussed in detail. Experiments are conducted to analyze the global research trends for Cuckoo related research. Year-wise data is recorded and analyzed for articles published, source-related, region-oriented, and cumulative increasing research trends along with application domains are discussed in detail in this paper.

References

1. Koleček J, Procházka P, Brlík V, Honza M (2020) Cross-continental test of natal philopatry and habitat-imprinting hypotheses to explain host specificity in an obligate brood parasite. Sci Nat 107(2):1–8. https://doi.org/10.1007/S00114-020-1667-0
2. Rajabioun R (2011) Cuckoo optimization algorithm. Appl Soft Comput 11(8):5508–5518. https://doi.org/10.1016/J.ASOC.2011.05.008
3. Chakraborty A, Kar AK (2017) Swarm intelligence: a review of algorithms. In: Nature-inspired computing and optimization. Springer, Cham, pp 475–494
4. Siddique N, Adeli H (2015) Nature inspired computing: an overview and some future directions inspiration from the nature. Cognit Comput 7(6):706–714. https://doi.org/10.1007/s12559-015-9370-8
5. Bedboudi A, Bouras C, Kimour MT (2017) An heterogeneous population-based genetic algorithm for data clustering. 5(3). https://doi.org/10.11591/ijeei.v5i3.299
6. Yang XS, Deb S (2009) Cuckoo search via Levy flights. In: 2009 World congress on nature and biologically inspired computing, NABIC 2009—Proceedings, pp 210–214. https://doi.org/10.1109/NABIC.2009.5393690
7. Rafe V (2014) Presenting a method for clustering using cuckoo optimization algorithm, vol 22, pp 30–42
8. Abdel-Basset M, Hessin A-N, Abdel-Fatah L (2018) A comprehensive study of cuckoo-inspired algorithms. Neural Comput Appl 29(2):345–361. https://doi.org/10.1007/s00521-016-2464-8
9. Aggarwal S, Singh P (2018) Cuckoo, bat and krill herd based k-means++ clustering algorithms. Cluster Comput 4. https://doi.org/10.1007/s10586-018-2262-4
10. Komaki GM, Teymourian E, Kayvanfar V, Booyavi Z (2017) Improved discrete cuckoo optimization algorithm for the three-stage assembly flowshop scheduling problem. Comput Ind Eng 105:158–173. https://doi.org/10.1016/J.CIE.2017.01.006
11. Mellal MA, Williams EJ (2014) Cuckoo optimization algorithm for unit production cost in multi-pass turning operations. Int J Adv Manuf Technol 76(1–4). https://doi.org/10.1007/s00170-014-6309-2
12. Singh P, Aggarwal S (2021) Software fault prediction using hybrid swarm intelligent cuckoo and bat based k-means++ clustering technique. Int J Adv Intell Paradig 20(1/2):1. https://doi.org/10.1504/IJAIP.2021.10016288
13. Kaur N, Aggarwal S (2017) Designing a new hybrid k-means optimization algorithm. Int J Adv Res Comput Sci 8(5):1567–1573. [Online]. Available: http://www.ijarcs.info/index.php/Ijarcs/article/viewFile/3875/3576
14. Long W, Liang X, Huang Y, Chen Y (2014) An effective hybrid cuckoo search algorithm for constrained global optimization. Neural Comput Appl 25(3):911–926. https://doi.org/10.1007/S00521-014-1577-1
15. Berrazouane S, Mohammedi K (2014) Parameter optimization via cuckoo optimization algorithm of fuzzy controller for energy management of a hybrid power system. Energy Convers Manag 78:652–660. https://doi.org/10.1016/J.ENCONMAN.2013.11.018
16. Puspaningrum A, Sarno R (2017) A hybrid cuckoo optimization and harmony search algorithm for software cost estimation. Procedia Comput Sci 124:461–469. https://doi.org/10.1016/J.PROCS.2017.12.178
17. Elyasigomari V, Lee DA, Screen HRC, Shaheed MH (2017) Development of a two-stage gene selection method that incorporates a novel hybrid approach using the cuckoo optimization algorithm and harmony search for cancer classification. J Biomed Inform 67:11–20. https://doi.org/10.1016/J.JBI.2017.01.016
18. Nawi NM, Khan A, Rehman MZ, Aziz MA, Herawan T, Abawajy JH (2014) Neural network training by hybrid accelerated cuckoo particle swarm optimization algorithm. Lect. Notes Comput. Sci. (including Subser. Lect. Notes Artif. Intell. Lect. Notes Bioinformatics), vol 8835, pp 237–244. https://doi.org/10.1007/978-3-319-12640-1_29

19. Chandra Pandey A, Singh Rajpoot D, Saraswat M (2017) Twitter sentiment analysis using hybrid cuckoo search method. Inf Process Manag 53(4):764–779. https://doi.org/10.1016/J.IPM.2017.02.004
20. Mohammadrezapour O, Yoosefdoost I, Ebrahimi M (2017) Cuckoo optimization algorithm in optimal water allocation and crop planning under various weather conditions (case study: Qazvin plain, Iran). Neural Comput Appl 31(6):1879–1892. https://doi.org/10.1007/S00521-017-3160-Z
21. Dang MP, Le HG, Le Chau N, Dao TP (2021) Optimization for a flexure hinge using an effective hybrid approach of fuzzy logic and moth-flame optimization algorithm. Math Probl Eng 2021. https://doi.org/10.1155/2021/6622655
22. Yang X-S, Deb S (2013) Cuckoo search: recent advances and applications. Neural Comput Appl 24(1):169–174. https://doi.org/10.1007/S00521-013-1367-1
23. Fister I, Yang X-S, Fister D, Fister I (2014) Cuckoo search: a brief literature review. Stud Comput Intell 516:49–62. https://doi.org/10.1007/978-3-319-02141-6_3
24. Wang G-G, Deb S, Gandomi AH, Zhang Z, Alavi AH (2015) Chaotic cuckoo search. Soft Comput 20(9):3349–3362. https://doi.org/10.1007/S00500-015-1726-1
25. Gandomi AH, Yang X-S, Alavi AH (2011) Cuckoo search algorithm: a metaheuristic approach to solve structural optimization problems. Eng Comput 29(1):17–35. https://doi.org/10.1007/S00366-011-0241-Y

Investigating Factors Influencing Retention in MOOCs

Harsh Vardhan Pant and Manoj Chandra Lohani

Abstract In recent years, growth of the Massive Open online courses has gained immense renown with the emergence of diverse MOOC providers. But with their popularity, the issue of MOOCs' acceptability and persistence has gotten a lot of attention in over the last few years. It will be vital to investigate the prior research to decipher the factors of the learner's retention, so that the ideal learning model can be, create. Based on direct and indirect MOOC service experiences, this study presented a measurement structure for the Learner Satisfaction Index (LSI) model. The current study used classification algorithm and Structural Equation Modeling to find out the hidden learner retention factors in MOOC and validate the proposed model (LSI) respectively. The study proved that Classification results show consistence with LSI model and majority influence factors correlative with the LSI. For this study, the MOOCs dataset was gathered from various Indian universities in the state of Uttarakhand.

Keywords Classification · Data mining · MOOC · Model · Factors · PLS · Retention

1 Introduction

The educational paradigm has enhanced in the twenty-first century due to the result of widespread use of information and communication technologies. With advancement of ICT, open learning has moved from the periphery of standard education to the foreground. The quality and the way of delivering the academic content has also changed and improved. The open education system has taken several shapes over. The concept of Massive Open Online Courses (MOOCs), which is drawing academic and business interest, has become popular during COVID-19, continuing the open learning trend. One of the trending topics during COVID pandemic is whether and how COVID-19 will change education patterns in the next few years. The MOOC's

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unique feature is its openness and large-scale sharing, making it a tool for improving the quality of education with high efficiency and proper education at an economic cost. In spite of the MOOCs' popularity and expansion, however, poor completion rates have sparked several arguments and provided a significant challenge to MOOC providers. Completion rates have been reported to be as low as 7–11% in previous studies [1].

In recent years, scholars have taken an interest in this popular learning tool. Various research studies have been undertaken to examine the causes that led to the creation of MOOCs, as well as the variables that motivate people to enrol in them. However, there are few research that addresses the actual need of MOOC learners, the factors that contributed to learner satisfaction, and retention. Besides this most of the previous studies focused on this issue based on either China or European demographic data. India Government starts their own MOOC platform (SWAYAM) on 2016, after that number of Indian universities run several courses on open learning mode using local MOOCs. Through the literature review, it was found that the trend of Indian people towards MOOC courses has increased in the last 3–4 years. Therefore, this research work attempts to find out the hidden learner retention factors in MOOC and validate the proposed model (LSI) respectively using a classification algorithm and Structural Equation Modelling. It will be also interesting to study the finding of motivational factors using Indian demographic data.

2 Literature Review

Although, MOOC has become well-known and is being widely used around the different countries, the key worry is that the learners' poor course completion rate cannot be overlooked [30]. To find the factors of the low course completion rate a detailed review of the existing literature is conducted. Based on the applied tools and techniques literature review section can be divided into the following subsections.

2.1 MOOC Retention and Completion

As per Keller and Suzuki [2] knowing the cause for low retention rate helps MOOC facilitator, formulate strategies for improvement of students' engagement and learning. However, a huge number of leaners that enrol for MOOCs, only about 7–10% of them can finish the courses [3]. According to numerous surveys, it has been observed that only about ten percentage of enrolled learners finish a MOOC course [4, 5].

2.2 Data Mining Approach in Massive Online Course

The technique of extracting useful information from a large set of data is called data mining. Researchers have effectively employed DM Tools, techniques, and algorithms to drop out prediction and retention causes in recent years. The most frequent methodologies used in previous research are Classification, Prediction, and Clustering. With a gradient boosting, decision tree model [6] achieves 89% accuracy in the dropout prediction challenge using the supervised classification strategy in the machine learning field. Gupta and Sabitha [7] uses data mining approaches to anticipate the variables that lead to the lowest attrition rate and to analyse diverse disciple behaviour and its effects on dropouts. It aims to create a more integrated learning environment for these students. Moreno-Marcos et al. [8] attempts to investigate how a variety of factors can affect student performance prediction.

2.3 Structural Equation Modelling

It is a set of statistical technique that is able used to evaluate the proposed model of learners' willingness for MOOCs [9]. The partial least square method structural equation model (PLS-SEM) is used to explore the factors of learning satisfaction in blended learning [10].

3 Hypotheses Development

Identifying the key factors that influence online learners' retention in MOOCs and to develop a learners' satisfaction model is the main objective of this research. Pant et al. [11] studied that some potential motivational factors are, goals for the MOOC, prior learning experiences, demographic information, learning behaviours, content localisation, and government support. It was found that these factors are untouched or very limited literature was found. As a result, the following specific literatures are used to support the hypothesis:

3.1 Content Localization

Liangxing [12] found that students with limited English skills consider English-language courses to be the most challenging obstacle, and they are less interested in taking them. In the context of Indian MOOC acceptability and continuation, the implications of MOOC language have never been examined. This is the first study to suggest that learners are more likely to have a favourable attitude toward MOOC

persistence if the courses are delivered in their regional language. As a result, for this study, the following hypothesis was developed:

H1 *: Content Localization will have supported a significant effect on the perceived usefulness in MOOCs*

3.2 Credit Mobility

Credit Mobility is a concept to transfer the credits of such learners enrolled in any higher education institution in India. Learner can opt for 12–16 weeks course equivalent to 3–6 credits under mentorship of faculty (MHRD MOOC's guidelines 11.1(J) issued by the MHRD [13]. However, credit mobility and credit recognition systems are still evolving, so it will be interesting to find out the impact of this factor in MOOCs. Sharma et al. [14], has supported credit mobility and seen it as an innovative next-generation pedagogy. In earlier research and literature certificate, credential was an important factor for the intention to continue in the MOOCs. Thus, it would be interesting to find out that what will be the impact of the Credit Mobility as a factor, in the intention to retention. Therefore, the following hypotheses proposed:

H2: *Credit mobility of MOOCs will have a significant positive impact on the behavioural intention to use MOOCs.*
H3: *"Credit mobility" of MOOCs will have a significant positive impact on perceived usefulness in MOOCs.*

3.3 Impact of Latest Trend Course on E-learning

Traditional degrees are being phased out in favour of new degrees that are desired by industry, and the majority of modern universities are establishing trendy and new courses. As per LinkedIn, the learners are showing high interest in the tech-related areas such as analytics, cloud computing, artificial intelligence (AI), and user experience (UX) design [15]. Therefore, the following hypotheses were proposed:

H4: *The latest trend course will have a positive impact on perceived usefulness in MOOCs.*
H5: *The latest trend course will have a significant positive effect on the behavioural intention to use MOOCs.*

3.4 Behavioural Intention

The major variable of the TAM model is behavioural intention, which is employed as a predictor of the technology used behaviourally. Khan [16] investigated the significant effects on the behavioural intention of the leaner. Learning habits may also play a

positive influence on behavioural intention to use MOOCs [17]. Therefore, this study hypothesizes that:

H6: *Behavioural intention of using MOOCs will have a significant positive effect on learners' retention on MOOCs.*

3.5 Perceived Usefulness

Daneji et al. [18] the most important factor to determining whether the learner will continue MOOC or not is a perceived usefulness. Daneji et al. [18] discovered that users' confirmation, perceived utility, and contentment are all directly associated. This means that if the learner believes that taking a MOOC is extremely beneficial to them, they will be more satisfied and likely to continue taking MOOCs. This study hypothesizes that:

H7: *The perceived usefulness will have a significant effect on learner retention in MOOCs.*

4 Research Approach

4.1 Data Preparation and Survey Design

Scales were used primarily in the development of an online questionnaire. The questionnaire was designed for the Indian learners that were studying in higher education institutions. It was prepared in both English and Hindi. A five-point Likert scale was utilised for attitude questions. Following scales were adopted from [19]: Perceived usefulness (PU, 3 items) and Behavioural Intention (BI, 5 items). Some items are new in this study like, Content Localization (CL, 6 items), Credit Mobility to promote e-Education (CM, 4 items), Latest Trend Course impact on e learning (LTC, 3 items), Social Influence (SI, 3 items), was created. Demographic data age, gender, education is also recorded. Complete scale can be seen in Appendix 'A'.

4.2 Sampling (Population and Sampling)

The survey was collected from the Uttarakhand Open University, Uttarakhand, India and the "Introduction to Cyber Security [20]" course hosted on the SWAYAM portal. This study had adopted a convenience sampling because it is easy for further pilot testing.

5 Data Analysis and Result

Out of 625 students, 390 responses were collected (response rate of 62.4%). The majority of the respondents were in their final year of study. 25 responses were either incomplete or not filled properly. So these questionnaires were removed from the analysis. The questionnaire was created in such a way that it has two segments: the first segment was related to the items that represents the demographic characteristics of the surveyed students, whereas the second segment was about the items that measures the factors of the study.

5.1 Assessment of the Measurement Model

Table 1 has demonstrated the convergent validity. Convergent validity specifies a group of indicators that come together to determine a single construct. As per Awang [21] it is significant, and its value should be above 0.5. Similarly, as per Awang [21] composite reliability (CR) of respective construct should be greater than 0.7. In addition, the average variance extracted (AVE) must be greater than 0.5 [22]. The total item factor loading, the composite reliability (CR) of each construct, and the average variance extracted (AVE) all met the specified threshold values, as shown in Table 1. This shows that the convergent validity is adequate.

Discriminant validity refers to the strength to which a construct is actually different from other constructs [23]. As stated by Fornell [22] discriminant validity is obtained when the AVE for two constructs is greater than their squared correlation (r2). The AVE value of the variables is bigger than the off diagonal squared correlations in

Table 1 Convergent validity of the selected constructs

Constructs	Items	Loading	CR (>0.7)	AVE (>0.5)
Content Localization (CL)	CL1, CL2, CL3, CL4, CL5, CL6	0.712, 0.703, 0.728, 0.846, 0.626, 0.754	0.850	0.587
Credit Mobility (CM)	CM1, CM2, CM3, CM4	0.762, 0.724, 0.762, 0.686	0.980	0.791
Social Influence (SI)	SI1, SI2, SI3	0.755, 0.743, 0.762	0.872	0.633
Latest Trend Course (LTC)	LTC_1, LTC_2, LTC_3	0.745, 0.812, 0.787	0.855	0.628
Perceived usefulness (PU)	PU1, PU2, PU3	0.723, 0.832, 0.684	0.880	0.613
Learner Retention (RET)	RET1, RET2, RET3	0.711, 0.820, 0.742	0.830	0.665
Behavioural intention (BI)	BI1, BI2, BI3, BI_4, BI5	0.692, 0.823, 0.752, 0.735, 0.824	0.895	0.725

Table 2 Discriminant validity index of variables in the proposed model

	CL	CM	LTC	SI	PU	RET	BI
CL	**0.742**						
CM	0.297	**0.654**					
LTC	0.387	0.128	**0.743**				
SI	0.416	0.492	0.685	**0.623**			
PU	0.434	0.326	0.672	0.442	**0.721**		
RET	0.3.83	0.634	0.619	0.523	0.328	**0.867**	
BI	0.643	0.357	0.521	0.231	0.273	0.535	**0.714**

the correlation analysis presented in Table 2. This indicates that the variables have sufficient discriminant validity.

5.2 Assessment of the LSI Model

The LSI structural equation model (SEM) was put to the test to see if it accurately represented the facts. The goodness-of-fit index (GFI = 0.912), the comparative fit index (CFI = 0.912), and the root mean square residual (RMSR = 0.062) were identified. These findings suggested that all of the indices matched the fit model's recommended values [24]. As a result, the research model is an excellent fit for the data in the study.

5.3 Hypotheses Result

The hypothesis testing result is given in Table 3. It is showing the relationships between seven hypothesis of constructs of the study. The results significantly support

Table 3 LSI structural model with smart PLS-SEM results

Hypothesis	Relationship	VIF	Std Beta	t-value
H1:	CL->PU	1.301	+0.247	3.362**
H2:	CM->RET	1.214	+0.223	3.323**
H3:	SI->BI	3.214	+0.036	1.632
H4:	LTC->RET	1.012	+0.169	4.210***
H5:	LTC->BI	1.033	+0.117	4.103*
H6:	PU->RET	2.965	+0.086	1.520
H7:	BI->RET	1.142	+0.118	3.242***

Note *, **, *** represent predicted values i.e. $p < 0.1$, $p < 0.01$, $p < 0.001$ respectively

all hypotheses except Hypothesis-3 and hypothesis-6. To verify the significance level, t-statistics were calculated using the bootstrapping function of SMART PLS 3.0. T statistic with a p value is used when a hypothesis test is run. Table-3 is also showing the 5 significant hypothesis relationship out of 7, based on the analysis of the path coefficient. All significant hypotheses have t-value >1.520, thus significant at 0.05 level of significance. Specifically, LTC->RET ($\beta = 0.169$, t-statistic $= 4.210$), BI->RET ($\beta = 0.118$, t-value $= 3.242$) and CM->RET ($\beta = 0.223$, t-value $= 3.323$) are significantly related with RET. Hence, H4, H5 and H7 hypotheses directly supported RET. Similarly, H1 and H2 also significant and partially supported (Table 5). The path coefficients were shown in Fig. 1.

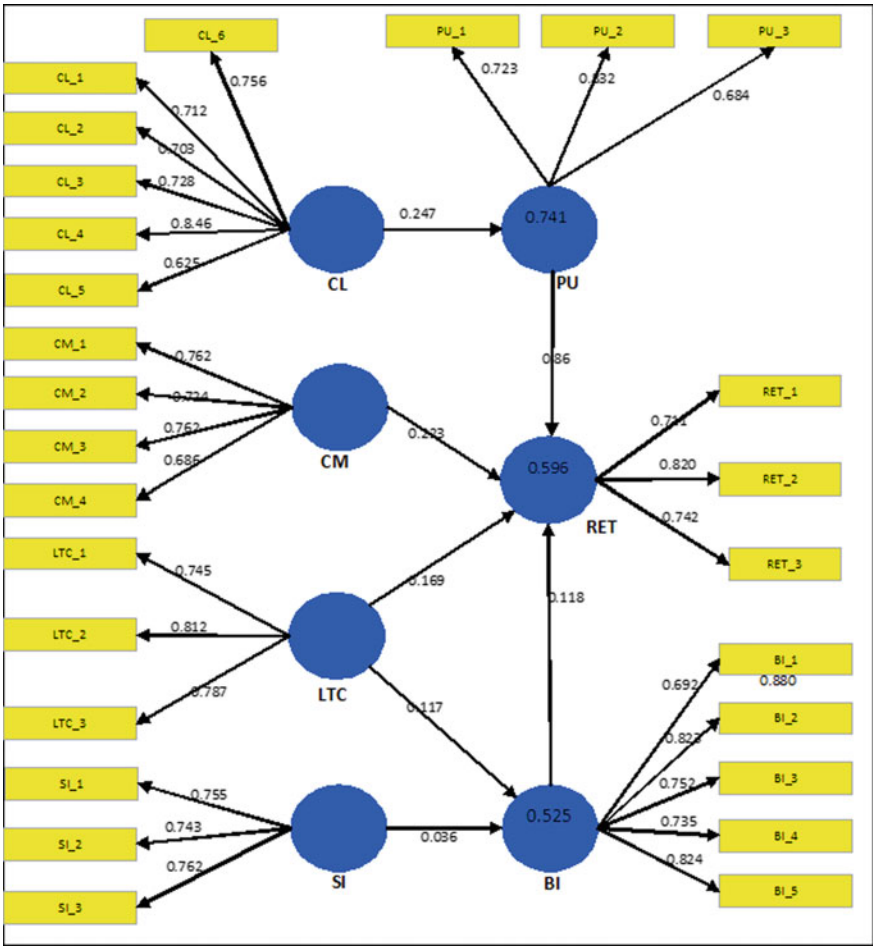

Fig. 1 Smart PLS analysis result in the complied LSI model

6 Analysis the Structure Model Using Classification Algorithms

The decision tree classifier was used to analyse the accuracy of the LSI model using the latent variable data generated by PLS-SEM in this study since decision trees are simple to understand and convert to a set of rules [25]. This study found that all classifiers have "Latest Trend Course" as root with a leaf of "Credit Mobility" and "Content Localization" on the judgement of learner retention and satisfaction. However, the correct classification rate of the classifier is only between 59.4 and 82.2% (except Random Tree 99.1%) as shown in Table 4.

In general, imbalanced or abnormal data may result in difficulty in classification [26]. In this study, we analysed different combination of datasets by classifier Tree J48 and Random Tree with tenfold cross-validation. The specificity (SP), Sensitivity (SE) and area under the ROC curve (AUC) of each data set are shown in Table 5, that represents the result of the measurement factors that affect the learner retention. According to the table result, Latest Trend Course (LTC) and supportive policy of the Indian Government i.e. Credit-Mobility are the major factor for retention and promoting the e-learning platform. Moreover, only ignoring Group A and D of the whole dataset, classification results showed that more than half classifiers take Behavioural Intention as primary factor that determine learner's retention and satisfaction, another primary factor classified by J48 is content localization and Graphical location are others important influence factors as Table 6, same as PLS-SEM assessment finding.

Table 4 Shows the results of classification for several decision trees

Classifier	TP rate	FP rate	Specificity	Sensitivity	AUC	ROOT	Leafs
J48	0.651	0.35	0.65	0.651	0.688	LTC	CL, CM
Random Tree	0.991	0.009	0.991	0.991	1	RGP	LTC, CL
Decision Stump	0.954	0.419	0.581	0.594	0.588	LTC	
ADTree	0.703	0.289	0.711	0.703	0.762	LTC	CL
BFTree	0.642	0.378	0.828	0.822	0.699	LTC	CM
SimpleCart	0.637	0.363	0.637	0.637	0.645	LTC	CM

Table 5 Performance of classification algorithms with different dataset analysis

Data set	Classifier	TP rate	FP rate	Specificity	Sensitivity	AUC
Whole sample	J48	0.556	0.52	0.48	0.566	0.495
	Random Tree	0.59	0.496	0.504	0.59	0.547
Exclude A, D	J48	0.681	0.373	0.627	0.681	0.688
	Random Tree	0.654	0.385	0.615	0.654	0.635
Group B, C	J48	0.822	0.172	0.828	0.822	0.803
	Random Tree	0.933	0.263	0.937	0.933	0.935

Table 6 Performance of classification algorithms for learners' retention analysis

Classifier	TP rate	FP rate	Specificity	Sensitivity	AUC	ROOT	Leafs
J48	0.91	0.132	0.868	0.91	0.932	LTC	CL, CM
Random Tree	1	0	1	1	1	BI	LTC, CL
Decision Stump	0.691	0.346	0.654	0.691	0.673	RGP	
ADTree	0.798	0.268	0.732	0.798	0.876	BI	GEL, CL
BFTree	0.883	0.179	0.828	0.822	0.923	BI	CM
SimpleCart	0.637	0.363	0.637	0.637	0.645	BI	CM

However, this study also compared the result of these above given classifier algorithms for result proofing. Because the results of this research were in the form of the decision tree training model; therefore, it required interpreting and generating explanation, which is human understandable and translated into meaningful sentences. The interested outcomes are as follows:

I. In the Decision Tree (Fig. 2) the Latest Trend Course (LTC) is a root node with descendant node of Credit Mobility and Content localization. This means that "latest trend courses" and Credit Mobility have high accuracy and information gain, indicating that most of the learners have chosen the course because the course was reflecting the emerging trend and supported by the Indian government policy of Credit Mobility. During pattern matching, it was also found in research that most of the learners that chose such type of course remained in the MOOC platform till the end.
II. This study has found that LTC, CM, BI factors have strong potential relationship with learners' retention in MOOCs (Table 3).

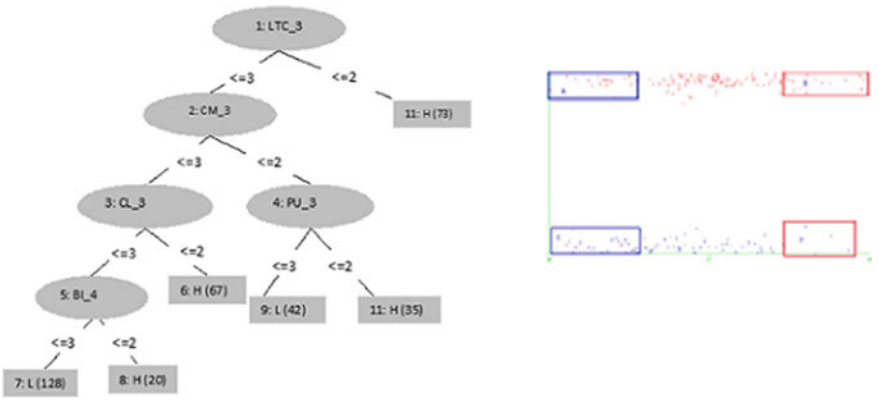

Fig. 2 Random Tree for learners' retention and satisfaction factors using group (B, C) data only and confusing-satisfaction matrix (Red as satisfied, Blue as dissatisfied) (Color figure online)

III. As Liangxing [12] studied that learners with limited English skills consider English-language courses to be the most challenging obstacle, and they are less interested in pursuing them, similarly this study also indicates that if the course is not trendy course but support content localization with government support like job motivation etc. then learners may retained in the MOOCs courses. So, this finding revealed that content localization was also found to influence learners' retention decision, in MOOC environments.
IV. During analysis of the decision tree it is observed that if the variable Latest trend course is strongly accepted, then there are 90 out of 150 objects that fall in the variable perceived effectiveness. This means the perceived effectiveness is the secondary factor that determines learner retention and satisfaction.
V. During the study of demographic details, it was found that the learners who live in a village or remote area, where the Internet connection speeds are very low, have shown a very low retention rate in the MOOCs platform.

7 Conclusion and Future Work

Although there are many research and studies in this field, but in this study the authors have focused only on those factors which are still not discovered or very less in the literature. This study sheds light on 5 possible factors that may affect on learner retention of MOOC i.e. 'Credit Mobility', 'latest trend course', 'Content localization', 'Behavioural intention' and 'Perceived usefulness' etc.

The overall explanatory power of satisfaction of the LSI model is only 54.5%, for further investigation, this study proposes a Confusing-Satisfaction Matrix to identify the relationship between the robustness of model structures and the quality of data.

The use of the PLS-SEM method of classification algorithms helped in examining the relationship between the above given various factors affecting learners' decision to retain in MOOCs. This current research is strongly suggesting that in a developing country like India, the Central or State Government can run a public awareness movement, to promote higher education through MOOC.

However, there were some unavoidable limitations on this study. The small sample size of various demographic is a constraint; more research is needed to verify if the above findings are applicable to other MOOC participants in other countries and learning contexts.

Appendix (Survey Items)

Content localization (CL) *(New variable)*	CL1	I will prefer to enroll in English language
	CL2	MOOC course can be useful to improve my study performance using the localization of content
	CL3	Translation skill is no longer the key differentiator in the various MOOC's platforms
	CL4	When I taught in their native language, I can retain information better compared to foreign language
	CL5	Language is one of the main barriers in participating in MOOCs platform
	CL6	I feel that the discussion forum feature of MOOCs can be more useful and vibrant if it could be discussed in localized language
Credit mobility (CM) *(New variable)*	CM1	Credit Mobility was very helpful for my Job promotion or course completion
	CM2	I will like credit transfer policy
	CM3	I felt credit mobility would give me competitive edge and improve their employability
	CM4	I felt, credit mobility is the way forward for future education
Social influence (SI) [27]	SI1	People who care about me think I should take MOOC courses
	SI2	During MOOC course choice, I feel social conversations influenced me
	SI3	To what extent does social media influence your behaviour's and actions?
Impact on e learning in latest trend course (LTC) *(New variable)*	LTC_1	I feel that 'Latest Trend Course' will have a significant positive effect on the perceived usefulness
	LTC_2	I have joined this course, because It is in trend and high demand in the market
	LTC_3	I have complete and retain this course due to high demand in market
Learner retention (RET) [1]	RET1	Did you complete the MOOC and receive a certificate of completion (Yes/No)? If you didn't finish, when did you drop out (the first few days, the first few weeks, middle, end/just before the end)?

(continued)

(continued)

	RET2	How many assessments did you submit (all, most, approximately half, a few, none)?
	RET3	What percentage of the MOOC content did you watch or read (all, most, approximately half, some, none)?
Perceived usefulness (PU) [28]	PU1	Using the study material of MOOCs enhances the learning performance
	PU 2	Using the MOOC platform can increase my study effectiveness
	PU3	I think the MOOC learning platform is useful to upgrade me in career
Behavioural intention (BI) [29]	BI1	Using MOOC materials in I had felt to enhance learning interest
	BI2	I increase the occurrences of using MOOC materials when I join the discussion forum in MOOCs' platform
	BI3	I intend to use MOOC courses that have use content localization
	BI4	I have committed myself to submit the assignment on due date
	BI5	I would recommend to use the e-learning platform/MOOCs platform for my friends

References

1. Hone KS, Said GR (2016) Exploring the factors affecting MOOC retention: a survey. Comput Educ 98:157–168
2. Keller J, Suzuki K (2004) Learner motivation and e-learning design: a multinationally validated process. J Educ Media:229–239
3. Chen J (2017) Motivations and challenges of using massive open online courses by students and instructors. Int J Educ Teach Anal
4. Breslow LP (2013) Studying learning in the worldwide classroom research into edX's first MOOC. Res Pract Assess 8:13–25
5. Jordan K (2014) Initial trends in enrolment and completion of massive open online courses. Int Rev Res Open Distrib Learn 15(1)
6. Liang J, Li C (2016) Machine learning application in MOOCs: dropout prediction. In: 2016 11th International conference on computer science & education (ICCSE), pp 52–57
7. Gupta S, Sabitha AS (2019) Deciphering the attributes of student retention in massive open online courses using data mining techniques. Educ Inf Technol 24:1973–1994
8. Moreno-Marcos PM et al (2020) Analysis of the factors influencing learners' performance prediction with learning analytics. IEEE Access 8:5264–5282
9. Al-Adwan AS (2020) Exploring student readiness to MOOCs in Jordan: a structural equation modelling approach. J Inf Technol Educ: Res 19:223–242

10. Huang C-H (2021) Using PLS-SEM model to explore the influencing factors of learning satisfaction in blended learning. Educ Sci 11(249)
11. Pant HV, Lohani MC, Pande J (2019) Descriptive analytics of MOOCs with ICT in respect of developed countries and Indian context. Int J Inf Commun Technol Hum Dev
12. Liangxing L (2017) An empirical analysis of Chinese college learners' obstacles to MOOC learning in an English context. English Lang Teach:136–150
13. MHRD (2020) National education policy 2020. Government of India
14. Sharma A, Ananthan PS, Sharma R (2019) Innovative gen next pedagogy: education model for the modern world of artificial intelligence and beyond. University News, Asso Indian Univ 57(50):28–32
15. Coursera (2019) 2019's most popular courses. Retrieved 09–02–2021, 2021, from https://www.coursera.org: https://www.coursera.org/collections/popular-courses-2019
16. Khan IU (2018) Predicting the acceptance of MOOCs in a developing country: application of task-technology fit model, social motivation, and self determination theory. Telematics Inform 35(4):964–978
17. Venkatesh VT (2012) Consumer acceptance and use of information technology Extending the unified theory of acceptance and use of technology. MIS Q 36(1):157–178
18. Daneji AA, Ayub AF, Khambari MN (2019) The effects of perceived usefulness, confirmation and satisfaction on continuance intention in using massive open online course (MOOC). Knowl Manage E-Learn 11(2):201–214
19. Peltier JD (2003) Virtual communities and the assessment of online marketing education. J Mark Educ 25(3):260–276
20. Jeetendra P (2020) Introduction to cyber security. Retrieved 21 Sept 2021, from https://onlinecourses.swayam2.ac.in/nou20_cs01/preview
21. Awang Z (2015) SEM made simple: a gentle approach to learning structural equation modeling. MPWS Rich Publication
22. Fornell C (1981) Evaluating structural equation models with unobservable variables and measurement error. J Mark Res 18(1):39–50
23. Hair J, Black W, Babin B, Anderson R (2010) Multivariate data analysis: a global perspective, 7th ed. Pearson Education
24. Gefen DS (2000) Structural equation modeling and regression: guidelines for research practice. Commun Asso Inf Syst 4(1)
25. Zhao Y, Zhang Y (2008) Comparison of decision tree methods for finding active objects. In: Advances in space research, pp 1955–1959
26. Garson GD (2016) Partial least squares: regression and structural equation models. Statistical Associates Publishers, Asheboro, NC, North Carolina
27. Mohan MU (2020) Intention and barriers to use MOOCs: an investigation among the post graduate students in India. Educ Inf Technol 25:5017–5031
28. Roca JC, Chiu CM et al. (2006) Understanding e-learning continuance intention: an extension of the technology acceptance model. Int J Human-Comp Stud 64(6):683–696
29. Weng F, Yang R-J, Ho H-J, Su H-M (2018) A TAM-based study of the attitude towards use intention of multimedia among school teachers. Appl Syst Innov 1(3):1–36
30. Ouyang Y, Tang C, Rong W, Zhang L, Yin C, Xiong Z (2017) Task-technology fit aware expectation-confirmation model towards understanding of MOOCs continued usage. In: Proceeding of the 50th Hawaii international conference on system sciences, pp 174–183

Green Energy Powered by Smart Grids: A Business Model for Long Term Sustainability

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Abstract In a small community, a microgrid is a generation source used for scaling down the centralized power system. It generates, distributes and controls the power in the community. It is flexible, reliable as well as can provide uninterrupted power for balancing the load demands of customers having changing power needs. The smart Microgrids connected with the utility grid support the electricity needs of the powering industries. They are very much dependent on modern, integrated, Information and Communication technologies (cloud, fog computing and IoT sensors, etc.). Though Cloud computing provides services at a low cost, the problems are response time, processing time and the management of resources. Fog computing develops as a complement to Cloud computing, providing services and addressing challenges such as latency, security and traffic. Owing to the increasing number of users to the fog servers the energy consumption increases. This paper proposes the VM allocation using the Jaya algorithm in the fog nodes to minimize the energy consumption.

Keywords Green energy · Microgrid · Fog computing · Jaya algorithm · VM placement

1 Introduction

Currently, the 'Energy for All' campaign is functioning with the leaders in government specially with a goal to facilitate progress and development in the rural areas. Since there is additional carbon emission owing to the recent development of the data centres, all IT giants are looking forward to accomplish 100% usage of green energy to run their data centres. Decarbonization is the global concern for the government and as well the IT giants. Basing on the current scenario, there is a need of microgrid

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based facilities—a local energy grid having controlling capabilities, which may be disconnected from the traditional grid and made to operate autonomously [1]. During emergencies a microgrid provides backup to the grid and also aids in cost-cutting; it also connects to a local resource which is too small or unreliable for traditional grid uses. A Microgrid authorizes communities to be energy independent as well as environmental friendly. However the renewable energy generating sources hinder the government, the IT industries and the other stake holders too. Consequently, Smart microgrid (the alternative) is connected with the utility grid for supporting powering industries in order to avoid the future power shortages. Smart Grids (SG) are beneficial in assisting electric power companies in measuring and managing customer power usage. Smart metres provide bidirectional data exchange in real time. When energy consumption hits a peak, SG balances the situation by sending messages to consumers. To meet high demand, users are advised to remove a few unneeded appliances from the electrical supply [2].

Both the computing platforms such as cloud and Fog computing are the elevated models for data processing that can assist the computational needs of SG [3]. Fog based computing extends the cloud computing in which the computation, storage and networking services can be done nearer to the sensor devices [4, 5].

In this paper, leveraging Cloud and Fog for SG Network is proposed and the energy consumption at the fog layers is minimized. Section 2 describes the advantages of SG, Sect. 3 depicts cloud computing for SG, Sect. 4 discusses the fog computing model for SG, Sect. 5 describes the proposed work, the JAYA algorithm is presented in Sect. 6, the performance of implementing JAYA algorithm in VM placement is shown in Sect. 7 and Sect. 8 gives the conclusion.

2 Smart Grid

The grid is smart because of digital technology that allows bidirectional communication between the utility and customers and senses the transmission lines [6, 7]. From a customers point of view it can be thought of as managing your personal banking from your laptop, in the same way electricity can be managed [8]. For e.g.,

- Instead of waiting for the monthly statement the customers can able to know the electricity consumption by them through "smart meters" which provides a timely and clear picture.
- Can able to see the electricity they are consuming, when to use with its cost. Combining with real time pricing, the customers are able to use the electricity during when it is of less cost.
- SGs helps the customers in saving money by managing the electricity usage and the suitable time to consume electricity with less cost.

A modernized grid that permits bidirectional energy flows and leverages two-way communication and control capabilities, according to NIST [9], would lead to an array of new functionality and applications. Figure 1 depicts the NIST Framework

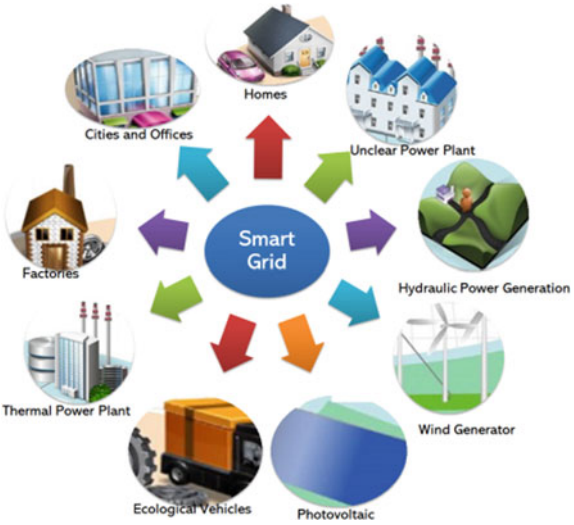

Fig. 1 Smart grid [12]

for SG, which depicts the applicable domains, actors, and the relationships between them. The SG aids in the regulation of electricity use at the consumer level. To achieve measurement and monitoring, SG's architecture includes a number of components [10, 11].

3 Leveraging Cloud Computing for Smart Grid

Since there is a lots of computation, security and storage required in the implementation of smart grid the computational requirements of smart grids can be met by cloud computing model as shown in Fig. 2. Parallel processing, flexible resources and shared services are some of the desirable features for smart grid applications provided by cloud computing. Though cloud computing is considered efficient for smart grid applications it has some constraints such as reliability and security.

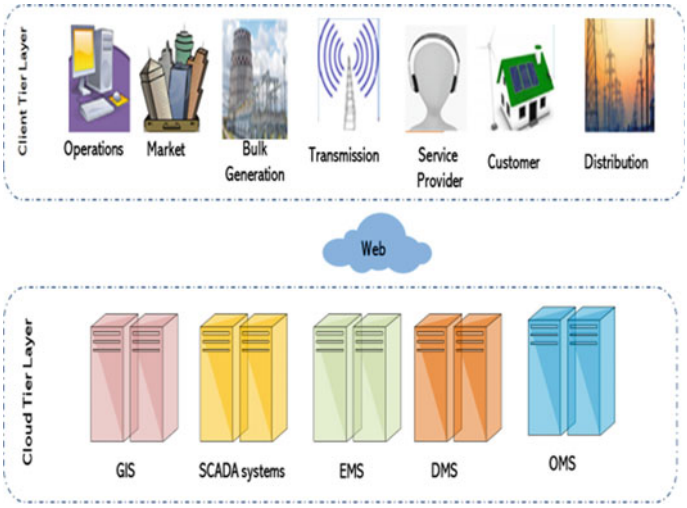

Fig. 2 Smart grids in cloud computing framework [13]

4 Leveraging Fog Computing for Smart Grid

Both computing using cloud and fog offers similar types of offerings in terms of service. Fog is not a replacement to cloud computing for SG, but it can be realized with cloud computing. Low latency and privacy is more important in many computational needs which all are addressed by fog computing [14]. The services the SG needs frequently are scalable real-time services, fault tolerant and consistent services, private data. Both cloud and fog [15] uses the same attributes virtualization with multi-tenancy. Although cloud and fog both share several properties, fog computing has the capabilities to extend the cloud computing in several including latency, geo-distribution, and aggregation. Compared to cloud assisted SGs, fog computing is a anticipating area to realize SGs with reduced latency [16]. The fog computing framework for SG is shown in Fig. 3.

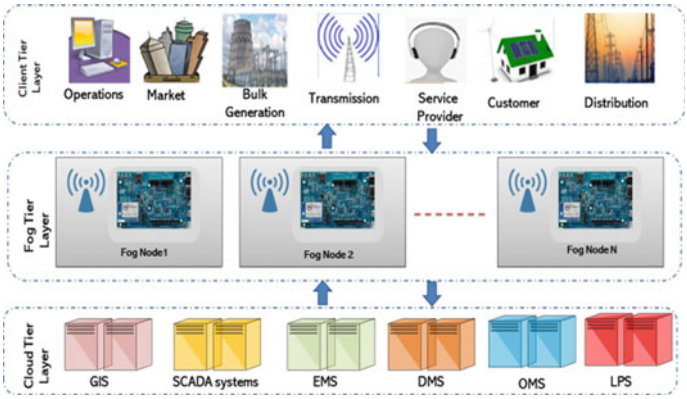

Fig. 3 Fog computing framework for smart grid [10]

5 Proposed Work

The VM placement is an promising aspect of the fog centers for boosting the resource utilization which helps in reducing the energy consumption while satisfying the SLA. The following section models the VMs scheduling and uses JAYA algorithm for solving the VM allocation problem in fog servers.

VM placement can be considered as a bin-packaging problem and is an NP-Hard problem where each server is considered as a bin and the need of each VM are denoted as an item in the input list. The aim of the research is to map the VMs to the fog servers so that the resource utilization will be maximized in the fog center and minimizes the SLA violation. The CPU Utilization is taken into consideration for placing the VMs. The objective is to maximize the resource utilization and so minimization of the energy consumption by following constraints:

1. Every VM is allocated to a single server.
2. A VM can only be allocated to a fog server if and only if the server have the available resources requested by the VM.

Let us consider there are M VMs denoted by $V = <V_1, V_2, V_3, \ldots V_m>$ need to be placed in N fog servers denoted by $F = <F_1, F_2, F_3, \ldots F_n>$. A mapping solution can be defined as $S = <S_1, S_2, \ldots S_n>$ where each S_i in S denotes the order of VMs to be placed into the fog servers. Let P_j be the power consumption by the fog server F_j.

A fog server is represented as a five tuple as (ID, Pr, Cr, St, NB) where ID = Identifier, Pr = Processing capacity, Cr = number of cores, St = storage capacity and NB = Network bandwidth capacity of the fog server.

A VM is represented as a four tuple (ID, Pr, St, NB) where ID = Identifier, Pr = Processing capacity requirement, St = Storage capacity requirement and NB = Network bandwidth requirement of the VM. In this paper we used the energy

consumption model suggested in [17]. The studies shows one idle server approximately consumes 70% of the energy as compared to the full CPU utilization. As a result, it is necessary to put idle servers into sleep mode, which reduces overall energy consumption. The energy consumption can be defined as [18]

$$E_i = k * E_{\max} + (1 - k) * E_{\max} * u_i \tag{1}$$

where E_{max} is the energy consumed when the VM is fully utilized; k is the fraction of energy consumed by the idle VM (i.e., approximately 70%) and u_i is the CPU utilization. In our experimentation we have set E_{max} as 250 W. Our goal is to minimize the consumed energy of the fog servers (T). T can be defined as:

$$Fitness\ function = T = \sum_{i=1}^{n} E_i \tag{2}$$

6 JAYA Algorithm

Many nature-inspired algorithms are probabilistic in nature. The appropriate parameters tuning of these algorithms generally affects the performance of a problem. JAYA is a population-based algorithm [14] has no algorithm-specific parameters. By avoiding the worst population at each iteration the algorithm reach to the best solution. The pseudo code for VM placement win fog centers with JAYA algorithm is shown in Algorithm 1.

Consider the case of an objective function f(y) that must be minimised or maximised. Let's say we have 'm' variables and n population size in the ith iteration.

Let best, $f(Y_{best})$, worst, and $f(Y_{worst})$ be the best candidate value, best fitness value, worst candidate value, and worst fitness value, respectively, from all candidate solutions. If the jth variable has the value $Y_{j,k,i}$ for the kth population in the ith iteration, then the updated value is expressed in Eq. (3) as follows:

$$Y'_{j,k,i} = Y_{j,k,i} + \alpha_{1,j,i}\,(Y_{j,best,i} - |Y_{j,k,i}|) - \alpha_{2,j,i}(Y_{j,worst,i} - |Y_{j,k,i}|) \tag{3}$$

where $Y_{j,best,i}$ and $Y_{j,worst,i}$ are the best and worst candidate's values for the variable j. The updated value of $Y_{j,k,i}$ is $Y'_{j,k,i}$ and the random numbers are $\alpha_{1,j,i}$ and $\alpha_{2,j,i}$ for the jth variable in the range [0, 1] for the ith iteration. The terms "$\alpha_{1,j,i}\,(Y_{j,best,i} - |Y_{j,k,i}|)$"and the term "$-\alpha_{2,j,i}(Y_{j,worst,i} - |Y_{j,k,i}|)$" demonstrates the trend of solutions to go closer to the optimal solution while avoiding the worst option. $Y'_{j,k,i}$ if it generates a better function value, it will be accepted.

Algorithm 1: Optimal VM placement using JAYA Algorithm in fog server

Input : Number of fog servers along with the VMs
1. Initialize the number of Iterations T and size of the population
2. Generate a random population (P)
3. for each candidate in population (P)
4. Evaluate the fitness function using Eq. (2)
5. Let Best_i be the best candidate with maximum fitness value and Worst_i be the worst candidate with the Minimum fitness value.
6. Repeat
7. for each candidate in population do
8. //Update each particle
9. $Y'_{j,k,i} = Y_{j,k,i} + \alpha_{1,j,i}\,(Y_{j,best,i} - |Y_{j,k,i}|) - \alpha_{2,j,i}(Y_{j,worst,i} - |Y_{j,k,i}|)$
10. Evaluate the fitness function using Eq. (2)
11. Let Best_{i+1} and Worst_{i+1} be the updated solution with maximum and minimum fitness values.
12. Let in the population C be the best candidate values
13. if $\text{Best}_{i+1} < \text{Best}_i$ then
14. Update C, in the population the best candidate
15. Improved= True
16. iter ++
17. if Improved==True && iter > T then
18. Return C
19. until T
20. Return C

7 Performance Evaluation

We verified the algorithm using ifogsim [19] with 50 VMs and 10 fog servers having distinct configurations. Three categories of VM configurations have been considered such as (40 MIPS, 700 MB RAM), (50 MIPS, 880 RAM) and (60 MIPS, 1750 RAM). Each VM have the bandwidth of 100 MBPS and storage requirement of 0.25 GB. During the simulation, the number of VMs are varied in the range between 50 and 300 and a constant fog servers are taken equal to 100.

- Experiments are carried out for homogeneous environment. We compared our algorithm with PSO and MBFD. We have taken 300 tasks having each task with 4 lakh million instructions to be executed on a VM. Table 1 shows the energy consumption, VM migration and the SLA violations by varying the number of VMs for various algorithms.

The energy consumption (in kWh) in the fog center is shown in Fig. 4 and the SLA violations in Fig. 5 by different algorithms.

Table 1 Performance of various algorithms

Number of VMs	Energy consumption (kWh)			Migrations			SLA violation		
Algorithm	JAYA	PSO	MBFD	JAYA	PSO	MBFD	JAYA	PSO	MBFD
50	0.37	0.37	0.38	42	42	41	10	10	10
100	0.49	0.56	0.52	83	61	58	10.72	9.87	9.4
150	0.58	0.68	0.67	150	144	139	11	10	9.8
200	0.64	0.76	0.81	123	217	172	9.87	10.87	9.68
250	0.73	0.96	1.1	187	278	282	9.98	10	12.41
300	0.78	1.2	1,36	213	308	320	10.35	9.83	13.22

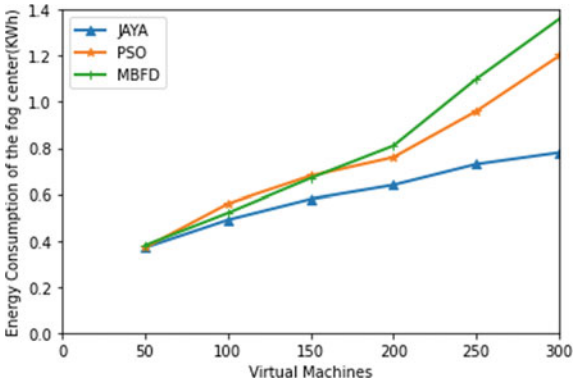

Fig. 4 Energy consumption (kWh) for various algorithms by varying the number of VMs

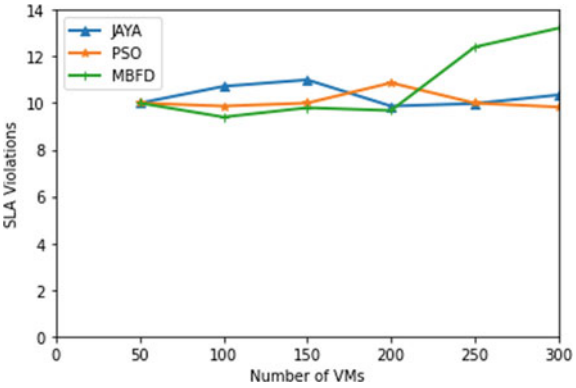

Fig. 5 SLA violation for various algorithms by varying number of VMs

8 Conclusion

The advancement of smart grids in the future will need a large volume of computation, statistical analysis and statistical inferences by capturing the data through sensors. The fog layer can act as a intermediary layer in between the cloud tier where the data can be stored and the sensors. Since many computations are handled by the fog layer it will consume huge energy. For reducing the energy consumption we may implement various optimized algorithms. The JAYA method is used in this paper, and its performance is compared to that of other well-known optimised algorithms. It has been discovered that JAYA algorithms outperform other algorithms.

References

1. Aslan M, Gunduz M, Kiran MS (2019) JayaX: Jaya algorithm with XOR operator for binary optimization. Appl Soft Comput 82:105576
2. Mukherjee P, Barik RK, Pradhan C (2021) eChain: leveraging toward blockchain technology for smart energy utilization. In: Applications of advanced computing in systems. Springer, Singapore, pp 73–81
3. Mukherjee P, Patra SS, Pradhan C, Barik RK (2020) HHO algorithm for cloud service provider selection. In: 2020 IEEE international women in engineering (WIE) conference on electrical and computer engineering (WIECON-ECE). IEEE, pp 324–327
4. Mohanty A, Samantaray S, Patra SS, Mahmoud AI, Barik RK (2021) An efficient resource management scheme for smart grid using GBO algorithm. In: 2021 International conference on emerging smart computing and informatics (ESCI). IEEE, pp 593–598
5. Patra SS (2018) Energy-efficient task consolidation for cloud data center. Int J Cloud Appl Comput (IJCAC) 8(1):117–142
6. Forcan M, Maksimović M (2020) Cloud-fog-based approach for smart grid monitoring. Simul Model Pract Theory 101:101988
7. Khalid A et al (2018) An efficient energy management approach using fog-as-a-service for sharing economy in a smart grid. Energies 11(12):3500
8. Kumari A et al (2019) Fog computing for smart grid systems in the 5G environment: challenges and solutions. IEEE Wirel Commun 26(3):47–53
9. Mukherjee P, Barik L, Pradhan C, Patra SS, Barik RK (2021) hQChain: leveraging towards blockchain and queueing model for secure smart connected health. Int J E-Health Med Commun (IJEHMC) 12(6):1–20
10. Leghari ZH et al (2020) A novel grid-oriented dynamic weight parameter based improved variant of Jaya algorithm. In: Advances in engineering software, vol 150, pp 102904
11. Okay FY, Ozdemir S (2016) A fog computing based smart grid model. In: 2016 International symposium on networks, computers and communications (ISNCC). IEEE
12. Barik RK, Gudey SK, Reddy GG, Pant M, Dubey H, Mankodiya K, Kumar V (2017) FogGrid: leveraging fog computing for enhanced smart grid network. In: 2017 14th IEEE India council international conference (INDICON). IEEE, pp 1–6
13. Sharma R, Gourisaria MK, Patra SS (2021) Cloud computing—security, issues, and solutions. In: Communication software and networks. Springer, Singapore, pp 687–700
14. Rao R (2016) Jaya: a simple and new optimization algorithm for solving constrained and unconstrained optimization problems. Int J Indus Eng Comput 7(1):19–34
15. Goswami V, Patra SS, Mund GB (2012) Performance analysis of cloud computing centers for bulk services. Int J Cloud Appl Comput (IJCAC) 2(4):53–65

16. Khan HM, Khan A, Jabeen F, Rahman AU (2021) Privacy preserving data aggregation with fault tolerance in fog-enabled smart grids. Sustain Cities Soc 64:102522
17. Patra SS, Barik RK (2015) Dynamic dedicated server allocation for service oriented multi-agent data intensive architecture in biomedical and geospatial cloud. In: Cloud technology: concepts, methodologies, tools, and applications. IGI Global, pp 2262–2273
18. Goswami V, Patra SS, Mund GB (2012) Performance analysis of cloud with queue-dependent virtual machines. In: 2012 1st International conference on recent advances in information technology (RAIT). IEEE, pp 357–362
19. Gupta H et al (2017) iFogSim: a toolkit for modeling and simulation of resource management techniques in the Internet of Things, edge and fog computing environments. Softw Pract Exp 47(9):1275–1296

Cloud Based "Energy Aware" Routing Protocol for Predetection and Its Prevention of Fault Tolerance

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Abstract In the Modern computer era Energy consumption major issues in all the network. Several researchers have developed numerous methods to avoid the fault tolerance. However so far researchers have not found the absolute solution for detection of the problem and avoid the fault for routing protocol. In this paper, we have designed a protocol, named DBTR that can used to select the next node if failure accrue, and check's fault tolerance and gives absolute solution.

Keywords Real time · Fault tolerance · WSN effecting network lifetime · Wireless sensor and actuator networks (WSANs) · Routing protocol Kautz graph

1 Introduction

The objective of this paper in brief is explained with the definition of importance of energy efficient pre-fault detection in WSNs. We propose a disseminated important productive steering calculation for WSNs that takes mind adaptation to internal failure of the network. At that point, we propose a circulated steering calculation called DBTR (Dispersed blame tolerant directing calculation) that considers important utilization of the CHs yet additionally their adaptation to non-critical failure. The commitments of this work include:

A hypothetical study of the Kautz diagram for its relevance in WSANs to meet the important proficiency and ongoing correspondence requirements in overlay support and steering. A Kautz diagram installing convention that uses Kautz charts to the

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physical topology of a WSAN and interfaces the diagrams utilizing disseminated hash table (DHT) [1] for high versatility and ongoing correspondence, and important productive topology upkeep system. A hypothetical investigation of directing ways in the Kautz chart and an effective detection of the fault tolerant steering convention is analyzed to help detection of fault tolerance, continuous and important productive information transmission.

Piecemeal from these, multitudinous judges have proposed the application of some uncommon capitals called doors/ transfer. Our commitment in this paper is to present a new protocol and performing with numerical description for energy effective fault mitigation, monitoring and conceivably the junking of the fault. Consequently, keeping in mind the end thing to do with utility of the WSNs, the directing computations should acclimatize to fault tolerant perspective, particularly when some CHs give negative acknowledgement. The computation empowers a transfer mecca to fleetly and productively fete the following stylish path from itself to the endpoint after steering failure without data transmission. Each group has an innovator called cluster head (CH) which gathers information from its part detector capitals totals them and shoot it to the BS. The detector capitals smell the near information and further it to a distant base station (BS) called Gomorrah. Because of mecca versatility and attendant commanding packet transmission failures, adaption to noncritical failure is critical to guarantee reliable mecca correspondence. A remote detector arrange (WSN) naturally comprises of hundreds or thousands of detector capitals, which are conveyed physically or arbitrarily, finished an objective corner. A WSAN comprises of detector capitals equipped for estimating jolts in the earth and selector capitals fit for impacting their near condition.

Donation—It allows a relay knot to fleetly and adeptly identify the fault forbearance, assign the tasted data through selector to the alternately stylish path (algorithm), rather than counting on retransmission from the source therefore saving the fresh energy consumption.

Provocation—Energy preservation and fault acceptance are the most two important stimulating issues for the development of large-scale wireless detector networks (WSNs).

Ideal—All the real bumps are sensibly tasted through an selector. Our protocol is salutary over former Kautz graph-grounded workshop in that it doesn't need an energy-consuming protocol to find the possible path; rather, detects the fault at succeeding knot and diverts into the other possible path following suitable routing path algorithm. We also hypothetically study colorful fault discovery and forestallment fashion in all the possible routing paths, innovated on which we develop a well-organized fault-accepting routing protocol by optimizing energy effectiveness. We all are apprehensive that in real-time, energy apprehensive fault-pre discovery has come one of the serious issues in WSNs to enable tasted data to reach selectors reliably and snappily. Thus, a routing algorithm in WSNs should be energy apprehensive as well as fault tolerant. The paper provides expansive experimental results from OMNET of our protocol and associates the analogous with utmost recent WSN systems in relations of real-time communication, energy effectiveness,

fault-accepting and scalability. The paper proposes the protocol by multipath-based routing and energy-effective, independently.

2 Literature Review

Capitals, which are provisioned with fresh important and bigger correspondence, extend than the ordinary detector capitals. Second, allude can fleetly and productively distinguish the optional ways and their lengths basically in light of mecca IDs upon a directing disappointment, once fashion [18] needs to calculate upon an important expending steering age computation. We perform broad examinations on the proposed computation by recreation and discrepancy the issues and the dispersed important acclimated steering (DVAS) computation [2], the responsibility tolerant bunching computation as proposed by Petrioli et al. [1]. Further, a multiway commanding computation and an important effective multicasting computation are proposed for intra and between Kautz cell correspondences. In this paper, we will probably outline an important effective steering computation for WSNs by taking consideration of adaption to internal failure of the CHs. Especially, the disappointment of a CH dislocations the correspondence with its part detector capitals as well as with different CHs as they're associated with steering collected information to the Gomorrah through different CHs [3]. The issues demonstrate that our proposed protocol and posterior computation performs superior to the former computations regarding the volume of dead CHs, add up to important application of the system, the volume of information pack conveyed to the BS and standard divagation of residual important of the entries amid the system continuance. Likewise, the two ways use either geological commanding [4] or topological steering [5, 6], which expend a lot of important by depending on position data created by Global position system or a virtual synchronization strategy [3, 7, 8] or overflowing to find and refresh directing ways. Along these lines, the overlay is not steady through the unseen physical topology and multi jump commanding must be employed for the correspondence between two bordering Kautz capitals in MANETs. In multitudinous uses of WSN, CHs are picked among the typical detector capitals, which may attack the succeeding knot because of quick prostration for similar fresh knot. The lesser part of the directing conventions for protean indecorous systems (MANETs) and WSNs treat each mecca also and neglect to use the capacities of asset rich widgets to dwindle the correspondence trouble on low-asset detectors. The computation depends on Cost work, the packets that are conceded negatively and the separation of coming-knot from the BS.

3 Survey of Kautz Graph Methodology

The Kautz graph *KJI* 1 is a directed graph. The directed graph then refers to the movement of the path with the knowledge of geste of succeeding knot while the

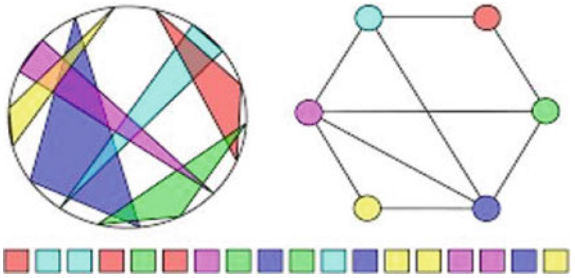

Fig. 1 Example of Kautz graph on 3 nodes

resource is at the present knot. We define this with an supposition that let the degree J and dimension I 1, which has (J 1) JI vertices labeled by all possible strings c_0, c_1, c_2, c_3, c_4, c_5, c_6, c_7, … c_J. Now, this c_0, c_1, c_2, c_3, c_4, c_5, c_6, c_7, sc are supposed to be composed of bumps c_J, chosen from an ABC A containing J 1 bumps. J 1 bumps are subordinated to the condition that conterminous bumps in the entire covering path cannot be equal

$$\text{i.e. } c_J, \neq c_{J+1}$$

Referring to the Fig. 1, the Kautz graph K_J^{I+1} has $(I + 1)I^{J+1}$ edges
i.e. $\{(c_0c_1, \ldots c_J, c_{J+1}) \mid c_J \dot{\varepsilon} A\, c_J, \neq c_{J+1}$
It is natural to label each such edge of K_J^{I+1} as c_0, c_1, … c_J, c_{J+1}, giving a one-to-one correspondence between edges of the Kautz graph K_J^{I+1} and vertices of the Kautz graph K_J^{I+2}

4 The Proposed Energy Model

Continuing the introduction and related works in Sects. 1 and 2 above, we start with the following parameters before proposing our new model:

1. Action detection using sink node, which will be referred as SN (Actuator)
2. Analyze and Application of Kautz Graph Theory to realize the sensed data to be sent to the actuator
3. Pre-fault detection
4. Fault Tolerance.

Let the energy consumption be E(x; y).

Pre-requisites

E(x; y) is used to sense the bit data from x to its neighboring node (here in this case we have assumed it as 'y'). As we are aware, there are four issues related with the energy consumption.

1. path loss between the nodes depending on the transmission environment/impairments
2. energy used by receiving nodes (here 'y')
3. energy consumed while processing the signal within the *channel*
4. fault detection at the succeeding node (if any) (here it is 'y')

We now define the above energy consumption mathematically as below:

E(x, y) has four parts as per the pre-requisites defined above which can be equated as below:

$$E(x; y) = E_1 \Rightarrow_a (x, y)d(x, y)^l + K_b + K_c + K_d \square d(x, y)^{l+1} \quad (1)$$

In above equation

x, y is denoted as distance between the two bumps in the network x and y.
K is number of node.
– denotes the nodal distance with path loss denoted by l
– are the assumed constants that do due to the issues mentioned in the pre-requisites above i.e. path loss between the bumps depending on the transmission terrain/impairments; energy used by entering bumps (then 'y'); energy consumed while recycling the signal within the channel.
– represent the energy used by entering knot where K_d is again a constant which do while entering i.e., transmission impairments or electronic dissonancy likely to do at entering knot.

Most importantly, we assume that for every succeeding bumps i.e. for every neighboring knot (then 'x' to 'y'), the detector bumps have the same K_b, K_c, and K_d

5 The Methodology

Before defining the proposed protocol, we go through with the following definitions, which are based on the discussion made on the preceding sections.

Definition 1 If E(a, b) is the energy consumption and E(a, b) E_0(x, y), then do *till all the hop distances are equal i.e. d(x, y) must be having equal nodal distance between x and y*

Check if $d(x, y)^l$ *occurring is*
Initialize the actuator
Choose the optimum routing hops

Definition 2 If E(x, y) is the energy consumption and E(x, y) > E_0(x, y).
then minimize.

Definition 3 The absolute relay location function node (f) node is U is defined as the straight line from the node.

U, and anchor node or receiver node is notated as V
Where d(u:F) = do.

$$E(x; y) = E_1 \Rightarrow a(y)d(x)^l + K_b + K_c + K_d * d(x + y) \quad (2)$$

6 Proposed Algorithm

Algorithm 1: Identify the error defecating Node using Kautz burst packet method over an actuator $'

Input: Sender Node a, receiver Node b
1. Array t(a; b) = [constant □; $] Sensor node and actuation:
2. a get sets
3. A send a packet of burst to b and attached with
4. Array(a, b);
5. If constant value in the next node gets the packet, then
6. update the array (xi; array list (a; b))
7. end if statement
8. if x packet is receive the feedback packet from y then
9. update Array(a; b) = [const and; $0, $1, $2, $3, $4, …$n]
10. initialize the absolute packet and send to the packet y via $0, $1, $2, $3, $4, …$n
11. end if Statement
12. if $wi = = K Ɛ {Kb, Kc and Kd} gets the packet from S then
13. send this packet to Kd + 1
14. else
15. if $wi is next node then 15: Array (wi; Array (a; b))
16. end if Statement
17. end if Statement
18. Update the list of Array (wi; Array (a; b))
19. if checks wi Ɛ Array (a; b) then
20. Delete all the nodes in the array
21. end if statement
22. Checks all the nodes are in intermediating nodes a and b then
23. Compute the distance and energy consumption of the node based to Eq. (2)
24. Add wi to Array(a,b)
25. Send Array(a, b) to wi + 1 next constant
26. end if Statement
27. Check wi == b then
28. send Array (a; b) to x
29. end if
30. end function

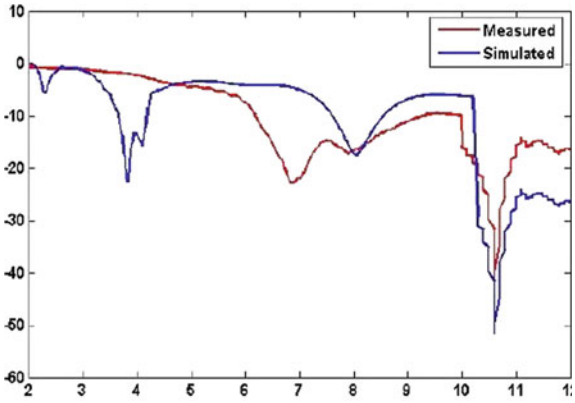

Fig. 2 Measured and simulated

7 Results and Discussion

This algorithm finds three types of packets which are Ideal packet, burst packet and data packet in our result pattern. In that the first packet ideal or lamp packet is used to do the switching position information and stable energy among the around bumps. In alternate knot burst packet is used find the anchor list in the network. Figure 2 shows that burst packet details. The burst packet consists of anchor list, the anchors array checks sequence of bumps in the network and checks the fields the packets are bypassed the routing holes by retaining the right-hand rule or left-hand rule. The bypass system contains empty knot for temporarily but after the transmission the knot get canceled grounded on the dogged rules of anchor knot. i.e., the knot (e.g., knot u in Fig. 1) which won't find a neighbor being near to the boundary than itself, indeed though there's a path from the base knot to boundary in the network.

8 Conclusion and Future Scope

In inference, we have discoursed about the issues of energy for all networks, particularly the feasting and improved consumption of energy. We have obtainable our explanations for energy efficient protocol and rigorous imitations have been worked out with applicable proofs for fault discovery too. The proposed algorithm reduces the consumption of energy. Also, our algorithms discoursed the fault discovery too. Our research paper proposed discrete clarification pre error—"fault tolerant avoidance" using **Kautz burst packet method over an actuator $'**. DBTR (Dispersed blame tolerant directing calculation)—Dispersed blame tolerant directing calculation algorithms will find the absolute node and reduce the more in then power consuming and fault tolerance that will be discussed in my future research.

References

1. Petrioli C, Nati M, Casari P, Zorzi M, Basagni S (2014) ALBA-R: load-balancing geographic routing around connectivity holes in wireless sensor networks. IEEE Trans Parallel Distrib Syst 25(3):529539
2. Li X, Yang J, Nayak A, Stojmenovic I (2012) Localized geographic routing to a mobile sink with guaranteed delivery in sensor networks. IEEE J Sel Areas Comm 30(9):17191729
3. Chen Q, Kanhere SS, Hassan M (2013) Adaptive position update for geographic routing in mobile Ad Hoc networks. IEEE Trans Mob Comput 12(3):489–501
4. Chen D, Varshney PK (2007) A survey of void handling techniques for geographic routing in wireless networks. IEEE Commun Surv Tutor 9(1):50–67
5. Bose P, Morin P, Stojmenovic I, Urrutia J (2001) Routing with guaranteed delivery in Ad Hoc wireless networks. ACM/Kluwer Wirel Netw 7(6):609–616
6. Liu W, Feng K (2009) Greedy routing with anti-void traversal for wireless sensor networks. IEEE Trans Mob Comput 8(7):910–922
7. Frey H, Stojmenovic I (2006) On delivery guarantees of face and combined greedy face routing in AdHoc and sensor networks. In: Proceedings ACM MobiCom 2006, CA, USA, pp 390–401
8. Fang Q, Gao J, Guibas LJ (2004) Located and bypassing routing holes in sensor networks. In: Proceedings IEEE INFOCOM 2004, Hong Kong, China, pp 24582468

Unmasking the Malware Using Android Debug Bridge

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Abstract The growing number of malware puts security in peril, several studies highlight the stark consequences of malware, so the abstraction of malware is crucial to keep personal information confidential. The motive of this research is the detection and abstraction of malware present on an android device using the Android Debug Bridge (ADB), Android debug bridge is utilized for communicating with an android device and acquiring information about the device. The detection process is achieved by creating a shell script and executing it on a Unix terminal. Hereafter, if malware is detected the script will automatically abstract them and exhibit the number of malware detected. Along with detection, a comparative analysis is performed which indicates various advantages over free anti-malware software one of them is a sanction, the antiviruses present on the Google Play Store can share or store data and shows superfluous ads, these antiviruses require many sanctions from the user before scanning, while in this research no third party software is required user can itself run the script without involving any third party tool or without compromising security. This research unveils malware from android devices in a security-friendly way.

Keywords ADB · USB · Shell script · Terminal

1 Introduction

The ADB is a multipurpose command-line tool which when connected with an android device through USB cable allows communication and various other actions

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like installing and debugging applications using a Unix shell. Its three components are:

1. Client—It sends and runs commands on a development computer. By issuing a command from a command-line terminal, one can invoke the client.
2. Daemon—It runs in the background, executes commands on an android device.
3. Server—It runs as a background process on the development computer and establishes communication between the daemon and the client [1].

A study conducted by International Data Corporation (IDC) states that the Android platform is still dominating the smartphone industry with a share of more than 86%. Its popularity is incrementing rapidly with more developing sensitive operations and features being integrated [2]. But along with this, Android malware is also growing, and that too with more complex anti-analysis techniques and logic [3]. Mobile malware is a malicious software which specifically targets mobile operating systems. Nowadays, malware can be utilized for numerous purposes like for tracking user activity, spreading spam, stealing data, etc. [4]. It is generally used for more than 1 purpose. To explain malware classification, we require two terms: Malware type (Based on its General functionality, what it does) and Malware family (based on its particular functionality, how it acts) [5, 6].

2 Literature Review

The paper named "M0droid: An android behavioural-based malware detection model" [7] represents a model used for detection of malware codes or harmful scripts on an Android device. The process flow of the model given in the paper was to install an application on a mobile device and then analyze the data on the server. The results from the experiments conducted demonstrates that the detection rate of the model used is 60.16% where false positives percentage was 39.43%.

SAndroid [8], the tool which enhanced the malware and harmful scripts detection by application signatures [9, 10], over detection and tracking of malicious and harmful process signatures [11, 12]. Though, there are some disadvantages of this method like high amount of battery consumption.

Canfora et al. [13] estimated some techniques to detect malevolent apps. Their perspective is potent for desktop malwares and categorize the ill-natured applications. Practically, they attain a precision "0.96" to differentiate the malicious applications, and "0.978" to determine malware family.

Feizollah et al. [14] came up with AndroDialysis, to judge how efficient the android application intent: explicit and implicit, like specification to check the ill-natured applications. They convey that the intents have semantically better structures as compared to other attributes [15]. Though, they said that not all these features are the final solution, and also it can be used with other well known positive features [16, 17]. It's outcome depends on the probe of data present of 7406 apps (5560 infected apps and 1846 clean). They attain 91% accuracy by operating the Android Intents, while 83% uses Android permissions and the merging of these characteristics they get

the spotting rate as 95.5%. They declare that in the process of malware identification, Intents are more worthwhile than the permissions [18].

Then, another paper named "Comparative study of mobile forensic tools" [19] described a method termed as FAMOUS stands for Forensic Analysis of Mobile Devices. This method examines app permission to determine whether the app is a malware or not. Tools like Droid Scope [20] and Profile Droid for analyzing apk files so that there is any scope of malware in them. The paper named "On the Efficacy of Using Android Debugging Bridge for Android Device Forensics" [21], this paper concluded that ADB is unable to flag any file but can effectively find and extract the present malware files [22].

The literature review includes Malware detection using System Calls, Intents, Manifest file, Permissions required by the application and ADB (Android Debug Bridge). Very few studies have been done using ADB and more work can be performed by using Android Debug Bridge as a malware detector [23–25].

3 Implementation

For the detection of malware in any android phone, a shell script and a text file are created. The name of the shell script is checkapk.sh and that of the text file is malwarehashes.txt. checkapk.sh consists of a script which is used for detecting and abstracting the malware in the android phones and malwarehashes.txt file consists of hash codes of malware.

3.1 Steps of Implementation

Step 1: Connect the phone with a laptop or computer running the ADB command line. Turn on the USB debugging from the developer options and sanction the permissions. For the developer options click on the build number 7 times in the about phone menu.
Step 2: Type commands in the command line:

1. "adb shell"—to grant permission for connecting the android phone with ADB
2. "exit"

Step 3: Type command "bash checkapk.sh" and the file will start running.

The process of detection and abstraction of malware takes place until the "Success" message appears.

Backend working:

1. The shell script was written to detect and remove malware consists of ADB and Linux commands, which is used for fetching the packages on the android phone and removing it if malware is detected
2. When the shell script is executed, the packages present on the android phone are fetched with their consummate name and location. By using the location of the

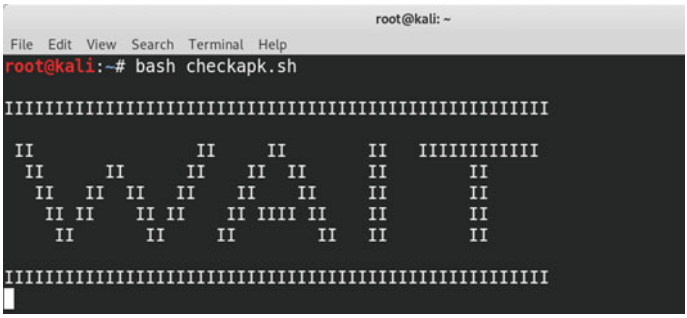

Fig. 1 Running shell script

package, md5sum of that package is generated and stored in a file designated as apphashes.txt.

3. After generating the file apphashes.txt, the hash codes of the file are compared with the hash codes of malwares which are already stored in a file designated as malwarehashes.txt.

After comparing both the files with each other, If any hash code is obtained which is mundane in both the files, then the package of that hashcode will be permanently deleted and uninstalled And, if no hash code is mundane then simply a message appears on the screen "No malware detected".

In the terminus, "rm" command is used in a script to abstract all the files generated during implementation to minimize the internal system storage utilized by the script (Fig. 1).

4 Result

The script created in this research can detect and remove malware utilizing the android debug bridge. There are two scenarios since an android device may or may not have any malware. The Figs. 2 and 3 shows the output when the device doesn't have any type of malware and when the system has only one malware respectively.

4.1 Comparative Analysis of Our Study with Pre-existing Tools

For the comparative analysis, malware is designed using the MSF venom and injected within an android device then some antivirus is used to detect that malware, and likewise the script created in this research is used and the analysis is shown.

Table 1 shows the comparison between different antiviruses available. Despite these tools, certain applications present on the play store required credit card information for a free tribulation of some days and then pleaded for payment. This table

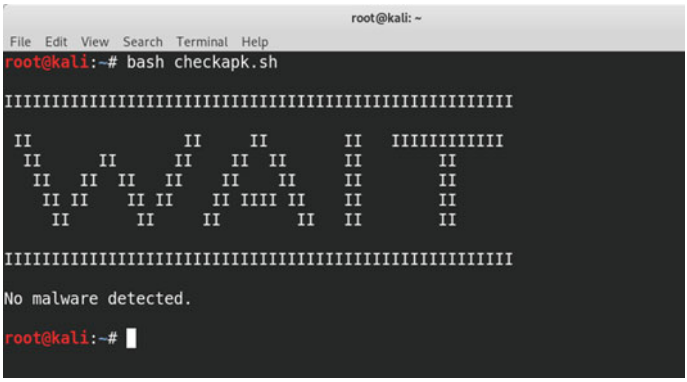

Fig. 2 No malware detected

Fig. 3 One malware detected

Table 1 Comparative analysis

Antivirus	Permission required					
	Photos and media files	Modify system settings (erase data, change screen look etc.)	Storage	Camera	Location	SMS
Samsung inbuilt scanner	☑	☑	☑	☑	☑	☑
AVG	☑	☑	☑			
Avast	☑		☑	☑		
Spyware detector		☑ modify SD card data	☑			
Kaspersky internet security			☑	☑	☑	☑
Spy apps finder			☑			☑
Antispy and spyware scanner	☑		☑			

compare them on the basis of permission required, whenever we use any third-party tool then there is always a security concern due to the fact that the tool can access some confidential information due to the various permissions required to run the software but while using ADB only the owner of the device has the permission and there is no involvement of any third party tool and can efficiently detect and remove malware.

5 Conclusion

This paper concludes that users can themselves detect and remove malware present inside an android device without compromising security by using android debug bridge. It is efficacious for detecting and abstracting the malicious software or application with the avail of shell script without involving any third party application. Most of the free third-party applications are not able to detect and abstract the malware injected on the testing phone. These third-party applications require sanction for accessing the internal storage and the external SD card or recollection card connected and additionally the credit card and debit card information for free trial. While in this research the shell script generated can be used by the user itself without involving any third-party application or software. Users can execute the script on their system and can abstract the malware if detected.

References

1. Amarante J, Barros JP (2017) Exploring USB connection vulnerabilities on android devices breaches using the android debug bridge. In: Proceedings of the 14th international joint conference on e-business and telecommunications (ICETE 2017)
2. Lee Y, Larsen KR (2017) Threat or coping appraisal: determinants of SMB executives' decision to adopt anti-malware software
3. Wei F, Li Y, Roy S, Ou X, Zhou W (2017) Deep ground truth analysis of current android malware
4. Salah A, Shalabi E, Khedr W (2020) A lightweight android malware classifier using novel feature selection methods
5. Banina S, Dyrkolbotnab GO (2018) Multinomial malware classification via low-level features
6. Al-rimy BAS, Maarof MA, Shaid SZM (2018) Ransomware threat success factors, taxonomy, and countermeasures: a survey and research directions
7. Damshenas M, Dehghantanha A, Choo KKR, Mahmud R (2015) M0droid: an android behavioural-based malware detection model. J Inf Privacy Secur 11(3):141–157
8. Niazi RH, Shamsi JA, Waseem T, Khan MM (2015) Signature-based detection of privilege-escalation attacks on Android. In: 2015 Conference on information assurance and cyber security (CIACS), pp 44–49, Dec 2015
9. Yang C et al. (2015) Using provenance patterns to vet sensitive behaviors in Android apps. In: International conference on security and privacy in communication systems. Springer International Publishing
10. Duc NV, Giang PT, Vi PM, Bhatt MS et al (2015) Int J Comp Technol Appl 6(5):852–856. Conference Paper, November 2015

11. Kumar M, Mishra BK, Panda TC (2016) Predator-prey models on interaction between computer worms, trojan horse and antivirus software inside a computer system
12. Rastogi V, Chen Y, Jiang X (2014) Catch me if you can: evaluating android anti-malware against transformation attacks
13. Canfora G, Mercaldo F, Visaggio CA (2016) An HMM and structural entropy based detector for android malware: an empirical study. Comput Secur 61:1–18
14. Feizollah A, Anuar NB, Salleh R, Suarez-Tangil G, Furnell S (2017) Androdialysis: analysis of android intent effectiveness in malware detection. Comput Secur 65:121–134
15. Zhang M, Song G, Chen L (2016) A state feedback impulse model for computer worm control
16. Eugene Schultz E Dr (2003) Pandora's box: spyware, adware, auto execution, and NGSCB
17. English ED (2014) Detection of bot-infected Computers using a web browser
18. Dawson JA, McDonald JT, Shropshire J, Andel TR, Luckett P, Hively L (2017) Rootkit detection through phase-space analysis of power voltage measurements
19. Agrawal AK, Khatri P, Sinha SR (2018) Comparative study of mobile forensic tools. In: Advances in data and information sciences. Springer, Singapore, pp 39–47
20. Amer N, Al-Halabi YS (2018) Android forensics tools and security mechanism: survey paper. In: Proceedings ACM the fourth international conference on engineering & MIS, p 12
21. Easttom C, Sanders W (2019) On the efficacy of using android debugging bridge for android device forensics. In: IEEE 10th annual ubiquitous computing, electronics and mobile communication conference, pp 0734
22. Zheng M, Sun M, Lui JCS (2013) DroidAnalytics: a signature based analytic system to collect, extract, analyze and associate android malware
23. Tan L, Liu C, Li Z, Wang X, Zhou Y, Zhai C (2013) Bug characteristics in open source software
24. Chatterjee R, Doerfler P, Orgad H, Havron S, Palmer J, Freed D, Levy K, Dell N, McCoy D, Ristenpart T (2018) The spyware used in intimate partner violence
25. Fatima U, Ali M, Ahmed N, Rafiq M (2018) Numerical modeling of susceptible latent breaking-out quarantine computer virus epidemic dynamics

Blockchain and Competitive Business Performance

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Abstract The study explores the mechanism and path how blockchain enhance firm performance. 360 participants gave their responses for the study. The analysis proves that blockchain enhance performance directly as well as through supply chain flexibility and agility. The study has theoretical and practical implications. The study provide basis for further research about blockchain and developing models for industrial use. The study is useful for managers to implement blockchain in supply chains. The study provide basis to explore application of blockchain in health care, banking, financial sector and many more.

Keywords Blockchain · Flexibility · Agility · Competitive business performance

1 Introduction

Technological disruptions play significant role in enhancing efficiency of supply chain [1]. Modern supply chains are complicated due to increasing scale of business and customized product, intense competition and lesser product life cycle. Due to this production planning, synchronization, and predicting demand has become difficult [20]. There is lack of accountability and transparency in complex supply chains [13]. This is too difficult for focal company to monitor their suppliers in real time. Blockchain can ensure traceability of every supplied item through various suppliers and reduce workload. Blockchain is a internet based technology which enhances visibility, transparency, traceability, and prevent data tampering in transactions. Blockchain has potential to achieve them [13]. However, no study till date empirically connects blockchain technology with supply chain parameters.

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2 Literature Review

Blockchain is integration of cryptography, database management, and IoT [16]. Blockchain does not require third party intermediation while using as transactional platform. Blockchain allocates nodes to all transaction parties and cryptography technology validates all transactions [2].The transaction between members are recorded and shared through decentralized ledger among trading partners. Blockchain enables accurate demand forecasting, efficient and effective management of resources and reduce holding cost of inventory because of excellent record keeping. More information sharing accrues more agility to supply chains and higher level of information sharing leads to more flexibility [15].

3 Conceptual Framework

Present study proposes following conceptual framework (Fig. 1).

Blockchain and competitive business performance

Improvement in trust among trading partners improves supply chain integration [12] and accrue better firm performance. Trust plays critical role in information system when there is no mechanism of audit or verification of sensitive data. Supply chain members can verify all transaction while using blockchain [12]. This generates distributed, non-editable, transparent and audit-able ledger. Blockchain removes trust related issues attaches with traditional accounting system [3]. On the basis of above we can posit that:

H1: Blockchain improves competitive business performance directly.

Blockchain and Supply chain flexibility

Flexibility means capability to respond according to change market conditions without significant cost. Blockchain improves flexibility due to 'level of network'

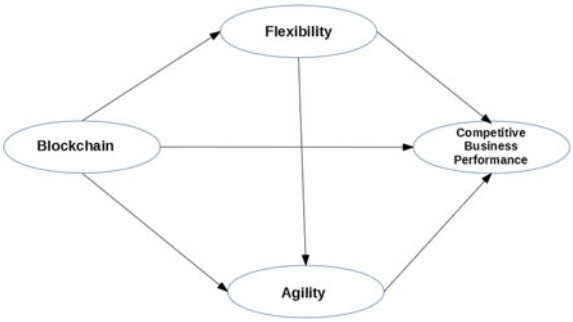

Fig. 1 Conceptual framework

effect. Increase in networking also increases effect of blockchain [13]. Demand forecasting can also be made more accurate through blockchain which results into better management of tangible and intangible resources. This reduces risk of excess inventory, capacity and backup sources to counter market disruptions [11]. On the basis of above we can posit:

H2: Blockchain improves SCF.

Blockchain and SCA

Agility enable firm to respond quickly to change market conditions [5]. Tamper proof data from multiple sources can be collected and analyze using blockchain in real time. This enhances supply chain transparency and also tracking of goods which get reflected in reduced delivery time [13]. Blockchain can be integrated with GPS and RFID technology which enhance operational efficiency and response time. Blockchain reduces need for verification of documents because they are not only digitally signed but also maintain secure storage and transmission [13]. This reduces decision making time and thus enhances agility. On the basis of above we can posit that:

H3: Blockchain improves SCA.

SCF

Flexibility is of two types: strategic and manufacturing [7]. Strategic flexibility addresses economic and political risks and manages market threats to capitalize opportunities in existing and new market, while manufacturing flexibility have four components: mix, volume, design, and modularity. Aggregate manufacturing flexibility is the capability to produce goods at acceptable price and quality [21]. Manufacturing flexibility depends upon manufacturing resources and strategic flexibility depends upon internal and external resources of organization. That's why manufacturing flexibility is sub-set of strategic flexibility. Moreover, manufacturing flexibility is sub-set of SCF.

Internal part of supply chain consists of procurement, manufacturing, distribution and new product development. All domains are related to flexibility. Mix and volume components refer to capabilities to produce products which differ in their features and also sufficient quantity to meet demand. Design and modularity component refers to architecture of product and developing modules. This reduces complexity and new product development time [19]. This capability enables an organization to deliver products at very short notice. Manufacturing flexibility brings change in procurement [17]. This improves firm performance and as manufacturing flexibility is sub-set of SCF, so, this improves firm performance. On the basis of above we can posit that:

H4: SCF significantly affects SCA.

H5: SCF significantly affects CBP.

SCA

This depicts interface strength between firm and market. Agility is required at product customization, delivery, and development cycle stages [14]. Blockchain can collect data from multiple sources in real time and analyze them accordingly. This enables

supply chain managers to make decisions quickly and correctly. Blockchain enable to share design related data with trading partners and with potential customers, this enables trading partners to develop new product quickly. Also, active participation enable organization to satisfy change market demand in a better way [13].This makes supply chain more agile. Improved agility means a firm can respond to change market demands quickly, which improves competitive business performance. On the basis of above we can posit that:

H6: SCA significantly affects CBP.

4 Research Methodology

Data collection was done through an online email survey. Three academic experts were chosen to deal content validity. These experts are researchers of Operations management, SCM and IT. Responses collected on 5 points Likert scale. Present study selected 950 respondents from 180 companies taken from the CMIE (Center for Monitoring Indian Economy) database. The survey participants were functional in-charge connected with SCM. Out of total 950 sent emails, 372 came back, so response rate was 39%. After cleaning and tabulation, 360 valid responses were obtained from survey process.

5 Data Analysis

For convergent validity three conditions must be satisfied, namely, all factor loadings must be greater than 0.5 and statistically significant. Average variance extracted (AVE) must be greater than 0.5 and composite reliability (CR) must be greater than 0.7 [10, 12]. From Tables 1 and 3, it is evident that measures used to satisfy these criteria and thus exhibit convergent validity. CR values lie within acceptance range [4]. Discriminant validity means how much constructs are distinct [12]. The diagonal values (which are the square root of AVE) are more than rest of the elements, indicating presence of discriminant validity (Table 4) [4]. This means constructs has its own identity and justify its existence. Construct validity refers to the degree to which inferences can legitimately be made from the operationalizations in our study to the theoretical constructs on which those operation alizations in our study to the theoretical constructs on which those operationalizations were based. Like external validity, constructs validity is related to generalizing. Construct validity is achieved when all fit indexes are within acceptance limits [18]. CMIN/df value obtained is 1.743 (should be less than 5) (Table 2), CFI value is 0.952 and RMSEA obtained is 0.046. All fit indexes (Table 2) are within acceptance limits [12]. Kurtosis and skewness are within acceptance range (acceptable limits of ± 2) (Table 5) [4, 6]. This means statistical tests are valid because the data is normally distributed. Non response bias occurs when non-responders from a sample differ in a meaningful way

Table 1 CFA result

Construct	Items	Source	Loadings
Blockchain technology	B1: Do you believe that transactions through blockchain are more reliable?		0.610
	B2: Do you believe that more transparency and visibility accrue through blockchain?		0.617
	B3: Do you believe that blockchain reduces transaction issues due to more traceability?	[13]	0.736
	B4: Do you believe that blockchain gives transaction data which is tamper proof and can be shared and analyzed among trading partners?	[13]	0.565
	B5: Transaction cost reduces due to use of blockchain	[13]	0.693
Supply chain flexibility	F1: Do you believe that firm can alter supplier order quantity?		0.743
	F2: Do you believe that firm can alter supplier delivery time?		0.732
	F3: Do you believe that firm can alter delivery schedules?		0.747
	F4: Do you believe that firm can alter production volume?	[43]	0.792
	F5: Do you believe that firm can alter production mix?	[17]	0.733
	F6: Do you believe that firm can decrease manufacturing time?	[43]	0.733
	F7: Do you believe that firm can decrease product development time?	[8]	0.746
Supply chain agility	A1: Reducing manufacturing lead time	[45]	0.750
	A2: Do you believe that firm can decrease new product development cycle time?	[5]	0.761

(continued)

to responders (or early responders). Common method bias occurs when the estimated relationship between one construct and another might be inflated.

From Table 6 it is evident that t-test conducted to check difference in last 54 responses and 100 randomly chosen early responses. All t-tests are insignificant (p value is greater than 0.05), so non-response bias is absent [12]. For common method bias, all items were loaded into a single factor. The variance explained by single factor is 22.839%, which is less than 50%, so common method bias is absent [12].

Table 1 (continued)

Construct	Items	Source	Loadings
	A3: Do you believe that firm can enhance frequency of new product introduction?	[5]	0.728
	A4: Do you believe that firm can enhance level of product customization?	[45]	0 0.715
	A5: Do you believe that firm can adjust its delivery capabilities?		0.740
	A6: Do you believe that firm can enhance customer services?		0.697
	A7: Do you believe that firm can enhance delivery reliability?		0.706
	A8: Do you believe that firm can respond quickly according to change market demand?	[5]	0.746
Competitive business performance	C1: Improvement in return on global assets due to blockchain		0.731
	C2: Improvement in global market share due to blockchain		0.815
	C3: Improvement in profit margins due to blockchain		0.565
	C4: Improvement in sales/per number of employees after using blockchain		0.844

Table 2 Fit indexes for measurement model

	Model chi-square	CMIN/df	CFI	RMSEA	P-CLOSE
Accept value	$p > 0.05$	<5	>0.90	<0.07	>0.05
Obtained value	428.852 at df: 246, $p < 0.05$	1.743	0.952	0.046	0.847

Table 3 AVE, CR and Cronbach's Alpha

Construct	AVE	CR	Alpha
Blockchain technology	0.632	0.7281	0.776
SCF	0.7465	0.8981	0.900
SCA	0.7303	0.9015	0.901
Competitive business performance	0.7387	0.8314	0.815

For hypothesis testing CFA was performed. Fit indexes (CMIN/df: 1.743; C.F.I.: 0.952; R.M.S.E.A.: 0.046) are within acceptance range (Tables 7 and 8).

Table 4 Discriminant validity

Constructs	Block chain	Flexibility	Agility	Competitive business performance
Block chain	**0.795**			
Flexibility	0.168	**0.864**		
Agility	0.333	0.170	**0.854**	
Competitive business performance	0.304	0.307	0.269	0**.859**

Table 5 Descriptive statistics for constructs

Constructs	N	Mean	Std. Error	Std. Deviation	Skewness	Kurtosis
Blockchain	360	4.2872	0.02569	0.48745	−0.242	−0.058
Flexibility	360	4.4631	0.02190	0.41557	−0.455	0.292
Agility	360	4.0601	0.03150	0.59762	−0.053	−0.460
Competitive performance	360	4.3354	0.02861	0.54290	−0.517	0.023

Table 6 Non response bias and common method bias

Construct	Category	Mean	t-value	Sig. of t
Blockchain	Early	4.420000	0.35124	0.7261
	Late	4.388889		
Flexibility	Early	4.360000	0.79799	0.4267
	Late	4.277778		
Agility	Early	4.390000	0.58766	0.558
	Late	4.333333		
Competitive business performance	Early	4.440000	0.167	0.8677
	Late	4.425926		

No. of late respondents: 54
No. of early respondents: 100 (randomly chosen)
Variance explained by single factor: 22.839% (less than 50%)

6 Discussion

Blockchain positively affects flexibility, agility and competitive business performance. These are two important supply chain parameters which collectively improves competitive business performance.

Table 7 Path analysis (structural model analysis results)

Path	Estimate	S.E	C.R	Significance
Flexibility ← blockchain	0.146	0.055	2.661	0.008
Agility ← blockchain	0.408	0.085	4.784	0.000
Agility ← flexibility	0.176	0.086	2.041	0.041
Competitive business performance ← flexibility	0.314	0.077	4.095	0.000
Competitive business performance ← blockchain	0.235	0.075	3.138	0.002
Competitive business performance ← agility	0.135	0.053	2.562	0.010
Indirect effect of blockchain on competitive business performance via flexibility and agility	0.105	–	–	0.004
Total effect of blockchain on competitive business performance	0.339	–	–	0.001

Table 8 Hypothesis testing results

Hypothesis	Result
H1–H6	Accept

7 Theoretical and Practical Implications

Theoretical implications—First, present study connects blockchain to supply chain parameters and CBP. Second, model is statistically fit and gives important information to researchers. Present study explains the path, how blockchain accrue competitive business performance. Third, how blockchain affects flexibility and agility.

Practical implications—First, the study can be used to conduct training sessions to supply chain experts. Second, marketing people can use this study about blockchain adoption. Third, technologists encourage developing more blockchain applications which are user friendly and accrue value to users.

8 Conclusion

This is the first ever empirical based study which connects blockchain with supply chain parameters. SCF and SCA are consider as important parameters and extremely useful to maintain competitive advantage to any organization.

9 Limitations

First, this study assumes that; all supply chains are same with similar needs. Second, current study assumes all regulations about blockchain are favorable to users. Third,

present study assumes that all privacy related issues are acceptable to blockchain users. Fourth, present study assumes blockchain as a stand-alone technology.

10 Future Scope of Work

Future research should focus on adoption models which can differ according to different blockchain applications. Also, effect of blockchain on different parameters of supply chain, e.g. trust and alignment, need to be explored. Different models of blockchain can have different effect on transaction cost, this need to be studied. Future studies can collect longitudinal data to explore effect of blockchain.

References

1. Craighead CW, Blackhurst J, Rungtusanatham MJ, Handfield RB (2017) The severity of supply chain disruptions: the design characteristics and mitigation capabilities. Decis Sci 38(1):131–156
2. Crosby M, Pattanayak P, Verma, Kalyanaraman V (2016) Blockchain technology: beyond bitcoin. Appl Inno 2(1):6–10
3. Davidson S, Filipi PD, Potts J (2016) Economics of blockchain. Available at: https://doi.org/10.2139/ssrn.2744751. Accessed 11 Feb 2018
4. Field A (2009) Discovering Statistics using SPSS. SAGE Publications, London
5. Goldman SL, Nagel RN, Preiss K (1994) Agile competitors and virtual organizations: strategies for enriching the customer. Van Nostrand Reinhold, New York, USA
6. Gravetter F, Wallnau L (2014) Essentials of statistics for the behavioral sciences, 8th edn. Wadsworth, Belmont, CA
7. Grewal R, Tansuhaj P (2001) Building organizational capabilities for managing economic crisis: the role of market orientation and strategic flexibility. J Mark 65(2):67–80
8. Griffin A (1993) Metrics for measuring product development cycle time. J Prod Innov Manag 10(1):112–125
9. Gupta YP, Somers TM (1992) The measurement of manufacturing flexibility. Eur J Oper Res 60(1):166–182
10. Hair JF, Anderson RE, Tatham RL, Black WC (2013) Multivariate data analysis. Pearson Education Limited
11. Ivanov D, Dolgui A, Sokolov B (2018) The impact of digital technology and Industry 4.0 on the ripple effect and supply chain risk analytics. Int J Prod Res 25(1):1–18
12. Kamble S, Gunasekaran A, Arha H (2018) Understanding the blockchain technology adoption in supply chains-Indian context. Int J Prod Res. https://doi.org/10.1080/00207543.2018.1518610
13. Kshetri N (2018) Blockchain's role in meeting key supply chain management objectives. Int J Inf Manage 39(1):80–89
14. Mason-Jones R, Towill DR (1999) Total cycle time compression and the agile supply chain. Int J Prod Econ 62(1):61–73
15. Mondragon AEC, Lyons AC, Kehoe DF (2004) Assessing the value of information systems in supporting agility in high-tech manufacturing enterprises. Int J Oper Prod Manag 24(12):1219–1246
16. Mougayar W (2016) The business blockchain: promise, practice and application of the next internet technology. John Wiley & Sons, Hoboken, New Jersey, USA

17. Narasimhan R, Das A (1999) An empirical investigation of the contribution of strategic sourcing to manufacturing flexibilities and performance. Decision Science 30(3):683–718
18. Nath V (2018) Statistical analysis using R. Kindle Direct Publishing, California, USA
19. Novak S, Eppinger SD (2001) Sourcing by design: product complexity and the supply chain. Manage Sci 47(1):189–204
20. Pereira JV (2009) The new supply chain's frontier: information management. Int J Inf Manage 29(5):372–379
21. Rai A, Patnayakuni R, Seth N (2006) Firm performance impacts of digitally enabled supply chain integration capabilities. MIS Q 30(2):225–246
22. Sethi AK, Sethi SP (1990) Flexibility in manufacturing: a survey. Int J Flex Manuf Syst 2(4):289–328
23. Sharifi H, Zhang Z (1999) A methodology for achieving agility in manufacturing organizations: an Introduction. Int J Prod Econ 62(1–2):7–22

Cloud Network Communication Performance Improvement Using a Stochastic Bandwidth Allocation and Swarm Optimization Algorithm

S. Dharmaraj and P. Kavitha

Abstract Cloud computing is fulfilling the dream of providing the highest resource utilization in the IT world. Many commercial applications also offer a wide range of shaded services. Owing to rapid increase in the usage of the internet, rapid access has also been the factor to the prosperity of the industry. Different services are built within the virtualized resources of cloud computing that allow us to perform the abstraction of the underlying resources. It offers flexibility, high capacity, and an ecological service-oriented mindset. In this work, algorithm development solves resource utilization, performance degradation, and availability issues. This problem requires an almost unlimited number of tasks assigned to cloud resources that are solved in polynomial time. The proposed Stochastic Bandwidth Allocation with Swam Optimization (SBA-SO) framework for dynamic network-based resource scheduling algorithms provides scalability and reliability by providing better resource utilization and minimum response times during migration. User requests arrive at the data center as bandwidth, response time and throughput quality check different parameters based on the request. Additive-polling load analysis is introduced to estimate each cloud datacenter load to categorize overload server and under load cloud servers. Each cloud resource monitors the usage and updates into the cloud index table. When the cloud suddenly increases the load, it searches other load servers to allocate to the user. The Swam Optimization method using a memetic hyper-heuristic algorithm is used to construct the network topology and establish the communication between servers. Optimization algorithms are also suitable for solving individual problems and can be used for managing cloud computing resources and scheduling resources.

Keywords Cloud computing · Memetic hyper-heuristic algorithm · Stochastic bandwidth allocation with swam optimization · Migration

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1 Introduction

Cloud computing offers a solution to this problem of high utilization of the resource and storage. It stores service providers so that all software, sites and infrastructure in the data center are easily accessed anytime, anywhere. In the last few years, Information Technology has embarked with "Cloud Computing", which brought revolutionary changes in the environment. Everyone who uses the Internet for their personal or professional work can involve cloud computing as a service. In traditional computing, it sometimes installs all the software needed to update the hardware.

Load balancing to distribute the work, it is a way to calculate the resources between all servers and network interface. The data that is distributed across multiple servers through a different algorithm in order to improve the performance and resource utilization. Load balancing in the cloud is achieved by off-the-shelf use and server racks to perform load balancing and achieve the classic perception of loads completely different from loads.

A distributed system is a process to distribute the load to other nodes to improve the response time, performance, and maximum use of resource utilization. It ensures that there are no idles when all servers are in use. Some servers are often very heavy and carrying heavy load against other nodes, although others may be idle or underloaded. Load balancing, it will be used to distribute the server that handles a small processing load in order to improve the overall performance. Performance degradation such as increased system diversity, population diversity, throughput occurs as the system size increases, and performance degradation is a major issue in the cloud. The cloud live migration process is shown in Fig. 1.

Here some vulnerability is appended while occupations are relegated. In networking, load balancing is used to avoid the overloading problem or under loading

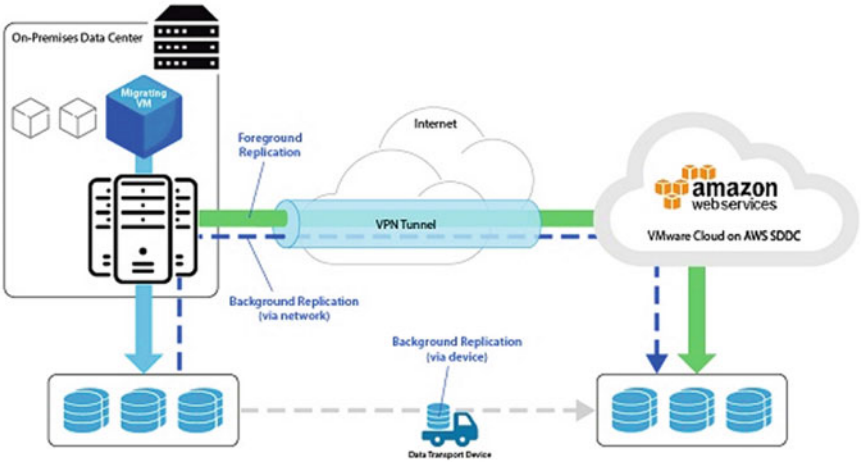

Fig. 1 Cloud live migration and resource allocation

any particular server. The main aim of a load balancer in the cloud environment is to implement and increase the response time, throughput by distributing the total load in servers. Optimization deals with finding the best solution which is optimal or near-optimal. For large problems, it is often difficult to find the optimal solution. Optimality is defined concerning some goal.

2 Literature Review

Some of the traditional method of assigning a description to the virtual machine. The author uses several algorithms in order to improve the performance of the cloud data center. In [1] author proposed a predictive control method based on cloud-based virtual machine computing infrastructure energy which are awareness integration. In addition, the Virtual Machines (VM) placement algorithm is proposed in [2] to determine the set of candidate hosts to reduce the migration of the migrated VM as soon as it is received. In this article [3], we propose a new solution called SnapMig to solve this problem and to improve real-time storage migration of virtual machines, and to effectively use existing VM snapshots on the source server. For the sake of reliability and availability of the virtual machine, snapshot of the VM, are widely used to recover a virtual machine for data loss of system crashes [4, 5].

To increase the flexibility of VMs, resources in the vehicle cloud are reused. These virtual machines enable the use of processes that can run without physical resources [6]. The physical resources are virtualized to the very today's data center based cloud computing network. Memory level, and change between the pause, in order to maintain the VM that is alive there are several steps during the migration process. Important network resources are consumed in this process [7]. Bandwidth allocation is difficult between transfers of multiple simultaneous real-time VMs in the margin cloud. It reduces migration time for single real-time VM migration between existing work margin clouds, ignoring QoS requirements for services running on VM during migration [8]. Virtualization, will be an important technology in both the fog and cloud computing to support the shared resources of the virtual machine (VM) a physical server in a coexistence (hosts) in [9].

The secured dynamic movement of virtual machines in the cloud alliance [10] has been proposed. The associated cost analysis is a serial port, parallel port and serial improvement strategy. The implementation of the new method [11], the CR/TR exercise, employs checkpoint for recovery and tracking regeneration techniques it provides a high-speed, transparent VM migration for a WAN environment and LAN. The synchronization algorithm runs on the execution trace and the source host until they coordinate the original execution and reach a consistent state by targeting the virtual machine.

Multiple bandwidth wireless network interface card used aggregation protocol control for emerging wireless devices Multipath TCP (MPTCP) protocol [12]. This article analyzes how much bandwidth can theoretically guarantee total travel time and downtime for real-time VM migrations. Proposed for new transmissions of the

[13] control mechanism to guarantee the calculated bandwidth. In order to avoid the possibility for Service Level Agreement (SLA) of vulnerability is required by the cloud applications, the paper [14] proposed iAware, a strategy which is conscious of interference lightweight for real-time migration of virtual machines.

This proposal is called the Adaptation Method (IMIG) to improve immigration [15]. It introduced the performance of some of the real-time of transition, in order to investigate the influence of important indicators on the Kernel-based Virtual Machine (KVM), made a number of experiments. Function and energy has been consumed by both the destination host and the source host. It is designed in [16] strategy to pre-find replication iterations to optimize different performance metrics for adequate bandwidth and VM migration over WAN. An underlying dedicated file system called MigrateFS can maintain virtual disks replicated and synchronized for brokerage purposes. In contrast, hypervisor virtual machines live to migrate (i.e., RAM and CPU state) [17].

Exhaust involves two main methods: Live migration of VN reconstruction and VM. For threat VN, EVLE remaps DRZ first with the least resource cost, then use the post replication techniques described in [18] migrating affect VM to a virtual node to reconstruct the corresponding. A geometric programming model [19] has been proposed to optimize bitrate allocation for real-time migration of multiple virtual machines and minimize total migration time. This analysis of the previous method contains important planning principles that reap more efficient solutions for more time and direct allocation to optimal task planning.

3 Implementation of the Proposed Method

In this proposed method, cloud network-based resource allocation is to improve cloud performance. The resource allocation technology integrates heterogeneous physical machines into one scheduling resource pool and creates a server which services cloud users. Additive polling load algorithm is based on the setting the non-overload and overload conditions and use resource thresholds for each node communication efficiency to be distinguished.

The bandwidth-based resource allocation method estimates the data transmission cost, response time, and throughput value and all information stored on the cloud index table. The memetic hyper-heuristic method assigns fitness value for each communication route and cloud server to allocate the best resource. The process of the proposed method is presented in Fig. 2.This paper proposes a Stochastic Bandwidth Allocation with Swam Optimization (SBA-SO) that uses task characteristics to map them to the resources with the shortest execution time while taking into account the fair use of available resource bandwidth to meet the quality of requirements of cloud users.

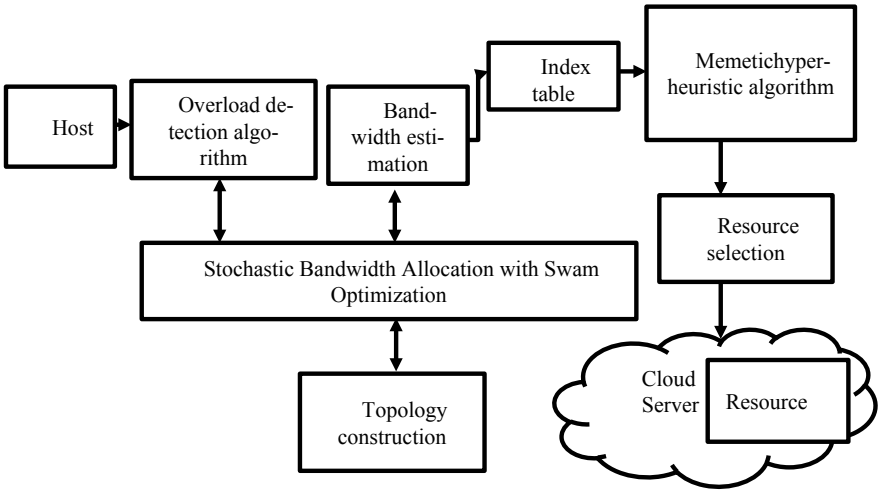

Fig. 2 Proposed method block diagram

3.1 Overload Detection Using Stochastic Approximation

Random approximations are an iterative method of finding loads using noisy observations. Algorithm, CPU utilization to consider the probability of exceeding a future overload threshold. If the predicted CPU use rate is larger than the overload threshold, the difference is called max_error, predicted CPU utilization or overload threshold has been found. The value of each VM finds high and low-load virtual machines. A list of virtual machines is given that are not utilizing the low-load virtual machine queue. The unique VM ID numbers and their respective physical mechanisms store high and low-load virtual machines. They are used to find virtual machines when the high load is light and map two-level thresholds namely high threshold and low load virtual machines. This mapping or indexing will not be emptied until the heavy queue is executed. The virtual machine's state is indexed by the upper and lower thresholds of the cloud PM resource table.

Physical Machine (PM) parameters, have been taken for analysis the VM resources such as CPU, memory, storage devices, and traffic, network bandwidth. Different targets (CPU, memory, Traffic and BW) have different scales and strategies. Therefore, there must be a formula to calculate host utilization. The estimation of VM capacity depends on the number of processors, MIPS, memory and Bandwidth.

$$\text{CPU utilization(u)} = \frac{Average\ idle\ task\ with\ no\ load * 100\%}{Average\ background\ Task\ with\ some\ load} \tag{1}$$

$$Actual\ CPU\left(A_{cpu}\right) = \frac{Scaled\ percent * 100}{Max\ value\ 8\ bit} \tag{2}$$

$$CPU = u + A_{cpu} \tag{3}$$

$$\text{Traffic feature(Tf)} = \approx \frac{\sum_{Rid}^{size(Cid)} + e^{-i\omega t}\{Route\ Process\ Time\}}{number\ of\ route(Rn) + Total\ Processing\ time} \tag{4}$$

$$\text{Memory} = \frac{actual\ memory\ size - used\ memory\ size}{total\ memory} * 100 \tag{5}$$

$$\text{Network utilization} = \frac{Transmission\ delay * bandwidth}{transmission\ delay + 2 * propagation\ delay} \tag{6}$$

This overload mode is monitored to track each PMs under the index table.

$$VM_{his} = \begin{bmatrix} CPU & net & mem & tf \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_i \\ x_{i+1} \\ x_n \end{bmatrix} \tag{7}$$

To identify each feature, VM overload host value using a Gradient function (Eq. 10). Get every feature between the -1 and $+1$ range within the PM ($n \geq 1$).

The generalization of stochastic gradient descent method has been determined to have been updated by the moving distance VM_i recursively by a distance d_i in the direction.

$$x_{i+1} = VM_i - d_i g(x_i, \varepsilon_i)\text{q} \tag{8}$$

The set of VM lists considers the x that maps $\text{x}_\text{i} - d_i g(x_i, \varepsilon_i)$ into the closest point of x. obtaining a gradient $g(x_i, \varepsilon_i)$ through direct observation of load.

$$T_c = \frac{N_w}{S_p} \tag{9}$$

The above equation is used to calculate data transmission cost (T_c), N_w denotes task weight, the processor processing speed S_p.

$$R_t = \sum_{i=1}^{n} \left(\sum_{j=1}^{m} T_c * c\left(S_p\right) \right) \tag{10}$$

The above equation is used to calculate the response time (R_t), cost of processor processing speed $c\left(S_p\right)$. The values are stored in index table.

Algorithm steps

Input: Cloud PM and VM list

To check the number of PM in the cloud server and estimate the load

For each PM in x

To estimate the actual load of each VM using Eqs. 1–6
To find the load of each VM if ($VM_i \leq 0.8 \&\& VM_i \geq 0.7$), then

To estimate the moving average closest point load value using an Eq. 7.
$VM_i^{host} \leftarrow \frac{n}{i-1}$ is host CPU corresponding state

End if

To create the VM host load table and maintain it add (VM_i^{host})
End for
If $VM[x(i)]$ higher then threshold load value then

To add the overload machine list ($VM[x(i)]$)

End if

Above the producer, using calculate the each VM host utilization and Stochastic Approximation method is useful to calculate the next observation.

3.2 VM Selection Using Correlation Policy

VM is selected and migrated from the host whose values of non-overload (index value 0 form VM table) VM are allocated to the host (H). To check sequence feature or equal load VM, the better destination VM server using correlation policy is to be selected. The Correlation policy is based on correlation load value and network of resources from the VM list. By utilizing the correlation between the resource usages of an application that runs on a resource server, it enhances the probability of server migration. The host overloading probability is higher when instances running on the host have a higher resource utilization correlation. As a result of this awareness, particular VMs with the highest correlation of PM utilization are selected for migration. At present, VM being migrated is denoted by index list (y).

$$VM_x = \begin{bmatrix} x_1 & x_1 & x_3 & x_n \\ .. & .. & .. & .. \\ x_{1,n-1} & x_{2,n-1} & x_{3,n-1} & x_{n,n-1} \end{bmatrix} VM_y = \begin{bmatrix} y_i \\ .. \\ y_n \end{bmatrix} \tag{11}$$

A multiple of correlation coefficients, in order to measure the quality of the associated predictor variables are used in multiple regression analysis.

$$R^2(VM_{host}) = \frac{\sum_{i=0}^{n}(VM(x-y))^2(VM(x_i)^2}{\sum_{i=o}^{n}(VM(x-y))^2} \tag{12}$$

This is related to the actual value as the square of the predicted value of the dependent variable.

3.3 Memetic Hyper-heuristic Algorithm

The proposed Memetic hyper-heuristic model functions are natural behaviors. Behavior of the cloud is the scientific study of natural behavior on the cloud network and evolutionary basis, particularly in natural environments. The bandwidth-based cloud network enables an accurate decision making of choosing the apt behavior and an apt set of actions for the current situation. To choose the apt behavior and its corresponding set of actions, it uses a hyper-heuristic notion. It considers all possible behaviors and their corresponding actions but selects the most appropriate behavior and its set of corresponding actions. The proposed generic model is divided into three major components. A high-quality solution must be produced by a balanced combination of global and local search. The non-dominant ranking is applied to the combined population and is large enough to meet the size of the population. The adaptive weight goal for virtual machine resources is another method of weight distribution. Adaptive weights span iterative changes in some relevant functions for each individual in the search space.

Algorithm steps

Step 1: To initialize the population to size of p
Step 2: Evaluate the fitness for every population VM_f

Initialize the fitness count $VM_f \leftarrow p$
Apply non-dominated sorting.
Compute Crowding Distance
While $VM_f < Max\left(VM_f\right)$ do, then

Initialize the set of Offspring to empty $O \leftarrow \{\}$
For each $VM_i \leftarrow$1 to P/2 do

To select the parent using an offspring value
To apply the polynomial mutation on both of O_1 and O_2 with probability.

End for
N number of decision parameter for j$\leftarrow$1 to n do

$O_j \leftarrow$ Preferential search (O_j)
$VM_f \leftarrow VM_f(j) + 1$ Update the fitness value

End for

End while

It computes the fitness only when a new individual is added to the population by designing the algorithm to select the best migration path and communication resource in a cloud server.

4 Result and Discussion

The proposed method simulation has considered 700 heterogeneous nodes with CPU cores, RAM, and different frequencies (MHZ) using a cloud environment to evaluate network-based live migration performance. The performance analysis section evaluates the proposed Stochastic Bandwidth Allocation with Swam Optimization (SBA-SO) method by comparing with existing Local Regression with Service Level Agreement (LR with SLAV) SnapMig methods.

4.1 Migration Time

Migration time, refers to the time required to transfer a virtual machine from the source to the destination node without affecting its availability. The network-based resource allocation during live migration and time taken for live migration depend on available network bandwidth. Migration (Mg) should be getting the minimum value

$$T_{Mg} = \int_0^T \sum_{i=0}^{n(s)} R(s) \tag{13}$$

The above Eq. 4 is used to calculate the Migration time (T_{Mg}) to switch over the task one executor server to another executor server. $n(s)$ refers to number server and $R(s)$ denotes status of server and T denotes number task.

The analysis of the average migration time comparison of proposed Stochastic Bandwidth Allocation with Swam Optimization (SBA-SO) and existing LR with SLAV, SnapMig is presented in Fig. 3. The proposed method SBA-SO has a lower migration time compared to existing LR with SLAV, and SnapMig which have a higher migration time.

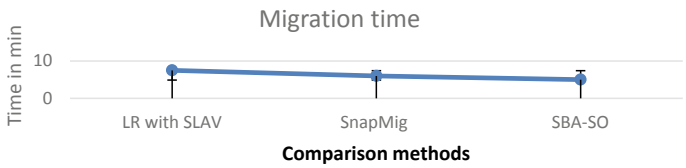

Fig. 3 Migration time comparison of the proposed SBA-SO

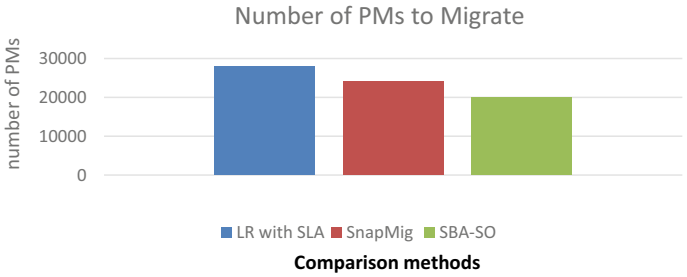

Fig. 4 PMs to migrate performance comparison of SBA-SO

4.2 Number of VM Migrations

If an overload condition or under-PM is found, for the merging of dynamic VM, the virtual machine has been selected for migration. The most important limiting factor in the migration process to be achieved by reducing the total number of VM migration to minimize the number of VM migration.

Figure 4 shows the results of the VM allocation algorithm's number of PMs to migrate. Simulation is performed in distinctive existing algorithms and proposed VM allocation algorithm. The proposed VM allocation algorithm reduces PMs needing migration, which means it efficiently finds overloaded PM for migration in the data center.

4.3 Average SLA Violation Ratios

Service Level Agreement Violations (SLAVs) are negatively correlated so that costs are reduced. The goal of the resource management system is to minimize the energy and SLA violations. Thus, the indicator will match the energy and SLA violations (ESVs) are captured simultaneously and expressed in energy consumption.

The analysis of the proposed SBA-SO search method and existing, Local Regression with Service Level Agreement (LR with SLAV) and SnapMig methods SLA violation is presented in Fig. 5. The proposed SBA-SO has a 0.09% low violation for 1500PMs, and the existing method LR with SLAV has a 0.1% higher SnapMig for 1500 PMs.

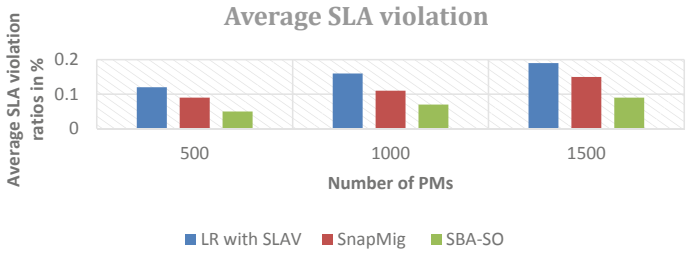

Fig. 5 Average SLA violation analysis comparison of the proposed SBA-SO

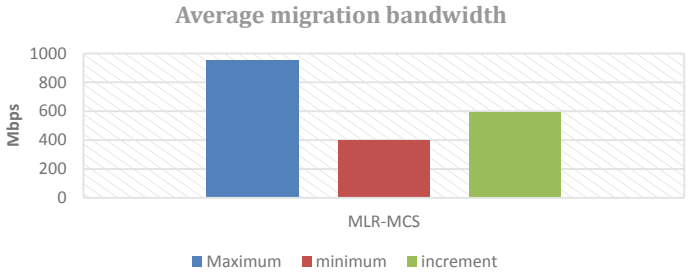

Fig. 6 Migration of bandwidth comparison of the proposed method

The SBA-SO method selects optimized network paths using a memetic hyper-heuristic search method to provide a higher bandwidth efficiency over live migration. SBA-SO method's comparison of maximum, minimum and increment bandwidth efficiency is shown in Fig. 6; results have proven that the proposed method provides more network performance.

5 Conclusion

To conclude this paper the proper management of resources is useful to both cloud service Provide (CSP) and cloud users. This research has proposed a novel live migration technique called Stochastic Bandwidth Allocation with Swam Optimization (SBA-SO) to balance the load in the Cloud systems. The proposed SBA-SO algorithm is done to perform providing better resource utilization and minimum response times during migration. The Swam Optimization method using a memetic hyper-heuristic algorithm is used to construct the network topology and establish the communication between servers. The proposed algorithm produced performance results are migration time $\left(T_{Mg}\right)$ 5 min, and Average SLA violation 0.09% for 1500PMs. The performance of the proposed algorithm has been analyzed and compared with two other

existing algorithms to understand the performance efficiency of the proposed SBA-SO method. This analysis confirms that the proposed method gives more satisfying results compared to existing methods.

References

1. Gaggero M, Caviglione L (2016) Predictive control for energy-aware consolidation in cloud datacenters. IEEE Trans Control Syst Technol 24(2):461–474. https://doi.org/10.1109/TCST.2015.2457874
2. Beloglazov, Buyya R (2015) OpenStack neat: a framework for dynamic and energy-efficient consolidation of virtual machines in OpenStack clouds. Concurrency Comput Pract Exper 27(5):1310–1333
3. Yang Y, Mao B, Jiang H, Yang Y, Luo H, Wu S (2018) SnapMig: accelerating VM live storage migration by leveraging the existing VM snapshots in the cloud. IEEE Trans Parall Distrib Syst 29(6):1416–1427. https://doi.org/10.1109/TPDS.2018.2790389
4. Cui L, Li B, Zhang Y, Li J (2013) HotSnap: a hot distributed snapshot system for virtual machine cluster. In: Proceedings of the 27th USENIX conference on large installation system administration (LISA'13), 2013, pp 59–74
5. Li J, Liu H, Cui L, Li B, Wo T (2012) iROW: an efficient live snapshot system for virtual machine disk. In: Proceedings of the 18th international conference on parallel and distributed systems (ICPADS'12), 2012, pp 376–383
6. Zhu L, Tan S, Zhang W, Wang Y, Xu X (2016) Validation of pervasive cloud task migration with colored petri net. Tsinghua Sci Technol 21(1):89–101. https://doi.org/10.1109/tst.2016.7399286
7. Meneguette R, Boukerche A (2019) An efficient green-aware architecture for virtual machine migration in sustainable vehicular clouds. IEEE Trans Sustain Comput:1–1. https://doi.org/10.1109/TSUSC.2019.2904672
8. Mandal U, Chowdhury P, Tornatore M, Martel CU, Mukherjee B (2016) Bandwidth provisioning for virtual machine migration in cloud: strategy and application. IEEE Trans Cloud Comput:1–1. https://doi.org/10.1109/TCC.2016.2545673
9. Osanaiye O, Chen S, Yan Z, Lu R, Choo KR, Dlodlo M (2017) From cloud to fog computing: a review and a conceptual live VM migration framework. IEEE Access 5:8284–8300. https://doi.org/10.1109/ACCESS.2017.2692960
10. Addya SK, Turuk AK, Satpathy A, Sahoo B, Sarkar M (2019) A strategy for live migration of virtual machines in a cloud federation. IEEE Syst J 13(3):2877–2887. https://doi.org/10.1109/JSYST.2018.2872580
11. Liu H, Jin H, Liao X, Yu C, Xu C (2011) Live virtual machine migration via asynchronous replication and state synchronization. IEEE Trans Parall Distrib Syst 22(12):1986–1999. https://doi.org/10.1109/TPDS.2011.86
12. Baccarelli E, Scarpiniti M, Momenzadeh A (2018) Fog-supported delay-constrained energy-saving live migration of VMs over multipath TCP/IP 5G connections. IEEE Access 6:42327–42354. https://doi.org/10.1109/ACCESS.2018.2860249
13. Zhang J, Ren F, Shu R, Huang T, Liu Y (2016) Guaranteeing delay of live virtual machine migration by determining and provisioning appropriate bandwidth. IEEE Trans Comp 65(9):2910–2917. https://doi.org/10.1109/TC.2015.2500560
14. Xu F, Liu F, Liu L, Jin H, Li B, Li B (2014) iAware: making live migration of virtual machines interference-aware in the cloud. IEEE Trans Comp 63(12):3012–3025. https://doi.org/10.1109/TC.2013.185
15. Li J et al (2015) iMIG: toward an adaptive live migration method for KVM virtual machines. Comp J 58(6):1227–1242. https://doi.org/10.1093/comjnl/bxu065

16. Mandal U, Chowdhury P, Tornatore M, Martel CU, Mukherjee B (2018) Bandwidth provisioning for virtual machine migration in cloud: strategy and application. IEEE Trans Cloud Comput 6(4):967–976. https://doi.org/10.1109/TCC.2016.2545673
17. Tsakalozos K, Verroios V, Roussopoulos M, Delis A (2017) Live VM migration under time-constraints in share-nothing IaaS-clouds. IEEE Trans Parall Distrib Syst 28(8):2285–2298. https://doi.org/10.1109/TPDS.2017.2658572
18. Bao N, Kuang M, Sahoo S, Li G, Zhang Z (2020) Early-warning-time-based virtual network live evacuation against disaster threats. IEEE Internet of Things J 7(4):2869–2876. https://doi.org/10.1109/JIOT.2019.2963319
19. Cerroni W, Esposito F (2018) Optimizing live migration of multiple virtual machines. IEEE Trans Cloud Comput 6(4):1096–1109. https://doi.org/10.1109/TCC.2016.2567381

Comparison of Read Stability and Write Ability of Low Power Nanometric SRAMs

C. Gangaiah Yadav, C. Keerthi, and A. Kiran Kumari

Abstract Present entire world depended on digital technology. From taking food of the humans to their health condition monitor by using digital devices. Now a days mobile phone is became as daily usage thing for every human. In digital devices for storing of past data for future reference purpose need memory unit. The Static Random Access Memories plays a powerful role in digital world. Designing of low power SRAM is a complex task now days. The Stability is the very important characteristic to describe the effectiveness of SRAM cell. The Read stability and Write ability of SRAMs describe by using Static Noise Margin. The conventional 6T SRAM suffering with stability problem because read and write operations are directly accessed with BL and BL_Bar pins. For improving read stability and write ability use an extra transistor in design of SRAM. The 7T SRAM has better stability than compare to the conventional 6T SRAM.

Keywords Static RAM · 6T SRAM · 7T SRAM · Static noise margin · Read stability · Write ability

1 Introduction

There are two types of RAMs. These are Static RAM (SRAM) and Dynamic RAM (DRAM). SRAM design with different number of transistors but DRAM transistor design with single transistor. SRAMs are classified based on the number of transistors used in this design i.e. 6T, 7T, 8T and 9T SRAMs. The different types of SRAMs designed based on operations such as Read and Write operation. In SRAM, during Read operation the data is required as well as during write operation the updating of the contents. The SRAM design to operate in Read/Write mode operations should have stability and reliability on Read and Write operation, respectively.

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Low power design techniques aim at reducing the consumption of the power per unit time. The total power consumption [1] of the circuit mainly divided into 2 categories, i.e. dynamic power as well as static power. The dynamic power consumption is consumed when the devices are in active mode and the signals are propagated from one part to the other. On the other hand, the static power consumption is consumed when the devices are powered up but there is no activity in the device and thus, no signals are propagated. Both the dynamic as well as static power is likely for increasing in the years to come. Moreover, it is predicted that the dynamic power consumption doubled [2] from 180 nm technology to 90 nm technology and 90 nm technology to 45 nm technology devices, whereas the static power consumption increased by 6.5 times. The reducing of total power consumption [3] of digital circuit concentration on reducing static power is must. This crystal clearly poses a researcher's challenges in area of sophisticated and advanced hand held electronic devices.

2 Literature Survey

Chhillar and Yadav [4] designed and simulated 6T SRAM with three different technologies like 180 nm, 90 nm and 45 nm by using H-Spice simulator. In this work also designed 7T SRAM along with 6T SRAM with three technologies. Measured the static power, dynamic power, average power and stability by simulating both 6T and 7T SRAMs. The 7T SRAM improved the write speed than compare to the 6T SRAM but consumed more area. The Read SNM and Write SNM of 7T SRAM was improved than compare to the 6T SRAM. The drawback in this work was not explained about leakage current and delay.

Kumar and Choudhary [5] designed 6T SRAM by using Visual TCAD tool. The proposed 6T SRAM designed with 90 and 180 nm technologies. In this work described the scaling of transistor effects on the read and write operations of SRAM. In this work also designed traditional 6T SRAM cell with 90 and 180 nm technologies. The performance of the proposed 6T SRAM cell compared with traditional 6T SRAM cell. In this work scaling done in the design of 6T SRAM. Due to scaling power dissipation reduced but stability of read and write operation also reduced. The drawback in proposed work was that it has more delay and high leakage current.

Shivaprakash and Suresh [6] proposed a 6Transistor SRAM for low power and high speed applications. The proposed 6Transistors SRAM designed with 90 nm technology and simulated by using the Cadence Tool. The proposed work designed and explained about only 90 nm 6T SRAM. In this work SRAM performance analyzed with SNM, read margin and write margin parameters. SNM is a most important factor which effects the stability of read and write operation. The data retention voltage calculated because it reflects the high speed of the 6T SRAM. The drawback in the proposed work was that it gave only SNM analysis.

Rath and Panda [7] designed 6T SRAM by using Cadence Virtuoso environment. In proposed work designed 6T SRAM with 180 nm, 90 nm and 45 nm technologies.

In proposed work given the analysis of power and delay only. The performance of 180 nm, 90 nm and 45 nm 6T SRAM measured and compared. The 45 nm 6T SRAM has low power dissipation than compare to the remaining SRAM designs. But SNM of 45 nm 6T SRAM reduced than compared to the 180 nm and 90 nm 6T SRAM designs. The drawback of this work was that it has more delay, i.e. 0.6 ns and 90 nm 6T SRAM has more SNM for write operation than compare to 45 nm 6T SRAM.

Lokesh et al. [8] designed and simulated proposed 6T SRAM by using the Tanner tool in the S-EDIT. The proposed work designed with 250 nm technology with supply voltage 2.5v. In this work given only power analysis. In this work performance of proposed design observed if scaling operation done in the circuit. The scaling reduced the size of transistor and improved the speed. Due to scaling stability of read and write operation reduced. The draw back in proposed work was not explained about the leakage current and delay of 6T SRAM.

Sridhara and Biradar [9] proposed the sub-threshold 6T SRAM cell for providing better stability as well as the low leakage current. The designed circuits simulated by using the HSpice in 90 nm. The process technology was used with Bsim4 model MOS transistor with of level 54.The drawback in the proposed work was that it has more delay.

Singh and Lakhmani [10] proposed a single ended six transistors SRAM for ultra-low voltage applications. The designed single ended 6T SRAM simulated by using SPICE simulator. In this SRAM data Read out operations performed via single ended bitline referred it as data line. In this work also designed traditional 6T SRAM and compared the performance with proposed design. In this design has more dynamic power dissipation and leakage current.

3 Stability of SRAMs

The read SNM and write SNM [11] are commonly using matrices for deriving read stability and write ability of SRAMs. For improving stability of SRAMs good SNM [12] is required that is also depends on cell ratio and pull up ratio. The read SNM measure from voltage transfer characteristics curve of SRAM cell. The write SNM is defined as a minimum bit line voltage required to flip the state of SRAM cell. The cell ratio defined as ratio of size of the access transistor to size [13] of the pull down transistor. Pull up ratio defined as ratio of size of the pull up transistor to size of the access transistor. The cell ratio [14] and pull up ratio given in below Eqs. 1 and 2.

$$\text{Cell ratio} = \frac{\left(\frac{W}{L}\right)Access}{\left(\frac{W}{L}\right)Pull\ down} \tag{1}$$

$$\text{Pull up ratio} = \frac{\left(\frac{W}{L}\right)Pull\ up}{\left(\frac{W}{L}\right)Access} \tag{2}$$

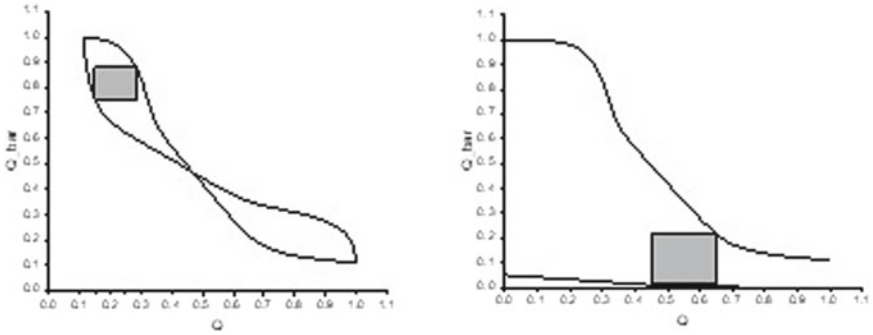

Fig. 1 Voltage characteristics curves of 6T SRAM during read operation and write operations

Table 1 SNM of read and write operations

SRAM circuits	Read SNM (mV)	Write SNM (mV)	Cell ratio (CR)	Pull up ratio (PR)
6T SRAM	125	200	1	1
7T SRAM	129	260	1	1
8T SRAM	135	200	1	1
9T SRAM	138	215	1	1

In 45 nm SRAMs width and length of access transistor, pull down transistor and pull up transistor are L = 45 nm and W = 120 nm, Cell ratio = 1, Pull up ratio = 1.

The voltage transfer characteristics [15], 16 of 6T SRAM during read and write operations shown in Fig. 1. The write SNM [17] measure based on this voltage characteristic curve. The minimum bit line voltage required [18] to flip the state of SRAM cell during write operation is write SNM. The SNM of read and write operations [19] are given in Table 1.

4 Results

The SRAM has a good read stability when it having high read SNM. And SRAM has good write ability when it having minimum bit line voltage to flip the state of SRAM cell during write operation. From Table 1, the increasing number of transistors in design of SRAM improve the stability.

The 9T SRAM [20] has a better stability than compare to the 8T SRAM [21]. Similarly 8T SRAM has better stability than 7T SRAM and 7T SRAM has better stability than 6T SRAM. The comparison of stability of the four SRAMs given in Fig. 2. Among these four SRAMs, 9T SRAM has good read stability and write ability because it having high read SNM, small write SNM i.e. 138 mV, 185 mV than compare to the 6T, 7T and 8T SRAMs.

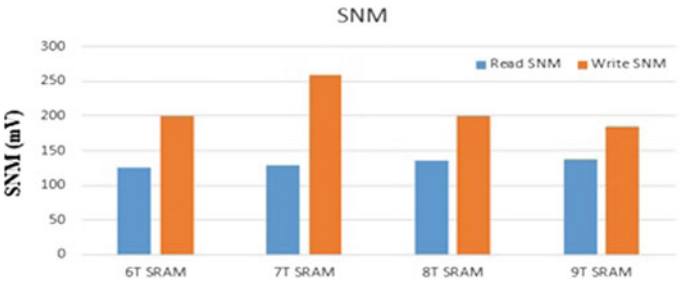

Fig. 2 Comparison of read and write SNM of four SRAMs

5 Conclusion

Over the last decade a tremendous increase has been witnessed in the demand of hand-held devices, for Example, PDAs, laptops as well as smart-phones. For these devices, battery life is an immensely important constraint of limiting the support for additional features in such devices and researchers around the globe have put their efforts together for extending it by using low-power design techniques. Low power design techniques aim at increasing the battery life while supporting the demand for additional features in such devices. He entire world is showing more interest on small size electronic devices which more compatible to use and carry anywhere with them. The size of electronic devices also depends on size of SRAMs. The SRAM cells are playing a pivotal role in microprocessors technology.

To improve both Read and Write stability of the basic 6T SRAM cell included an extra access transistors to 6T SRAM circuit. Designed SRAM with 6, 7, 8 and 9 Transistors in three nanometric technologies.

References

1. Mamatha S (2013) Energy efficient SRAM. Doctoral dissertation, IIIT, Hyderabad
2. Jadav S, Vikrant (2012) Design and performance analysis of ultra low power 6T SRAM using adiabatic technique. Int J VLSI Des Commun Syst (VLSICS) 3(3)
3. Kumar R, Choudhary S (2014) Simulation of 6T SRAM at 90 nm and 180 nm technology and study the effect of scaling on read and write operation. Adv Res Electr Electron Eng 1(4)
4. Chhillar M, Yadav G (2013) Average and static power analysis of a 6T and 7T SRAM bit-cell at 180 nm, 90 nm, and 45 nm CMOS technology for a high speed SRAMs. DOI: 02.AETAEE.2013.4.510, Association of Computer Electronics and Electrical Engineers, 2013
5. Kumar R, Choudhary S (2014) Simulation of 6T SRAM at 90 nm and 180 nm technology and study the effect of scaling on read and write operation. Adv Res Electr Electron Eng 1(4)
6. Shivaprakash G, Suresh DS (2016) Design of low power 6T-SRAM cell and analysis for high speed application. Indian J Sci Technol 9(46). https://doi.org/10.17485/ijst/2016/v9i46/106144
7. Arumí D, Rodríguez-Montañés R, Figueras J et al (2016) Test escapes of stuck-open faults caused by parasitic capacitances and leakage currents. IEEE Trans Very Large Scale Integr (VLSI) Syst 24(5):1739–1748

8. Rath S, Panda SK (2017) Analysis of 6T SRAM cell in different technologies. In: Circulation in computer science MCSP—2017
9. Sridhara K, Biradar GS (2020) Performance analysis and design of 6t sram cell using different circuit techniques. Int J Adv Sci Technol 29(7s)
10. Singh S, Lakhmani V (2014) Read and write stability of 6T SRAM. Int J Adv Res Electron Commun Eng (IJARECE) 3(5)
11. Mishra JK, Misra PK (2020) A low power 7T SRAM cell using supply feedback technique at 28 nm CMOS technology. In: 2020 7th International conference on signal processing and integrated networks (SPIN)
12. Narah P, Nath S (2018) A comparative analysis of SRAM cells in 45 nm, 65 nm, 90 nm technology. Int J Eng Res Appl 8(5 Part I). ISSN: 2248-9622
13. Bikki P, Reddy TMK (2019) Analysis of low power SRAM design with leakage control techniques. IEEE
14. Kassa S, Neema S (2019) Energy efficient novel design of static random access memory cell in quantum dot cellular automata approach. IJE, May 2019
15. Agarwal P, Saxena N, Tripathi N (2013) Low power design and simulation of 7T SRAM cell using various circuit techniques. Int J Eng Trends Technol (IJETT) 4(5)
16. Saxena S, Mishra S (2016) Analysis of leakage current and SNM for 7T SRAM cell in nanometre era. Int J Recent Trends Eng Res (IJRTER) 2(10)
17. Thomas O, Vinet M, Rozeau O, Batude P (2008) Compact 6T SRAM cell with robust read/write stabilizing design in 45 nm monolithic 3D IC technology. IEEE
18. Kariyappa BS, Madiwalar B, Palecha N (2013) A comparative study of 7T SRAM cells. Int J Comp Trends Technol (IJCTT) 4(7)
19. Sulaiman SM, Jaison B Dr (2018) Performance of 7T SRAM using triple threshold voltage CMOS technology. Int J Pure Appl Math 119(15)
20. Rukkumani V, Saravanakumar M (2016) Design and analysis of sram cells for power reduction using low power techniques. IEEE
21. Bharti S, Kumar A, Kandari R (2019) Performance analysis of SRAM cell designed using MOS and floating-gate MOS for ultralow power technology. IEEE

Forecasting Mental Disorders Through Aspect Identification from Social Media Posts

Shaurjya Mandal and Banani Saha

Abstract The traditional way of detecting mental disorders continues to be through complex psychological screening in a clinical environment. The process is often carried out over days and requires significant medical expertise in the psychological domain. Also, the diagnosis of these disorders is often late thus making it difficult to be treated. Most existing data for computational analysis is carefully collected and curated before analysis is carried out. This causes a dearth of publicly available datasets. We have designed a computational approach through which we analyze over a million tweets over Twitter from a set of people with self-proclaimed mental disorders. Our model could effectively identify the necessary aspects for different disorders and predict the onset of mental illness before the patient comes to realize the disorder. The proposed approach functions strictly on publicly available data with no added annotations. It predicts the occurrence of mental disorders with an overall accuracy of 89.6%.

Keywords Mental health · Deep learning · Social media

1 Introduction

In 2004, the World Health Organization predicted that by 2030, unipolar mental disorders shall be the most prominent lifestyle disease in the world [1]. Many mental disorders end up causing more severe conditions in the patients including disability [2]. The countries at the lower end of the economic strata allot an insignificant budget towards the diagnosis, treatment, and prevention of mental disorders. Even in more advanced nations of the world, low importance is attached to the psychological welfare of their population. The cases of depression still lack effective diagnosis which even deprives them of the required minimal treatment. A large proportion of the world's government tries offering primary healthcare facilities for treating mental

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health disorders, but a large chunk of them is unable to provide adequate healthcare programs and the necessary budget for the treatment [3].

A proper stepwise diagnosis of such disorders often requires multiple visits followed by rigorous tests and examinations. But, in most places, this process is replaced by a patient's reported experiences or behavior noticed by certain relatives or stakeholders. This heavily reduces the accuracy of the process thus leaving the disorders undetected. Social media becomes a popular means to investigate and process the changes in the behavior of the users. Earlier, through a variety of posts on Twitter, it has become possible to carry out various tasks like collective sentiment analysis and the prediction of cybercrimes [4]. A large part of the study comes from posts showcasing unusual behavior or signs of depression. Social media posts allow us to link the context of the post with symptoms of stress, anxiety, and other mental illness [5].

Since social media forms an integral part of people's lives, system analysis of social media posts can potentially give rise to insights for early detection and prediction of mental disorders. A platform such as Twitter consists of a stream of posts for the same individual. It becomes simple to obtain the information and possibly notice trends as part of an effective screening process for mental disorders. Further diagnostic measures could be taken based on the noticed behavior in an individual account. Prior studies report that people with depression have more negative expressions and show greater negative emotion [6, 7]. Studies also suggest that people with depression and suicidal individuals are detached from others and are preoccupied with themselves. They make greater use of self-referenced words [8]. But the millions of users on Twitter make it impossible to medical experts to monitor such data.

In this study, we perform aspect-based analysis with a large dictionary of words based on the prominence of various mental disorders. The proposed approach further computes the intensity of the targeted aspect through sentiment evaluation of the statements. The deep learning architecture analyses such trends and predicts a possible chance of mental disorder occurring in the user. Section 2 discusses the related works. Section 3 gives details of the work that include data gathering, pre-processing, and training. Section 4 discusses the results obtained from our model. Finally, Sect. 5 concludes the work and proposes the future work.

2 Related Works

Early attempts were made to excavate depression and Post Traumatic Stress Disorder (PTSD) symptoms from Twitter data. Park et al. [9] discovered that emotionally negative tweets from Twitter often serve as strong indicators of depression among the users. De Choudhury et al. [10] were the first to recognize postpartum depression in mothers shortly after delivery based on the variation in their Twitter feeds. Through a subsequent study, De Choudhury et al. [7] could find concrete signs of depression

through tweets of individuals suffering from depressive disorders. In another analysis, De Choudhury et al. [11] added social isolation and death of social activity in mothers suffering from postpartum depression. This analysis was performed through analyzing Facebook data. Studies with the objective of identifying PTSD markers from Twitter data [12, 13] had very limited results. The burgeoning literature in the social media sites, especially Twitter, led to the fabrication of a significant number of informed inferences regarding the mental health of the users. De Choudhury et al. [6] designed a predictive approach to forecasting the onset of depression based on the available tweets in a time window a year prior to the self-proclaimed depression episode. The model did not account for the exact date of the first depression diagnosis for each individual.

3 Work Details

The paper elaborates on an approach towards achieving accurate forecast regarding the mental health of an individual. The data used for the analysis are publicly available tweets from Twitter. The work can be segregated into 3 primary modules.

- The first module deals with the efficient collection of data and optimal storage of user information with adequate mapping.
- The next module involves the preprocessing of the tweet data and extraction of the sentiment and polarity of the tweet.
- The final module provides the details of the proposed deep learning architecture and elaborates on the training parameters.

3.1 Data Gathering

The proposed approach deals with data directly mined from Twitter after detecting users with self-proclaimed cases of mental disorders. Thus, it is absolutely essential to extract the data effectively before further analysis can be performed. Figure 1 displays a basic overview of the extraction setup from Twitter.

The web crawler or the engine communicates with the Twitter API using a two-way bridge. The system requests specific tweets from the API based on user, date, or type. To simplify the process of aspect identification, the tweets containing image data or particular hyperlinks have been ignored while extraction. The Twitter API is responsible for communicating and transmitting the desired results to the web crawler.

Before the system can request data through the Twitter API, it is essential to make sure that the relevance of these tweets is established. A predefined dictionary of words commonly linked to a particular disorder is coined before the request is made. We have referred to these linked words as keywords. The keywords primarily consist of a broad range of possible words in the tweets. Since delivering a large set

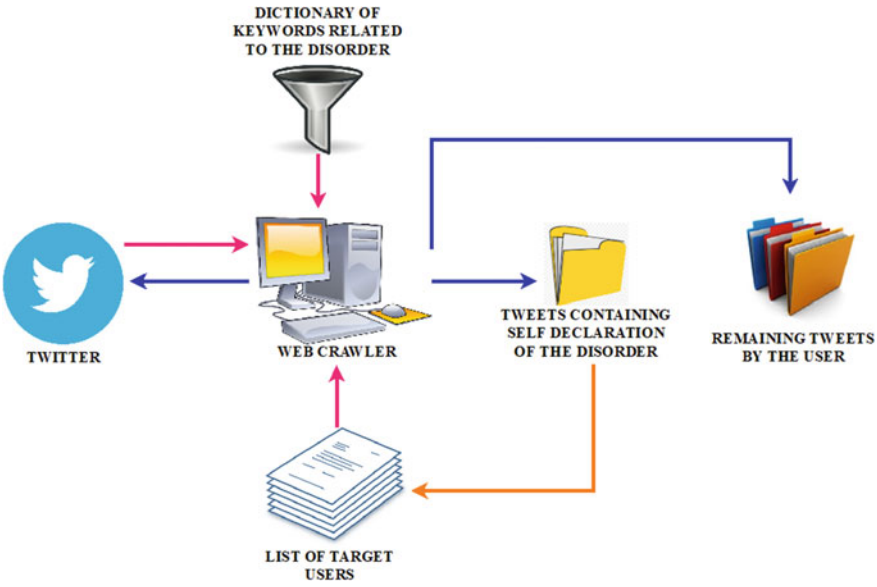

Fig. 1 Data collection

of words while making a request through the API is a computationally expensive process, the dictionary is stored in the system itself and repeated matching is carried out after each fetch is executed through the interface.

To keep track of the users, the relevant tweets based on the dictionary are stored separately. This allows the mapping to be carried out with a reduced set of tweets. The mapping enables us to group the tweets based on the user's authorized account and thus achieves a set of users with a probable disorder. The set stores the user id as the primary key and the crawler consequently requests the API for the rest of the tweets of the user. These tweets, after being obtained, are mapped to the respective user ids and stored separately.

3.2 Data Preprocessing

The raw data obtained from the multiple requests needs to be processed before it can be placed into the deep learning model for the final risk factor prediction to be carried out. It is crucial to quantify the aspects and determine the polarity of the tweets before the collective analysis is achieved. Figure 2 provides a comprehensive layout of the steps involved in the discussed method. A strong feature definition allows better aspect concatenation and sentiment classification in the subsequent steps. In our approach, we define the features corresponding to four disorders: depression, anxiety disorders, bipolar disorder and post-traumatic stress disorder (PTSD).

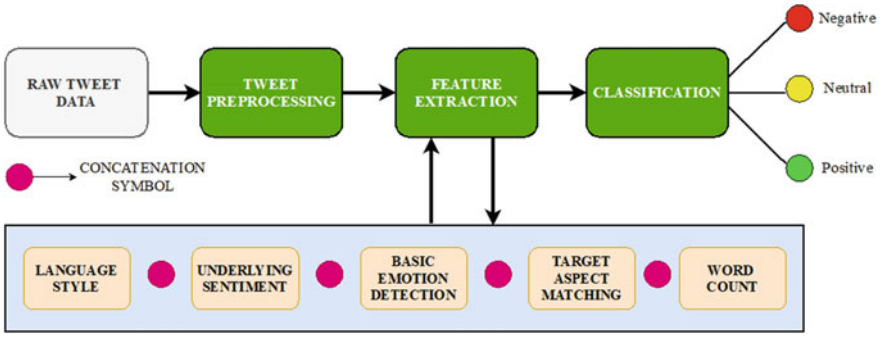

Fig. 2 Tweet preprocessing

Tweet Preprocessing. The tweet data obtained is in a raw text format. Initially, speech tagging is performed, through which the sentence is disintegrated into various parts. These primarily consist of verbs, adjectives, names, and nouns. This also allows the separation of punctuation, hashtags, and emoticons. The set of tags applied in the approach is ideally a reduced set of the Peen Treebank compendium [14]. Since some amount of filtering has been incorporated in the data collection phase, the requirement of noise removal is compromised. It only involves getting rid of precarious shorthand texts which are irrelevant to our analysis.

Tweets are frequently characterized by emoticons, which often form the best basis of sentiment classification for an individual tweet. The sentiment consistency theory establishes a strong correlation between the emoticons and the polarity of the posts [15]. Also, the platform-independent features or the n-gram features have been extracted [16]. This compares the word used in the post to the words in the entire corpus. This gives way to the identification of language patterns helpful for classification and analysis.

Feature Extraction. The extracted features form the basis for the polarity determination and classification of the tweets. The quantitative inference from a number of factors is concatenated to provide a highlight of the most prominent features.

The language style identified in the tweet preprocessing stage forms an important feature to match and consolidate the claims. The underlying sentiments are obtained from the structure of the sentences and the basic emotion of the tweet is often characterized by the usage of polar words. The placement of the emoticons as a part of the tweet and the handling performed in the preprocessing stage usually form the supporting framework for the determination of basic emotion and underlying sentiments.

The tweets further go through aspect-based analysis during this phase. The aspect for the targeted disorder is defined in the feature definition stage of the process. Our method leverages the existing definition of the feature to perform repeated aspect matching. The processed tweets are represented in the Aspect Aware Sentence Representation (AASR) format for faster aspect identification [17]. The word count is

obtained from the dissociation of the sentence is stored as a comparatively weak indicator of the intensity of the post.

Classification. Classification is the final step of the preprocessing module. The concatenated inference from the feature extraction phase forms the basis of classification. The tweets are broadly classified into positive, negative, and neutral tweets. Since the objective is projected at forecasting mental disorders, the negative tweets form the basis of prediction and are fed into the proposed deep learning model.

3.3 Training the Model

Mental disorders constitute a huge share of lifestyle diseases. To treat them or prevent them from reaching an acute stage, it is necessary to forecast the onset of these diseases as early as possible. It is necessary for our model to capture the time-evolving nature of the indicators to accurately arrive at the desired prediction. Our proposed model has been designed to capture the temporal patterns while exploiting the inter-aspect relations in the tweets. The memory representation is coined to accommodate both single and multiple memory hops to assure higher veracity [18]. Figure 3 shows a comprehensive representation of the proposed architecture of the deep learning model.

A set of 4 sequential Gated Recurrent Units (GRUs) pipelined with a set of 3 consecutive Long Short-Term Memory (LSTMs) forms the initial module of training before connecting to the input memory. Two GRU sets, having 2 components each are separated by an LSTM network. The output from the final GRU is fed into the

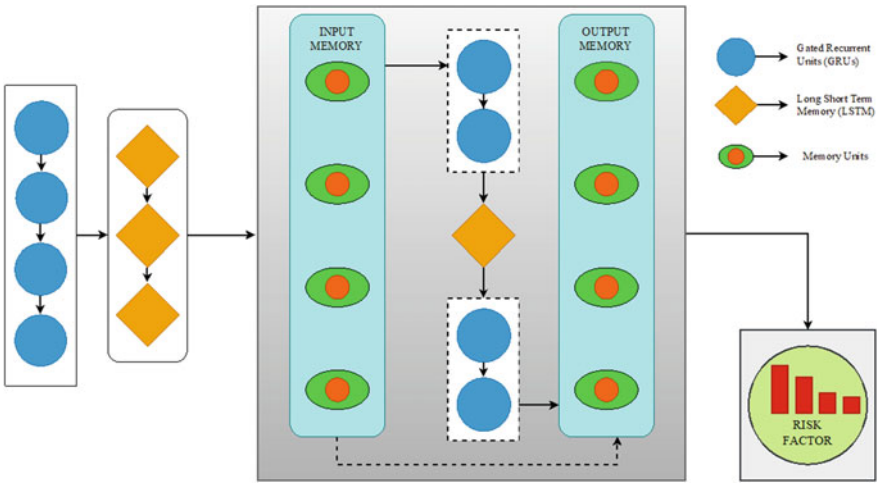

Fig. 3 The proposed architecture

output memory. A total of 46 epochs were required to train the model and the Softmax activation function has been used to determine the risk of the particular disorder. A dynamic threshold is determined depending upon the number of tweets processed or the general polarity of the tweets determined during the classification phase. The threshold determines the risk factor at which our proposed system will generate an alert if a certain mental disorder.

Stochastic Gradient Descent (SGD)-based ADAM algorithm [19] has been used for optimization. The adaptive learning rate is maintained at 0.1 owing to its parameter-wise learning scheme. Grid-search allows effective hyperparameter tuning to assure greater veracity.

4 Computational Results

The data consists of 1,005,672 tweets collected from a total of 1567 users. A total of 700,162 tweet data from 1002 users has been used to train the model and 305,510 tweets from the rest 565 users make our testing set. The users belonging to the testing set can be further divided into 115 self-proclaimed depression patients, 138 self-proclaimed anxiety patients, 179 self-proclaimed bipolar disorder patients, and 133 self-proclaimed PTSD patients. Table 1 shows the accuracy across all the disorder groups. Accuracy here is computed as the ratio of the number of correctly identified patients to the total number of patients with the given disorder.

Table 1 shows the accuracy of the model when the complete set of sample tweets have been passed for the forecast. It achieves an accuracy of 89.6%. But it is essential for our trained model to perform early predictions. If the proposed model is able to forecast and generate alerts regarding a possible mental disorder early, the patient has a chance of receiving more effective medical care. In this case, an early screening corresponds to the ability to forecast using a minimal number of initial tweets when sorted by date. So, while testing our trained model, we divide the tweets of the users into regular batches and test the outcomes.

Table 1 Performance across different disorders

Mental disorder	Total patients	Correctly identified	Accuracy percentage (%)
Depression	115	109	94.7
Anxiety disorders	138	126	91.3
Bipolar disorders	179	151	84.3
PTSD cases	133	120	90.2
Total cases	565	506	89.6

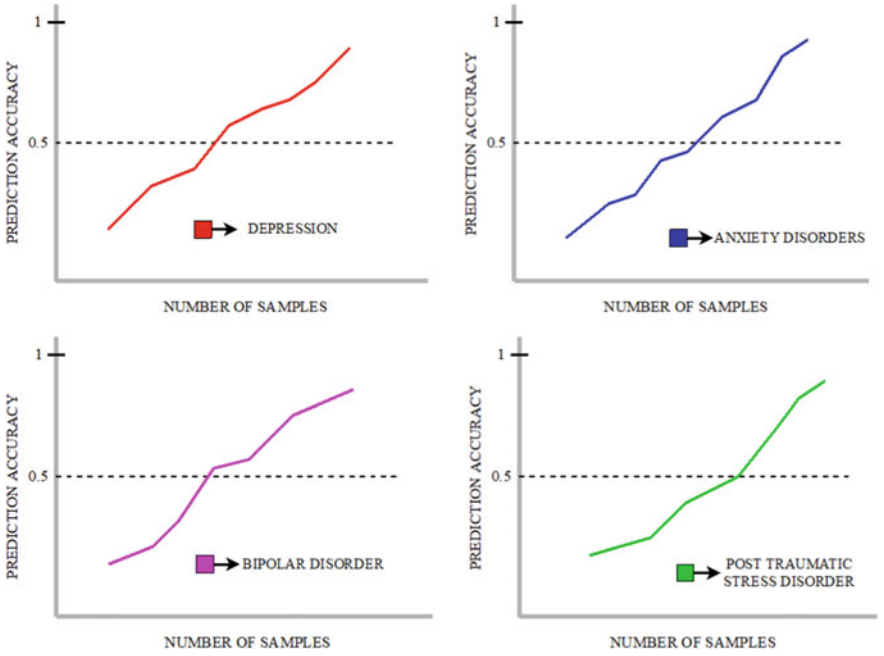

Fig. 4 Performance across increasing number of samples

Figure 4 demonstrates the performance of the trained model across the self-proclaimed patients of all the 4 mentioned disorders. Each graph correlates with each detection of trend regarding mental disorders along with the forecasting ability of our model. After each observation, the next batch of tweets are appended to the former batches and the accuracy is noted. The proposed model is able to establish uniformity in the trends observed in the tweets. This is given by the monotonically increasing nature of the tweets across all the four explored disorders.

5 Conclusion

The mental health of the people has been a burning topic of research for the past decade. Mental disorders such as depression are translating into prominent lifestyle diseases that shall affect millions. The proposed work attempts to achieve accurate forecasting of these disorders based on publicly available data. With the rapidly growing population, it becomes impossible to monitor mental health individually. The work aims to leverage the limited markers to identify the growing disorders and alert the individual accordingly. The paper discusses results for only 4 types of mental disorders. In the future, it is possible to define more mental disorders and take into consideration sentiments from images to derive an even more accurate

solution. Moreover, the expertise of psychology can be used to provide stronger feature descriptions for the disorders.

References

1. World Health Organization (2013) Investing in mental health: evidence for action
2. World Health Organization (2004) Global burden disease report
3. Detels R, Tan CC (2015) The scope and concerns of public health. In: Oxford textbook of global public health. Oxford University Press
4. Mandal S, Saha B, Nag R (2020) Exploiting aspect-classified sentiments for cyber-crime analysis and hack prediction. In: Kar N, Saha A, Deb S (eds) Trends in computational intelligence, security and Internet of Things. ICCISIoT 2020. Communications in computer and information science, vol 1358. Springer, Cham. https://doi.org/10.1007/978-3-030-66763-4_18
5. Cepoui M, McCusker J, Cole MG, Maida S, Belzile E, Ciampi A (2008) Recognition of depression by non-psychiatric physicians—a systematic literature review and meta-analysis. J Gen Intern Med 23:25–36
6. De Choudhury M, Gamon M, Counts S, Horvitz E (2013) Predicting depression via social media. In: Seventh international AAAI conference on weblogs and social media, Massachusetts
7. De Choudhury M, Counts S, Horvitz E (2013) Social media as a measurement tool of depression in populations. In: Proceedings of 5th annual ACM web science conference, Paris
8. Kale SS (2015) Tracking mental disorders across Twitter users. M.Sc. thesis, University of Georgia
9. Park M, Cha C, Cha M (2012) Depressive moods of users portrayed in Twitter. In: Proceedings of the ACM SIGKDD workshop on healthcare informatics (HI-KDD), pp 1–8
10. De Choudhury M, Counts S, Horvitz E (2013) Predicting postpartum changes in emotion and behavior via social media. In: Proceedings of the SIGCHI conference on human factors in computing systems. ACM, New York, pp 3267–3276
11. Choudhury MD, Counts S, Horvitz EJ, Hof A (2014) Characterizing and predicting postpartum depression from shared Facebook data. In: Proceedings of the 17th ACM conference on computer supported cooperative work and social computing (CSCW'14). ACM, New York, NY, USA, pp 626–638. https://doi.org/10.1145/2531602.2531675
12. Nadeem M, Horn M, Coppersmith G (2016) Identifying depression on Twitter. arXiv:1607.07384
13. Coppersmith G, Harman C, Dredze M (2014) Measuring post-traumatic stress disorder in Twitter. In: Eighth international AAAI conference on weblogs and social media
14. Herńandez A et al (2016) Security attack prediction based on user sentiment analysis of Twitter data. In: IEEE international conference on industrial technology (ICIT)
15. Sabottke C, Suciu O (2018) Dumitras: modeling inter-aspect dependencies for aspect-based sentiment analysis. In: Proceedings of the 2018 conference of the North American chapter of the association for computational linguistics: human language technologies, vol 2
16. Fürnkranz J (2001) A study using n-gram features for text categorization. In: Proceedings of the third annual symposium on document analysis and information retrieval
17. Majumder N, Poria S, Gelbukh A, Shad Akhtar Md, Cambria E, Ekbal A (2018) IARM: inter-aspect relation modeling with memory networks in aspect-based sentiment analysis. In: Proceedings of the conference on empirical methods in natural language processing
18. Hazarika D, Poria S, Vij P, Krishnamurthy G, Cambria E, Zimmermann R (2015) Vulnerability disclosure in the age of social media: exploiting Twitter for predicting real-world exploits. In: Proceedings of the 24th USENIX security symposium
19. Kingma DP, Ba J (2015) Adam: a method for stochastic optimization. In: 3rd International conference for learning representations, San Diego

Topic Popularity Prediction Using Similarity Graph on Twitter

Vishal Gaba and Vijay Verma

Abstract Information about what are the most popular topics is highly demanded and has a variety of uses in different areas such as marketing, business and even politics since it is an indication of public's thoughts and viewpoint. Predicting topics that may become popular in the recent future has even more practical applications, which includes user behaviour analysis, strategising campaigns for events, brand marketing, planning stock investments, and in politics to analyse public opinion. In our study, we aim to identify such popular topics on Twitter, which is a widely used microblogging platform with its users generating enormous data on a daily basis. Features such as hashtags are utilised to enrich the data obtained via Twitter API. We make use of techniques such as TF-IDF and LDA and present a unique approach to compare them on a similarity graph for popularity prediction. The glove model, an unsupervised algorithm that generates meaningful vectors from words, is used for mapping words to the graph, providing a visual representation for better understanding.

Keywords Sentiment analyses · Sentiment classification · Machine learning · CNN · LSTM · Twitter · Feature selection · Hashtag · Emoji · Hybrid classification

1 Introduction

Twitter is a social networking platform, also termed as a microblogging service where users post and interact using short messages called tweets. It has a huge pool of active users that create around 500 M tweets a day [1]. With such a vast user base and a high rate of data generation, Twitter is ideal for many studies, such as trend analysis that requires a considerable amount of social data. In Twitter, a word, phrase, or topic that is mentioned at a greater rate than others is said to be a "trending topic" or simply a "trend" [2]. Trending topics become popular either through a concerted effort by users or because of an event that prompts people to talk about a specific topic.

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For instance, climate change is often trending on Twitter and uses hashtags such as #ClimateChange, #MeltingGlaciers etc. [3]. Analysis of these topics helps Twitter and its users to understand current events globally and the underlying opinions about them. Such analysis could benefit not just social platforms but numerous other areas such as news organisations, government bodies, marketeers, etc. It is also interesting to note here that about 70% of B2B businesses use Twitter as their tool for online marketing, and an average user follows five brands [4, 5] which again makes Twitter suitable for such analysis. It is not hard to understand why the information of what is suddenly gaining popularity would be beneficial for numerous fields, regardless of whether it has a positive or negative sentiment attached to it. With this information, businesses, startups, and even advertisers can make real-time and effective strategies.

For this analysis, we need an estimation of the upcoming trend with decent accuracy. Although techniques exist about telling the popular topics, its estimation is still limited and lacks prediction accuracy [6]. Several methods exist, that are common in many studies, and are concerned with finding popular or significant terms for a given data. Term frequency (TF) is most commonly used to calculate topic popularity. Term frequency, $\mathrm{tf}_{\mathrm{t,d}}$ of term t in document d is the count of occurrences of t in d, i.e., its frequency. A normalised way to get TF value, accounting for the document length is as follows:

$$\mathrm{tf}_{\mathrm{t,d}} = \frac{d_t}{N} \tag{1}$$

where dt is the number of occurrences of term t in document d, and N is the total number of terms in the document.

Although relevance is not guaranteed by TF, as it may include terms that are more frequent but less informative than other terms, we would thus want less weight for less informative terms. For example, stopwords such as 'a', 'and', 'is', 'the' etc., are not helpful in text mining/classification. TF-IDF is another measure used to get relevant terms from a document that are of contributive value. IDF (inverse document frequency) weighs down the frequent terms (e.g., stopwords) and scales up the rare ones:

$$\mathrm{IDF}_{\mathrm{t}} = \log_{10} N/\mathrm{d}f_t \tag{2}$$

where N and $\mathrm{d}f_t$ are the total number of documents and number of documents that contain t, respectively. TF-IDF is calculated as:

$$W_{t,d} = \mathrm{tf}_{\mathrm{t,d}} * \log_{10} N/\mathrm{d}f_t \tag{3}$$

i.e. TF (Eq. 1) multiplied by IDF (Eq. 2).

Also, in order to introduce a link between various terms while analysing text data, we make use of word embedding. Figure 1 shows an illustration of word embeddings with words represented as vectors of length 25. This technique represents words in vector form, which makes it easier for algorithms to identify similarities between

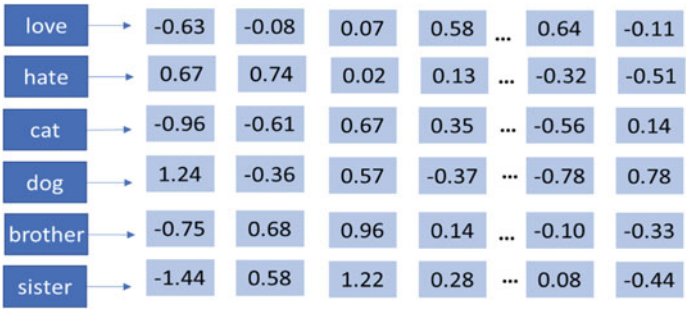

Fig. 1 Word Embedding using Glove[20] 25d with a 6-word sentence. This would later be used as weights while training NN models

various vectors and thus relate various words. For instance, words such as 'cat' and 'dog' would have similar vectors, and words such as 'good' and 'bad' would have opposite vectors.

In this study, we also introduce novel methods for topic popularity using a similarity graph. Various studies have found that a trend change is directly inclined with the sentiment of a topic. We have further tried to incorporate the sentiment value of words while detecting topic popularity. For this, we use a modified TF-IDF algorithm which will be discussed in further sections.

2 Related Work

Many approaches exist for detecting trends and predicting topics that could be popular in the near future, with slight differences in the algorithms and their quantification techniques [6–9]. Relation between words and quantifying popularity differs from one approach to another [6, 7]. Twitter API is used with constraints for fetching specific data (i.e. for targeting specific users or particular geographical areas) according to the requirements of the study. Commonly it is seen that both TF (Term Frequency) and TF-IDF (Term Frequency Inverse Document Frequency) techniques are used wherever popularity or trend is to be calculated [6, 7, 9].

2.1 Data Collection

The data is usually obtained in JSON format from online platforms with slight variations. Data collection is either done continuously for a specified duration (e.g. days or weeks, or more), or it is done at once as in [9]. Former is used if time-series data is required, and it uses online services such as AWS EC2 [6, 10]. In [9], the dataset was around a thousand tweets, which was reduced further after the preprocessing

phase. To detect a trend, the TF-IDF technique is used, after which machine learning algorithms are used to predict mood.

2.2 Advanced Trend Detection Approach

Term frequency and word occurrences are quite logical and frequently used whenever the popularity of any term is sought [7, 6]. A recent approach considers a novel method to combine popularity and sentiment analysis [6]. In this, the author generates time-series data for sentiment (Sentiment Time Series) and popularity (Popularity Time Series) and combines them, considering optimal global alignment between time series. For this record of words occurring at time sequence were considered. i.e. w_j^t to denote jth word at time t, and Wt denotes the collection of words at time t. The popularity of a topic is quantified by combining the frequency and semantic association of the topic and words. For detecting trending topics and quantifying popularity, it is common to use the TF-IDF scheme. The author in [6] also uses ARIMA to predict future time series. Text Rank is used here to calculate the relation between words and topic and DancingLines algorithm in [11] used for the similarity between word pairs while calculating topic popularity. To overcome the far-matching and singularity problem of DTW compound distance and temporal weight approach was used. It is also found that hashtags tend to enrich existing data [12], which could help achieve better results, especially for microblogging platforms such as Twitter. A different approach is used in [8] and [7], where LDA is also utilised but for different purposes. Zhang et al. [7] uses it indirectly by determining topics that a user is interested in and uses it for popularity prediction. Whereas [8] uses LDA for getting an idea about hashtag trends. The author in [8] also considers factors other than just tweets data contents, including user behaviour and user information for popularity prediction. The difference is usually in the way popularity is quantified, [6] also takes semantic and similarity of words into account. For the scope of our study, we would include content information and methods such as TF, TF-IDF, and LDA but not go into user details.

3 Challenges and Problem Statement

The methods and techniques adopted in this paper aim to aid in finding topics that may become popular in the recent future. For this, current data from social media needs to be collected and analysed. Enormous amounts of data are generated on the Twitter platform each day [4, 5]. Twitter provides us with an API to access its data. Since Twitter is used worldwide, data being accessed from API could be from any location, of any language, and in any context. This imposes a challenge to limit our domain of search. We can impose a limit, either by categories or context we want our data to be or by location or region parameters we want our dataset to be from.

If required, we can also limit data from just specific users. For instance, if analysing election results of a particular state, we could narrow our domain to fetch data by filtering tweets belonging to that state as in [10]. Another challenge is selecting keywords related to a particular topic, in case we plan to fetch data from Twitter about that topic only, for instance, on Environment. API supports keywords, location and certain filters to facilitate our requirements. Even after getting data from API, fetched data include much content that is not just text, such as images, videos, links, special characters, emojis etc. which may or may not be useful for further analysis [16, 17]. Or, even if it does contain text, it may not be relevant [13]. Identifying and removing such data is another challenge. Though omitted in some studies, hashtags and emojis have proved to help analyse text, especially for sentiment analysis.

Some features and issues while fetching and processing data before analysing it further are discussed below.

3.1 Twitter Specific Features

Twitter has many elements related to even a single tweet. These attributes may prove to be of significant use for one study and could be irrelevant for some other. E.g., location attributes could be very useful while analysing the influence of a specific political figure over a certain region/state in order to predict election results. However, many elements may be omitted because of the lack of methods or techniques to use them appropriately. For instance, hashtag and emoji data is not considered in certain studies and removed in the preprocessing stage, but recent studies utilise them after converting them to suitable text form.

3.2 Retweets

Retweets are copies of another person's tweet and are removed from the dataset to avoid unnecessary repetition of topics. Other features of Twitter, such as Likes and Shares, may be of use to detect the popularity of particular tweets. However, as per the scope of this paper and the techniques used, these features are not considered for further analysis.

3.3 Irrelevant Words, Slang and Abbreviations

Certain words, in addition to stop-words, may be of little or no use while finding topic popularity. However, they may still be detected as significant or frequent by certain algorithms such as TF, TF-IDF or LDA. The use of slang, abbreviations and acronyms is common in social media platforms. E.g., DM means Direct Message,

HBD means Happy Birthday. Using these helps users to express more using few words.

Though NLP algorithms attempt to make sense of words as numbers and observe their occurrences, it is not a trivial task to understand a language for a machine. Thus, analysing data and correctly predicting a popular topic is still a challenging task.

4 Proposed Method

Our study aims to utilise and improve upon existing techniques for topic popularity. Important steps are discussed as follows with their implementation specifications.

4.1 Initial Analyses

Data needs to be in a proper format for further analysis and better results. In addition to data cleaning, we also keep in mind various attributes of Twitter. Several studies show that attributes such as hashtags help in enriching text for increasing efficiency and outcomes. Since we are concerned with finding popular terms, we use lemmatisation with POS (Parts-of-Speech) and omit stemming in preprocessing. Details of data preprocessing steps are explained in Sect. 6.2. Also, to enhance TF-IDF results, we include sentiment information along with TF-IDF values. Words that contain more sentiment value are detected using popular libraries in python (Afinn, Vader and TextBlob). Standard deviation value is computed for TF-IDF table and added to TF-IDF value of detected words.

4.2 Combining Results from LDA

TF-IDF alone is not sufficient or accurate to get popular topics from a microblogging website like Twitter due to its short text size (250 characters). Latent Dirichlet Allocation (LDA) model is an unsupervised learning algorithm used to get categories and highlight popular topics from a dataset. LDA sees documents as a set of words, and thus order does not matter. These topics would further serve as an input to the similarity plot. The plot would highlight topics detected from LDA and TF-IDF to show topics similar to topics around detected terms.

4.3 Similarity and Topic Popularity

We compute similarity with the help of a novel approach. Our approach involves plotting a graph and checking words similar to the popular words by checking the distance between words. Here, we make use of a scatter plot for plotting words that are represented using a two-number notation. This will help us identify those topics that are not detected by LDA or other topic popularity algorithms on words. However, these words are selected from current data under analysis and are similar to the supposedly popular topics as per the algorithm applied. Thus, these words or topics detected may get popular in the near future. Not only words detected from the LDA algorithm but also word occurrences, ranking words by any algorithm or technique, for e.g., frequency wise and according to tf-idf values together with LDA topic analysis, can be plotted. Glove data is used to compute similarity using numbers [14]. GloVe is an unsupervised learning algorithm for obtaining vector representations for words. Training is performed on aggregated global word-word co-occurrence statistics from a corpus, and the resulting representations showcase interesting linear substructures of the word vector space. In our case, we obtain 25-dimensional pre-trained word vectors, which are then reduced using PCA to a 2-number representation. This is then used to plot words on a 2D Graph, which will tell us a list of popular topics in the database.

5 Tools and Techniques

We use Python, a fast, interpreted, high-level programming language suitable for data analysis and machine learning applications. Google Colab is the underlying platform for all executions and results in our study. It is like Jupyter Notebook, free, cloud-based, requires no setup and allows us to perform various data analysis and ML tasks. Natural Language Toolkit (NLTK) is a suite containing programs and libraries to help machines interpret human language. We use NLTK while data preparation before analysing it for further examination.

6 Data

6.1 Dataset Creation

Twitter API has been used to download the data. For interacting with API, we use the Tweepy library written in python language. Certain authorisation credentials are required to provide a user with secure access to Twitter data, such as Consumer Key, Consumer Secret, Access Token and Access Token Secret. Since twitter generates enormous amounts of data daily, we also use certain keywords on certain broad

domains such as Healthcare, Sports, Politics, News and Technology to limit the type of data. Additionally, we use emojis as well in the search parameter of Tweepy since it is found that data with sentiment value is more likely to get popular [6, 11]. The fetched data contains many entities in addition to the tweet text, such as 'id'—which is a unique number assigned to each tweet, 'retweeted_status'—whether the tweet is a reposted one, 'coordinates'—tells the geographic location of a tweet, 'lang'—tells machine detected language of a tweet and other such entities such as URL's, hashtags, retweet_count etc. We mainly utilise full_text, language, hashtag and related attributes to get the full text for tweets in the English language. This data is now saved as a data frame using pandas, which is a python library for data analysis and manipulation. This is still raw data and would now be processed further for data analysis.

6.2 Data Preprocessing

Data collected from Twitter API needs to be processed before further analyses. At this stage, data is considered noisy and contains many words and characters that are not required and may alter the results [16]. For this, we perform certain preprocessing steps as shown in Fig. 2 to ensure we get the required data in a proper format.

Firstly, we convert all text to lower case. After this, we remove certain twitter specific entities such as user mentions (e.g., @User_mention), Urls and retweets. Punctuations and special characters are now removed from the text, which is followed by removing stopwords. For identifying stopwords (English language), we make use of the NLTK library. Moving further, we now deal with hashtags and emoji data. Although these are considered as noise in many studies and removed in the preprocessing stage, we make use of these attributes in further analysis. Hashtags are kept with the tweet text, removing the '#' symbol prefixed before each hashtag. We also separate multiple words, if present, in a single camel-cased hashtag. E.g., #PollutionFreeAir is replaced by 'pollution-free air.' This, in turn, enriches our text data [19].

Additionally, we convert Emoji data to text using data from a popular online resource [15] to further add to text value and enhance the sentiment value of the text. In the next step, we lemmatise the text by detecting parts of speech (adjective, verb,

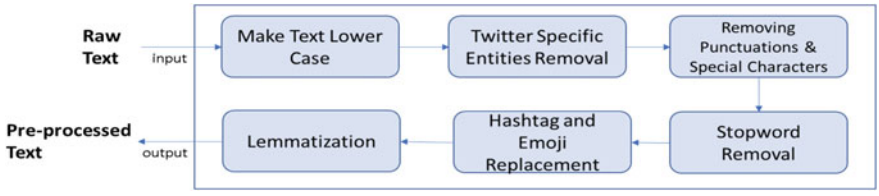

Fig. 2 Preprocessing steps

noun etc.). This step is used as an alternate to stemming for preserving the word form.

6.3 Data Storage

We run our python program in Colab notebook to fetch and store data in online cloud storage provided by Google Drive. After the data is fetched using Twitter API, it is stored as a pandas data frame object in a runtime environment. Pickle is a python module used to serialise and de-serialise python objects. It can convert python variables and objects into byte format to store them in a file or database or share it over a network. This saved data can then be retrieved in its original form for later use. This technique is popularly called pickling and is commonly used in machine learning tasks where a trained model and related entities need to be saved for reuse. In our case, we pickle the data and save the file in google drive mounted on colab workspace.

7 Experiments and Evaluation

We detect topics keeping into account their frequency (TF) and TF-IDF approach [18]. In addition to this, we make use of popular algorithms like LDA to detect such popular topics. We have illustrated topics from TF, TF-IDF and LDA algorithms in a scatter plot, as illustrated in Fig. 3. Using this, we can identify other topics that occur in our dataset. Now topics that are present in the plot are analyzed on the basis of their similarity to one another. It is done using Glove data and TNSE library, which reduces word vectors and would help us to plot and analyze words in a 2D space [20, 21]. This is a novel approach that uses a similarity plot to find other potential popular topics.

Table 1 shows the results of LDA algorithm from scikit learn module python. It maps a text document to a list of topics assuming that the document has words that could decide the topic. The result shows a list of possible topics according to the content of a document. It could be a challenge to determine the correct topic because of the short length of tweets. Here a list of seven topics is illustrated extracted from our Twitter dataset.

Similarity plot: Above 2D scatter plot shows words and data points with a zoom section in the bottom right. This plot uses glove vector data as discussed in earlier Sect. 4.3 and gives us similarity between the words that occur in our dataset. However, since glove vector gives words as 25-dimension vectors, we use TSNE library in python to reduce the dimension of these word vectors to 2D vectors so that they can be mapped on a 2D plot. These words are from our dataset under examination and have been used frequently over multiple tweets. To detect such words, we make use of modified TF-IDF, LDA and the frequency of words. These words can be treated

Fig. 3 Similarity graph illustrates similarity among various topics

Table 1 LDA illustrating topic detection for our dataset

SNo	Tp1	Wt	Tp2	Wt2	Tp3	Wt3	Tp4	Wt4	Tp5	Wt5	Tp6	Wt6	Tp7	Wt7
0	Banks	285.1	Bssc	108.1	Gujarat	99.1	Day	49.9	Good	106.2	Bts	95.1	Media	129.9
1	Swiss	190.1	Times	100.6	Covid	87.2	Fit	43.1	Health	72.2	Food	95	Join	112
2	Modi	121	Vacancies	72.1	Modi	75.6	Not	43.1	Amp	66.3	Order	88.1	Freaky	108.1
3	Must	104.1	Covid	53.7	Yrs	71.1	Getting	38.1	Follow	53.1	Pm	83.1	Give	74.2
4	Money	102.6	Away	45.8	Govt.	59.4	Food	37.2	Morning	51.9	App	80.5	Groceries	64.1
5	Anti	102.1	Would	44.8	Really	58.9	Govt.	31.1	Happy	31.9	Follow	80.1	Real	59.1
6	Used	101.1	Pandemic	44.1	New	50.7	Media	29.5	Look	31.7	Delivery	80.1	Whatsapp	59.1
7	Indian	100.1	Passed	43.1	Oh	50.7	Covid	25.8	Food	31.6	Show	76.9	Covid	58.4
8	Govt.	100.1	Two	42.5	Said	50.7	Way	25.7	One	29.9	Meal	76.1	Funny	58.1
9	Result	100.1	Cheen	42.1	Imagine	50.1	Social	24.9	Us	29.9	One	75.1	Amp	57.7

as hot words and can be used to observe other terms and topics that are similar to them and are present in our dataset. The highlighted words (detected from TF-IDF), as well as words near to these (detected by LDA and count vectorizer), have the potential to become popular topics in the near future.

We can see highlighted words such as 'government' detected using TF-IDF are among hot words, and words near to it include healthcare, congress, leaders, nurse, vacancies, safety. We can see such words are also detected in LDA. For example, 'vacancies' words seen in the graph is listed with 'bssc', which stands for Bihar Staff Selection Commission. With enquiry, we saw that demand for pending vacancies was actually trending online for the result of bssc mains exam. Also, the words 'lockdown', 'banks' and 'modi' were detected as popular topics. Words near to word 'lockdown' include 'vaccine', 'wellbeing', 'pandemic', 'vitamins', 'protocols'. This suggests that discussions on vaccines, vitamins, protocols related to pandemic (coronavirus) and wellbeing could also become trending. Also, 'bank' and 'swiss' were detected close to Modi in the plot and under the same topic in the LDA model as well. On inspection, we saw that the same topic was trending in the news about a speech in 2014 made by current and then prime minister Narendra Modi regarding bringing back black money of corrupt citizens, which is allegedly kept in their Swiss bank account. Other rather general topics detected from the plot includes social media and words similar to them- 'twitter', 'app', 'online', 'delivery', 'whatsapp' are also being discussed and are popular. This could be repeated for new datasets to get results on the latest tweet data.

8 Conclusion

In our study, we make use of existing methods for the frequency of words and for finding significant terms from a document. To enhance the results, we use sentiment information in topics detected using TF-IDF and include hashtag and emoji data in text. The main components highlighted in our approach were the use of TF-IDF as well as LDA on tweets for helping in predicting topic popularity and Glove vector embedding for similarity calculations. Glove embedding helped to give vector notations of popular terms, which were then reduced to 2-dimensional vectors. These words with their vectors as coordinates help interpret results when plotted using vector notation on 2D scatter plot. The popular topics are detected from our dataset and we can clearly see the similarity between words using this plot. Thus, it can be seen which other popular topics detected from our data could be popular in the near future. In future work, we could target our data to specific domains and find ways to integrate sentiment analysis information even further to make our findings more specific.

References

1. Internet Live Stats (2019) Twitter statistics. Accessed on 10 June 2021. Available: http://www.internetlivestats.com
2. Annamoradnejad I, Habibi J (2019) A comprehensive analysis of twitter trending topics. In: 2019 5th international conference on web research (ICWR). IEEE, Tehran, Iran, pp 22–27
3. Hamed AA, Ayer AA, Clark EM, Irons EA, Taylor GT, Zia A (2015) Measuring climate change on Twitter using Google's algorithm: perception and events. Int J Web Inf Syst
4. "10 Twitter Statistics Every Marketer Should Know in 2021 [Infographic]." Accessed on 10 June 2021. [Online]. Available: https://www.oberlo.in/blog/twitter-statistics
5. "The 2014 #YearOnTwitter." Accessed on 10 June 2021. [Online]. Available: https://blog.twitter.com/official/en_us/a/2014/the-2014-yearontwitter.html
6. Li J, Gao Y, Gao X, Shi Y, Chen G (2019) SENTI2POP: sentiment-aware topic popularity prediction on social media. In: 2019 IEEE international conference on data mining (ICDM), Beijing, China, pp 1174–1179. https://doi.org/10.1109/ICDM.2019.00143
7. Zhang X, Chen X, Chen Y, Wang S, Li Z, Xia J (2015) Event detection and popularity prediction in microblogging. Neurocomputing 149:1469–1480
8. Zhang P, Wang X, Li B (2013) On predicting Twitter trend: factors and models. In: Proceedings of the 2013 IEEE/ACM international conference on advances in social networks analysis and mining, pp 1427–1429
9. Rathod T, Barot M (2018) Trend analysis on twitter for predicting public opinion on ongoing events. Int J Comput Appl 180:13–17
10. Almatrafi O, Parack S, Chavan B (2015) Application of location-based sentiment analysis using Twitter for identifying trends towards Indian general elections 2014. In: Proceedings of the 9th international conference on ubiquitous information management and communication, pp 1–5
11. Gao T, Bao W, Li J, Gao X, Kong B, Tang Y, Chen G, Li X (2018) Dancinglines: an analytical scheme to depict cross-platform event popularity. In: DEXA, pp 283–299
12. Alfina I, Sigmawaty D, Nurhidayati F, Hidayanto AN (2017). Utilising hashtags for sentiment analysis of tweets in the political domain. In: Proceedings of the 9th international conference on machine learning and computing, pp 43–47
13. Abrol S, Khan L (2010) Twinner: understanding news queries with geo-content using twitter. In: Proceedings of the 6th workshop on geographic information retrieval. ACM, p 10
14. Pennington J, Socher R, Manning CD, GloVe: global vectors for word representation. Accessed on: April 24. 7, 2017. [Online]. https://nlp.stanford.edu/projects/glove/
15. "Emojipedia." Accessed on: April 12. 7, 2017. [Online]. Available: https://emojipedia.org/people/
16. Tatar A, De Amorim MD, Fdida S, Antoniadis P (2014) A survey on predicting the popularity of web content. J Int Serv Appl 5(1):1–20
17. Achrekar H, Gandhe A, Lazarus R, Yu SH, Liu B (2011). Predicting flu trends using twitter data. In: 2011 IEEE conference on computer communications workshops (INFOCOM WKSHPS). IEEE, pp 702–707
18. Joshi K, Bharathi N, Rao J (2016) Stock trend prediction using news sentiment analysis. Int J Comput Sci Inform Technol.https://doi.org/10.5121/ijcsit.2016.8306
19. Asur S, Huberman BA (2010) Predicting the future with social media. In: 2010 IEEE/WIC/ACM international conference on web intelligence and intelligent agent technology, vol 1, pp 492–499. IEEE

20. Word Embedding: Basics. Accessed on: April 24. 7, 2017. [Online]. Available: https://medium.com/@hari4om/word-embedding-d816f643140
21. Mikolov T, Sutskever I, Chen K, Corrado GS, Dean J (2013) Distributed representations of words and phrases and their compositionality. In: NIPS, pp 3111–3119

Bolster Shark Smell Optimization Routing Protocol (BSSORP) for Routing in Underwater Wireless Sensor Networks

S. Boopalan and S. Jayasankari

Abstract Underwater Wireless Sensor Network (UWSN) is a modern wireless sensor system that includes the most promising mechanisms and methods for exploring the aqueous world. It has several important uses in the underwater world. It performs admirably in a variety of settings, including (i) environmental monitoring (ii) military (iii) industrial (iv) data collection, and (v) disaster monitoring. Routing is a significant issue in UWSN. Poor routing leads a way to reduced packet delivery ratio and network lifetime. In this paper, Bolster Shark Smell Optimization Routing Protocol (BSSORP) is proposed to increase the efficiency of routing in UWSN by absorbing the natural characteristics of sharks towards hunting its prey. Simulation has been carried out to analyze the performance of BSSORP against previous routing protocols with standard evaluation metrics. Results indicate that the proposed routing protocol BSSORP has better performance than other routing protocols.

Keywords Routing · WSN · UWSN · Bio-inspired · Network lifetime · Delay

1 Introduction

In UWSN, the use of sound is essential. Using acoustic links costs a lot when opposed to radio links is Speakers with higher delay and lower bandwidth are typical for high-end recordings, such as podcasts [1]. If a packet of data arrives at the receiver, it is sent via radio waves to the rest of the sinks and transmitters. The underwater sensor network has far less capacity than a conventional wireless sensor network. Proprietary routing protocols can't be utilized in submarine networks [2]. Several similar technologies for underwater sensor networks exist up to this day. Nodes are defined as identifiable resources, i.e. local, and sinks are defined as links to other resources i.e., remote in network experience. If it is necessary to determine the location of other nodes or sinks before making routing decisions, then these protocols are location-dependent; if not, they are considered location less [3–6].

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Tiny sensor nodes are installed in seawater in this kind of network. The antenna, battery, and central processing unit are also used in these nodes. These sensor nodes batteries are not rechargeable or replaceable [7, 8]. These sensors gather the necessary information and transfer it to sinks located offshore. Unmanned and autonomous underwater vehicles with sensors developed explicitly for underwater contact are most widely utilized in environments where humans cannot explore infrastructure present underwater directly. Unmanned vehicles collect information about aquatic natural resources and send them to sinks [9, 10].

1.1 Problem Statement and Objective

The technological constraints in the deployment of routing protocol in UWSN are discussed below:

- **Routing Protocol**: Protocols developed for regular WSN will never suit UWSN due to the network's natural characteristics.
- **Constrained Energy**: Energy is a scarce resource underwater. So underwater communication nodes are more significant, which takes more energy. Finally, the energy used to communicate was higher for acoustic than terrestrial networks. Due to the batteries in the UWSN not being rechargeable or replaceable, and since power consumption in network communication is continuously increasing; the efficiency of the communication network is required.

The objective of this research is to develop a routing protocol for UWSN to improve scalability and minimize energy consumption. Based on the natural characteristics of sharks towards hunting their prey this research work has proposed routing protocol namely Bolster Shark Smell Optimization Routing Protocol (BSSORP) to find a better route to a destination in UWSN. It intends to maximize the route finding and search capabilities in the event of a failure.

1.2 Organization of Paper

The current part has covered UWSN, difficulties with UWSN routing protocols, and the research work's problem statement and purpose. The second section examines the relevant literature. Section 3 introduces the Bolster Shark Smell Optimization Routing Protocol (BSSORP) as a unique protocol for routing in the UWSN. The simulation configuration and performance measures used for evaluation are discussed in Sect. 4. Section 5 examines the outcomes acquired against the prior protocols. The conclusion ends with a discussion of future research directions in Sect. 6.

2 Literature Review

"Non-Uniform Clustering-based Routing Protocol" [11] is proposed based on distributed fuzzy logic. This protocol ultimately considers the balance of energy, location, and distance of a base station from the node. The protocol has given low performance in terms of delay and error rate, because of unable to predict the number of nodes and clusters to send the data to the destination. "Virtual Grid Mobile Sink Routing Protocol" [12] is proposed to maintain the location information steadily for the better performance of WSN. Still, the network overhead got increased in maintaining the node location table when the nodes move from one position to another position. "Three Dimensional Routing Protocol" [13] is proposed for WSN to address the issue of low-level sensing nodes to increase the sensing level and capacity. This protocol has prioritized increasing the sensing of nodes. The routing overhead increased and faced the issue of network lifetime. "Gradient Gravity Routing" [14] is an ensemble of expected delivery and resilience methods to load route the sensed data in a heterogeneous environment. It used fog to alert the nodes to send data to the destination for further processing, but the delay got increased due to calculating the nearby nodes and their distance. "Energy-Aware and Void-Avoidable Routing Protocol (EAVARP)" [15] contains the layering phase and data collecting phase. Concentric shells develop around a central node that serves as a sink. Concentric shells are constructed around the sink node during the layering step, while sensor nodes are placed on various layers. The sink node executes hierarchical activities at regular intervals to make sure the structure's validity and real-time. It makes EAVARP adapt to an unpredictable network environment. When using opportunistic directional forwarding, data packets are transmitted across concentric shells even if there are voids. "Energy-optimized Path Unaware Layered Routing Protocol (E-PULRP)" [25] is proposed to determine how fast a connection may be made in UWSN. E-PULRP requires a layering and communication phase. A random variable represents the chance of successfully transmitting a packet, together with an associated transmission energy level.

3 Bolster Shark Smell Optimization Routing Protocol

3.1 General Ideology of Shark Smell Optimization

The animal's olfactory system is a primary sensory system responding to a chemical signal originating from somewhere else. Fishes have a different system of olfactory sensors. In their olfactory pits, placed on the sides of their heads, are the sensors. The two apertures on the outside of each pit are also included. The waves inside the water are created by the movement of microscopic hairs on the cell membrane and the power of fish swimming in the water. Chemicals dissolved in the environment of the nasal cavity link to the exposed surface area of the olfactory nerve terminals. Other

sensory nerves in vertebrates connect directly to the brain without any intermediate connections. This first section of the brain (called the olfactory bulb) receives smell impulses and sends them on to the rest of the brain. Like humans, fishes have two bulb-like structures that are placed in separate olfactory pits. Fishes' odor sense is supported by increased surface area allocated to olfactory nerves and a larger area for smell information in the brain. The most oversized olfactory bulbs in the eel and shark bodies are used for scent information processing. Sharks appeared almost 400 million years ago, at the dawn of time, when the world was forming and sharks were better able to capture prey. A significant reason why sharks can survive in the environment is because of their acute sense of smell. Sharks have highly effective senses, such as their sense of smell. Like the rest of its body, a shark's nose is entirely contained within its streamlined shape. The water goes from the nasal cavity to the olfactory pits, where it is met by cells covered with skin folds, enabling the olfactory senses to work. It is theorized that sharks can identify tiny amounts of blood by detecting cells that sense chemical changes in body tissue. Sharks can, for example, detect a single drop of blood in a swimming pool which is ten times the volume of the body of water where the blood was spilled. Thus, sharks can detect fish that are damaged from over a kilometer away.

3.2 Formulation of BSSORP

It is possible to interpret assumptions as building the mathematical formulation. These elements include:

(i) Fish gets harmed, and as a result, seawater is flooded with blood (the search space). This study is most likely to have limited relevance to the world of sharks. It may disregard the velocity of the wounded fish concerning the shark's movement velocity. This is to say, the prey (source) is expected to be constant.

(ii) Seawater routinely gets blood injected into it. For odor-distorting particles, water flow has little or no effect. The concentration of odorous particles increases significantly around the wounded fish. Since these odor particles lead the shark to its food, following the scent trails helps it find its food.

(iii) In the shark's search habitat, a wounded fish creates some source of unique odor sources.

3.3 Initialization

To find the shark, the scent of blood must be found. It should be noted that when the smell of an injured fish is on the wind, it (prey) has a poor diffusion. An initial solution set is created from a random starting point for a problem-focused on the viable search space. These are all distinct traces of the shark's presence, providing probable positions during the search process.

$$y_1^l, y_2^l, y_3^l, \ldots, y_{PS-1}^l, y_{PS}^l, \tag{1}$$

where y_j^l indicates the initial location (or position) j present in the overall vector population, PS indicates the size of the population. The problem related to the optimization is mathematically expressed in Eq. (2).

$$y_j^l = \left[y_{j,1}^l, y_{j,2}^l, y_{j,3}^l, \ldots, y_{j,CD-1}^l, y_{j,CD}^l\right], j = 1, 2, 3, \ldots, CD-1, CD \tag{2}$$

where $y_{j,k}^l$ indicates the shark's traveling dimension j, and CD represents the count of decision variables present in the route optimization problem.

An increase in odor strength at each location is indicative of the organism's proximity to the prey. SSO modeling in the method uses an objective function to simulate the process. We can, in this case, assume a maximization problem and look at the principle at large. A higher value for the objective function results in a stronger odour (or more odour particles) when we do this. Due to this, the shark is closer to its prey in this process. The SSO algorithm begins according to this idea.

3.4 Progress of Shark Towards Prey

Sharks must move to get prey; however, each shark travels at a different speed to get closer to the prey. Equation (3) may be found from the position vectors.

$$\left[VV_1^l, VV_2^l, VV_3^l, \ldots VV_{PS-1}^l, VV_{PS}^l\right] \tag{3}$$

Equation (3) holds the velocity vectors in a different dimension with components.

$$VV_j^l = \left[VV_{j,1}^l, VV_{j,2}^l, VV_{j,3}^l, \ldots VV_{j,CD-1}^l, VV_{j,CD}^l\right] j = 1, 2, 3, \ldots, CD-1, CD \tag{4}$$

While the shark is tracking its prey based on its odor, its movement is influenced by the strength of that odor. The higher concentration of odor in the water boosts the movement of the shark. This movement may be described quantitatively by calculating the correlation coefficient of the goal function. As the gradient suggests, the function grows to its maximum rate in the direction of the gradient. According to Eq. (5), this procedure occurs.

$$VV_j^m = n_m.RV.Grad(ObjFn)_{y_j^m} j = 1, 2, 3, \ldots PS\ m = 1, 2, 3, \ldots, m_{max} \quad (5)$$

where VV_j^m represent the approximate constant velocity of shark, n_m represents a value falling in the interval [0, 1], RV represents the random value that is distributed in the uniform manner which falls in the interval [0, 1], $Grad$ represents the gradient function, $ObjFn$ represents the objective function, m_{max} denotes the count of stages for the shark's forward movement, m indicates the count of stages.

n_m might not be possible for a shark to attain the velocity found by $Grad$ function. RV attempts to provide an increased number of random searches, which is inherently given by the SSO algorithm. The algorithm of Gravitational Search has influenced the initial design of RV. This expresses that each dimension velocity and it is computed using the equation Eq. (6).

$$VV_{j,k}^m = n_m.RV.\left[\frac{d(ObjFn)}{dy_k}\right]_{y_j^m}$$
$$j = 1, 2, 3, \ldots PS - 1, PS; k = 1, 2, 3, \ldots, CD - 1, CD, m = 1, 2, 3, \ldots, m_{max} \quad (6)$$

3.5 Inertia on Acceleration

The effect of inertia on acceleration means that the shark can only reach a specific acceleration rate and velocity depends on the shark's initial velocity. The processes in question are represented using a simplified version of Eq. (6) as follows:

$$VV_{j,k}^m = n_m.RV.\left[\frac{d(ObjFn)}{dy_k}\right]_{y_j^m} + \beta_m.RV.VV_{j,k}^{m-1}$$
$$j = 1, 2, 3, \ldots PS - 1, PS;\ k = 1, 2, 3, \ldots, CD - 1, CD, m = 1, 2, 3, \ldots, m_{max} \quad (7)$$

For stage k, the β_m Coefficient becomes a constant value, and the RV random number generator has a uniform distribution over the interval [0, 1]. The greater value of β_m To understand better, mathematicians state that momentum creates smoother solution pathways. It implies more substantial inertia, resulting in a slower movement speed. The R2 increase contributes to making the algorithm more diverse. Sharks have a typical cruising speed of around 20 km/h, but they may accelerate to speeds

of up to 80 km/h if they try to catch anything. There is a finite limit to the range of velocities between the highest and lowest in the group of sharks. The SSO algorithm has a velocity limitation set for each stage, and it is expressed in Eq. (8).

$$\left|VV_{j,k}^{m}\right| = \min\left[n_m.RV.\left[\frac{d(ObjFn)}{dy_k}\right]_{y_j^m} + \beta_m.RV.VV_{j,k}^{m-1}, \left|\gamma_m.VV_{j,k}^{m-1}\right|\right]$$
$$j = 1, 2, 3, \ldots PS-1, PS; k = 1, 2, 3, \ldots, CD-1, CD, m = 1, 2, 3, \ldots, m_{max} \tag{8}$$

where γ_m indicates the ratio to limit the velocity at stage m. $VV_{j,k}^{m}$ is computed using Eq. (8), and it has the same characteristics while selected in minimum operator.

3.6 Location Identification

The location of the shark has shifted ahead, and as a result, Eq. (9) expresses a new position Z_j^{m+1} based on the prior position and velocity.

$$Z_j^{m+1} = Y_j^m + VV_j^m.Grad(ti_m) \tag{9}$$

where $Grad(ti_m)$ indicates the interval of time at stage m which is assumed at all stages with the same value.

3.7 Searching

Besides moving ahead, the shark also rotates to follow stronger scents. This boosts its movement. Figure 2 depicts the pictorial representation of the shark's rotational movement. When the shark spins, it travels along a very close path and does not necessarily have to be a circle. When applying optimization techniques, the shark will do a local search at each level to identify better solutions. The local search of BSSORP is approximated by Eq. (10).

$$A_j^{m+1,n} = Z_j^{m+1} + RV.Z_j^{m+1}$$
$$n = 1, 2, 3, \ldots, N-1, N\ j = 1, 2, 3, \ldots, PS-1, PS\, m = 1, 2, 3, \ldots, m_{max} \tag{10}$$

where $A_j^{m+1,n}$ denote the nth position in search that is made locally. RV denotes a random value, and it falls between the interval $[-1, 1]$, N denotes the count of points in the search made locally at every stage. Algorithm 1 provides the pseudocode of BSSORP.

Algorithm 1: BSSORP

Begin

Initialization

Parameters PS, m_{max}, n_k, β_m and γ_m are set
Initial Population is generated with individuals
Based on the allowable range, generate random decision
Fix the iteration count $m = 1$

Foreach $\boldsymbol{m} = 1 : \boldsymbol{m_{max}}$

Forward Movement

Compute velocity vector $VV_{j,k}^{m}$ for each component

Identify new position based on forwarding movement Z_j^{m+1}

Rotational Movement

Identify new position based on rotational movement $A_j^{m+1,n}$

Select next position based on forwarding and rotational movement

End Foreach $\boldsymbol{m}$

Fix $m = m + 1$

Select the finest position in the last iteration that has the greatest $ObjFn$ value

End

4 Simulation Settings

4.1 Simulation

The protocol's performances are analyzed with several parameters, such as link failure, network size, and malicious nodes. In this research, we selected the variable network size (i.e., No. of Nodes) to run the simulation experiment. In the 3D monitoring area, 250 nodes are deployed in a distributed manner. To simplify the things, layer's width is set to 400 m, and the layer's communication radius is 500 m. Acoustic pressure depends on the distance between the transmission and the receiver. The parameter settings that were utilized to measure BSSORP's effectiveness against earlier routing protocols, notably EAVARP [15] and E-PULRP [16] are Underwater speed of sound is 2000 m/s, Acoustic pressure of data transmission is 113 dB (μPa), Acoustic pressure of layer is 110 dB (μPa), Bandwidth is 100 Hz, Boundary of Network is 1.5 km × 1.5 km × 1.5 km, Data transmission rate is 20 kbps, Each node of the initial energy is 450 J, Size of Packet is 74 bytes, Transmission radius of sensor nodes is ≈350 m.

4.2 Performance Metrics

End-To-End Delay (ETED): Consumption of time taken by data packets to reach the destination from the source.

Packet Delivery Ratio (PDR): The success rate of data packets reached destination against the data packets sent by the source.

Energy Consumption (AEC): Energy consumed by packets to reach the destination from the source.

Node Death Rate: Nodes that are exhausted from energy against the number of initialized.

5 Results and Discussions

5.1 Ends-To-End Delay Analysis

In Fig. 1, the y-axis is plotted with end-to-end delay in milliseconds, and the x-axis is plotted with nodes. Figure 1 makes a clear indication that the proposed protocol BSSORP attains a minimum delay than E-PULRP and EAVARP. Route optimization in BSSORP leads the way to reduced end-to-end delay. Existing protocols E-PULRP and EAVARP intend to identify a route on a first-in-first-out basis without checking for its quality and results with route failure.

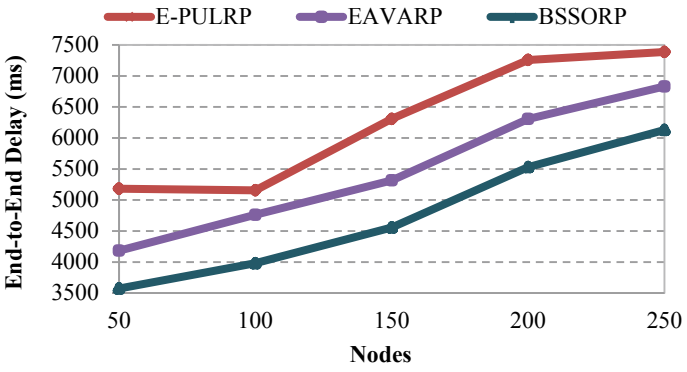

Fig. 1 End-to-end delay versus routing protocols

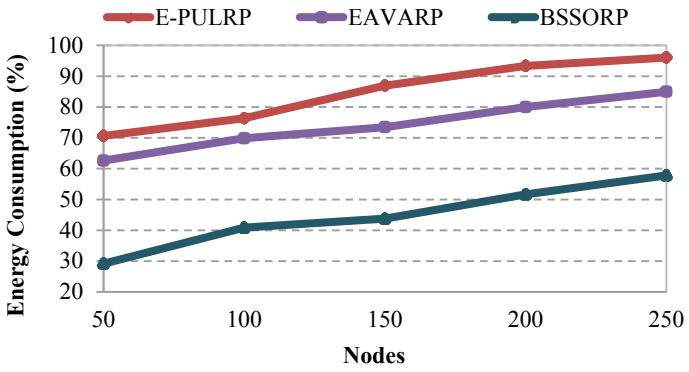

Fig. 2 Energy consumption versus routing protocols

5.2 Energy Consumption Analysis

In Fig. 2, the y-axis is plotted with energy consumption in percentage, and the x-axis is plotted with nodes. From Fig. 2, it is clear to understand that BSSORP has outstanding performance in energy consumption, that is, BSSORP has minimum energy consumption than the existing routing protocols E-PULRP and EAVARP. Synchronization of the velocity of node movement provides a way to find a stable route till the data reach the destination. Existing protocols E-PULRP and EAVARP find the route without considering the velocity of node movement. Due to this route, failure gets happen multiple times and packet retransmission occurs, leading to enormous energy consumption.

6 Conclusion

In this paper, a novel bio-inspired routing protocol, namely BSSORP has been proposed for UWSN. BSSORP is inspired by the natural characteristics of sharks towards hunting for their prey. Sharks use their unique characteristics of smelling to find their prey for hunting, and this same characteristic is used in BSSORP to identify the best route in UWSN. BSSORP gives importance to the velocity of nodes before selecting them in routing. When it's put through its paces with various factors, its performance can suffer. The current study was tested utilizing the network size parameter and produced better outcomes than existing techniques. Future aspects of this research can be focused on using various bio-inspired optimization strategies and evaluated using various criteria.

References

1. Chander B, Kumaravelan (2021) Wearable sensor networks for patient health monitoring: challenges, applications, future directions, and acoustic sensor challenges. In: Healthcare paradigms in the internet of things ecosystem, Elsevier, pp 189–221
2. Noh Y et al (2016) HydroCast: pressure routing for underwater sensor networks. IEEE Trans Veh Technol 65(1):333–347. https://doi.org/10.1109/TVT.2015.2395434
3. Ramkumar J, Vadivel R (2020) Improved Wolf prey inspired protocol for routing in cognitive radio Ad Hoc networks. Int J Comput Netw Appl 7(5):126–136. https://doi.org/10.22247/ijcna/2020/202977
4. Ramkumar J, Vadivel R (2020) Meticulous elephant herding optimization based protocol for detecting intrusions in cognitive radio ad hoc networks. Int J Emerg Trends Eng Res 8(8):4549–4554. https://doi.org/10.30534/ijeter/2020/82882020
5. Ramkumar J, Vadivel R (2019) Performance modeling of bio-inspired routing protocols in cognitive radio ad hoc network to reduce end-to-end delay. Int J Intell Eng Syst 12(1):221–231. https://doi.org/10.22266/IJIES2019.0228.22
6. Ramkumar J, Vadivel R (2021) Multi-adaptive routing protocol for internet of things based Ad-hoc networks. Wirel Pers Commun, pp 1–23. https://doi.org/10.1007/s11277-021-08495-z
7. Boopalan S, Jayasankari S (2021) Dolphin Swarm inspired protocol (DSIP) for routing in underwater wireless sensor networks. Int J Comput Netw Appl 8(1):44–53. https://doi.org/10.22247/IJCNA/2021/207981
8. Ramkumar J, Vadivel R (2020) Bee inspired secured protocol for routing in cognitive radio ad hoc networks. INDIAN J Sci Technol 13(30):3059–3069. https://doi.org/10.17485/IJST/v13i30.1152
9. Ramkumar J, Vadivel R, Whale optimization routing protocol for minimizing energy consumption in cognitive radio wireless sensor network. Int J Comput Netw Appl 8(4). https://doi.org/10.22247/ijcna/2021/209711
10. Lingaraj M, Sugumar TN, Stanly Felix C, Ramkumar J (2021) Query aware routing protocol for mobility enabled wireless sensor network. Int J Comput Netw Appl 8(3):258. https://doi.org/10.22247/IJCNA/2021/209192
11. Li Q, Sun R, Wu H, Zhang Q (2018) Parallel distributed computing based wireless sensor network anomaly data detection in IoT framework. Cogn Syst Res 52:342–350. https://doi.org/10.1016/j.cogsys.2018.07.007
12. Yarinezhad R, Sarabi A (2018) Reducing delay and energy consumption in wireless sensor networks by making virtual grid infrastructure and using mobile sink. AEU Int J Electron Commun 84:144–152. https://doi.org/10.1016/j.aeue.2017.11.026
13. Myoupo JF, Nana BP, Tchendji VK (2018) Fault-tolerant and energy-efficient routing protocols for a virtual three-dimensional wireless sensor network. Comput Electr Eng 72:949–964. https://doi.org/10.1016/j.compeleceng.2018.02.012
14. Ivanov S, Balasubramaniam S, Botvich D, Akan OB (2016) Gravity gradient routing for information delivery in fog wireless sensor networks. Ad Hoc Netw 46:61–74. https://doi.org/10.1016/j.adhoc.2016.03.011
15. Zhang S, Sui Y (2018) An energy-aware and void-avoidable routing protocol for underwater sensor networks. IEEE Access 6:7792–7801. https://doi.org/10.1109/ACCESS.2018.2805804
16. Gopi S, Govindan K, Chander D, Desai UB, Merchant SN (2010) E-PULRP: energy optimized path unaware layered routing protocol for underwater sensor networks. IEEE Trans Wirel Commun 9(11):3391–3401. https://doi.org/10.1109/TWC.2010.091510.090452

Intrusion Detection System Based on Feature Reduced Back Propagation Neural Network Using Ant Colony Optimization

Ghanshyam Prasad Dubey and Rakesh Kumar Bhujade

Abstract Intrusion Detection Systems (IDS) acts as a Security Management Tool for safeguarding a Computer Workstation or Network from Intrusions, Attacks and Unauthorized Access; at the same time, they detect and handle the Malicious Activities occurring in the Network or System. It plays a significant role in ensuring the Security of the System and uninterrupted availability of Resources, Services and Data to Valid and Authorized Users. Feature Reduction plays a significant role in uplifting the performance of the classifier models by reducing the processing time and computational cost. This paper proposes three feature selection approaches for improving the classification accuracy of IDS. Two approaches are based on mutual information and correlation; one is based on Ant Colony Optimization. The generated reduced feature sets are provided to Back Propagation Neural Network (BPNN) for training and performance analysis of the IDS model. The performance of the proposed BPNN based IDS using feature reduced datasets is evaluated as binary classifier along with multi-class classifier. Seven different performance metrics are evaluated over five different datasets including the original KDD for judging the performance of the proposed IDS classifier. Results show that the proposed feature reduced datasets improves the classification performance of the BPNN based IDS. The improvement in performance as a binary classifier is around 3%; while there is an improvement of around 8% as a multi-class classifier.

Keywords Intrusion detection · Back propagation · Mutual information · Dimensionality reduction · Machine learning

1 Introduction

There is an enormous increase in the misuse of data, services and resources from beginning to end unfair means or illegal access due to recent trends in networking and technology. There is an immediate requirement of a solution for preventing these

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misuses to ensure valid utilization to Resources [1]. Intrusion Detection System (IDS) is a suitable solution to overcome these issues; Firewalls and Intrusion Prevention Systems (IPS) can also be deployed for overcoming these situations. These solutions can handle security of networks, clouds, sensors, MANET, IoT systems and may others, apart from the computer system. Integrity of data, Confidentiality and Availability of Resources are the fundamental goals of security; however, user authentication, non-repudiation and authorized access to resources are also equally important for achieving high level of security [2].

An IDS observes the flow of traffic and detect misuses, attacks and anomalies. If it detects a malicious pattern, it immediately informs the Administrator to take appropriate measure for handling it; simply by raising an alarm or generating an alert. Recent implementations of IDS automatically take appropriate action, if an anomaly is detected. Denning proposed the term "IDS" in 1987 [3]. Host based IDS (HIDS) analyzing the traffic for a single workstation and Network based IDS (NIDS) analyzing the entire network traffic are the two broad categories of IDS [4]. Apart from NIDS and HIDS, there are various other models of IDS, such as Hybrid IDS and Distributed IDS [5]. Based on the type of detection approach, IDS are classified as Misuse-based and Anomaly-based. Misuse Detection is simple but inefficient in detection of new or unknown attack patterns. Anomaly Detection is more accurate and efficient in detection of new or unknown attack pattern but large number of false alarms reduces its effectiveness. Machine Learning (ML) techniques are universally used in development of recent IDS models based on Anomaly detection. Such systems exhibits high sensitivity and Self-Learning ability; they also lowers the possibility for generation of false alarms [6, 7].

Even after so many years since the development of first IDS, there is a scope of improvement for enhancing the accuracy of the IDS to deal with the recent and newly generated attack patterns. It is necessary to consider issues, such as low False Alarm rate, high sensitivity, effective processing of unbalanced datasets, low processing time, etc. while developing an optimal model for IDS. An Intrusion Detection System i.e. based on ML techniques resolves most of these issues; except the processing time that depends on the type of technique used for developing the IDS [8].

2 Related Work

Machine Learning is a recent trend in computing that can be used as a companion with any other domain of Computing, like Big Data, Cloud, IoT and Security; its primary role is to impart the "Self-Learning ability" in Models [9, 10]. Limited data is enough for development of Machine Learning model that can run over normally configured workstations in limited training time and follows divide and conquer strategy [11]. Supervised and Unsupervised are the two broad categories of Machine Learning techniques [9]. Machine Learning models exhibits self learning ability and are more accurate. New or unknown attack patterns are effectively detected using Anomaly-based approach; however, high rate of false alarms results in inferior performance

of such systems. Anomaly-based IDS developed using Machine Learning technique can be a suitable solution; as such systems exhibit self-learning ability and high sensitivity. The possibility of false alarms is also greatly reduced using ML techniques. The processing time of datasets related to IDS is very high; this is because the size of datasets such as NSL KDD and KDD CUP 99 is very large. The size of these datasets must be reduced such that the resultant reduced Dataset must contain all the insights existing in the original. This is known as Dimensionality Reduction or Feature Engineering. It is an integral step in the process of developing a ML model [12].

Enhancing the relevancy and eliminating the redundancy is the significant characteristic of feature selection. Redundant features are eliminated from the dataset and the reduced dataset with relevant features is used to train the model [13]. Akashdeep et al. proposes a feature reduced IDS using ANN classifier, termed as IG_C_3. Information Gain and Correlation are computed to identify the most relevant and non-redundant set of features. Features are ranked according to correlation (C) and information gain (IG) computations. The feature set is divided into 3 parts, namely C1, C2 and C3 based on correlation computations. Similarly, IG1, IG2 and IG3 feature sets are created using Information Gain computations. C1 and IG1 contain the 10 most relevant features, C2 and IG2 contains the next 15 features based on relevancy and C3 and IG3 contains the remaining features. Now, union of IG1 and C1 will become IG_C_1 and intersection of IG2 and C2 will become IG_C_2. The union of IG_C_1 and IG_C_2 will be the final set of features present in the reduced dataset [14].

Back Propagation is the most common and widely used Neural Network approach [15]. It was proposed in 1986 by Rumelhart. It is a multi-layer (MLP) Neural Network trained using Error Back Propagation algorithm (EBPA) [16]. It is a Supervised Learning approach involving training of the Model using Labeled Data [17]. BPNN works in two phases, namely Forward phase (feed-forward) and Backward phase (feed-backward). In forward phase, input is provided to the model and the output is generated; then the output is evaluated to the preferred output and accordingly Error is computed. During Backward phase, the Error is propagated in the Network and the weights of the links connecting nodes are updated and the input is provided again to the model and output is generated. It is a feed-forward neural network; as processing is carried out only in forward phase; backward phase is responsible for error propagation and necessary weight updates. This process repeats, until the Error doesn't reach to 0 or desired minimum. Back Propagation is widely used because of its simplicity; yet considerable accuracy and performance. It is widely applicable in development of IDS models [16].

3 Proposed BPNN Based IDS Using Feature Reduction

This work proposes an accomplishment of IDS model focused on machine learning with high detection precision and low false alarms. The proposed model is implemented using the BPNN and Ant Colony Optimization (ACO) approach. To diminish the training time and uplift the performance of this model, dimensions of the intrusion datasets are reduced using feature reduction techniques, based on estimates like mutual information and correlation among features. The resultant IDS will perform more efficiently and effectively, compared to other approaches. This paper suggests the use of Mutual Information among features and Kendall's Correlation Coefficient among features for generating an optimal subset of features. The Dense_FR and the Sparse_FR are the two approaches suggested for generating the reduced feature subset. An ACO based approach (ACO_FR) is also proposed for identifying the most relevant and non-redundant set of features. This helps in reducing the training time and improving the performance of the classifier model. The step for generating the reduced feature sets is given below:

Steps for Dense_FR

1. Import the KDD Dataset.
2. Relevancy Ranking of attributes is computed based on mutual information (Mut_Info) and correlation using Kendall's coefficient (K_Corr) among attributes in a pair-wise manner.
3. Based on Mut_Info and K_Corr, the attributes are ranked.
4. Attributes in Mut_Info and K_Corr are divided into 3 parts, namely MI_1, MI_2 and MI_3 for Mut_Info and C_1, C_2 and C_3 for K_Corr with highest 30% attributes, next 30% attributes and rest 40% attributes.
5. Compute MI_1 ^ C_1, MI_2 ^ C_2 and MI_3 ^ C_3, where ^ represents Intersection among sets. Name the resultant sets as MI_C_1, MI_C_2 and MI_C_3 respectively.
6. Compute MI_C_1 U MI_C_2 U MI_C_3, where U represents Union among sets; the resultant set is the reduced feature subset generated by this approach.

Steps for Sparse_FR

1. Import the KDD Dataset.
2. Relevancy Ranking of attributes is computed based on mutual information (Mut_Info) and correlation using Kendall's coefficient (K_Corr) among attributes in a pair-wise manner.
3. Based on Mut_Info and K_Corr, the attributes are ranked.
4. Attributes in Mut_Info and K_Corr are divided into 3 parts, namely MI_1, MI_2 and MI_3 for Mut_Info and C_1, C_2 and C_3 for K_Corr with highest 30% attributes, next 30% attributes and rest 40% attributes.
5. Compute MI_1 ^ C_1 and MI_2 ^ C_2 where ^ represents Intersection and name them MI_C_1 and MI_C_2 respectively.
6. Compute MI_C_1 U MI_C_2, where U represents Union; the resultant set is the reduced feature subset generated by this approach.

Steps for ACO_FR

1. Let N denote a feature set from a dataset D that contains d distinct groups, Ci (for I = 1, 2, …, d). If we count the total number of functions, then there will be n. Assign equivalent values to t and c to start the pheromone trails t and the correlation (c) of all n functions.
2. Create a set of artificial k ants that are equal to n, i.e. k = n.
3. According to the subset size estimation scheme, determine the subset size r for each of the k ants. Then, for the probabilistic transformation, use the standard law for selecting features and construct subset according the value of pheromone train t and correlation information (c).
4. Based on t and c add features on partial solutions and complete the progress done by all ants.
5. Evaluate all the newly formed subsets according to the evaluation criteria (value of correlation and heuristic information).
6. In line with the classification scheme, pick the locally optimized subset, S^l (t), from all S^k (t), and the globally optimized subset, S_g, from all S^l (t). t = 1, 2, 3, …, l, where l represents the number of iterations.
7. Ensure whether S^l (t) accomplishes expected accuracy, or the algorithm implements a iteration threshold, Ith, then terminate the FS process.
8. According to the principles of pheromone updating and heuristic knowledge estimation, update the values of s and g for all functions.
9. Create a new set of artificial k ants and follow the same procedures as before.

Table 1 represents the number of features in each dataset under consideration.

The classifier model for IDS is implemented using Back Propagation Neural Network (BPNN), which is a multi-layer neural network having single intermediate/hidden layer, designed with the following specifications:

* Neurons of input layer = features in the Dataset.

* Neurons of output layer = possible outcomes for the target.

* Number of Neurons within Hidden Layer is computed, according to certain standard rules, as:

Let, "I" be the number of features or neurons in input layer and "O" be the number possible outcomes for target or neurons in output layer and "H" be the number of neurons in the hidden layer, then, possible values for "H" can be computed, as [18]:

Table 1 Size of reduced feature set generated using different feature selection techniques

Dataset	Number of features
Original KDD	41
IG_C_3	25
Dense_FR	20
Sparse_FR	07
ACO_FR	28

- Average frequency (Eq. 1) of neurons available in input and output layer, i.e.,

$$H = (I + O)/2 \tag{1}$$

- 70% to 90% of the count of neurons in the input layer (Eq. 2), i.e.,

$$0.7 * I \Leftarrow H \Leftarrow 0.9 * I \tag{2}$$

- Square Root of the sum of neurons in input layer and output layer (Eq. 3), i.e.,

$$H = \sqrt[2]{I + O} \tag{3}$$

- Square Root of the sum of number of neurons in input layer (I) and output layer (O) with addition of some constant "α" (Eq. 4), i.e.,

$$H = \sqrt[2]{I + O} + \alpha \tag{4}$$

where, $0 \leq \alpha \leq 10$.

For example, let us assume that the dataset under consideration has 25 features and 5 possible outcomes, then the number of hidden layers according to (8) with α = 3 is 8 (Fig. 1).

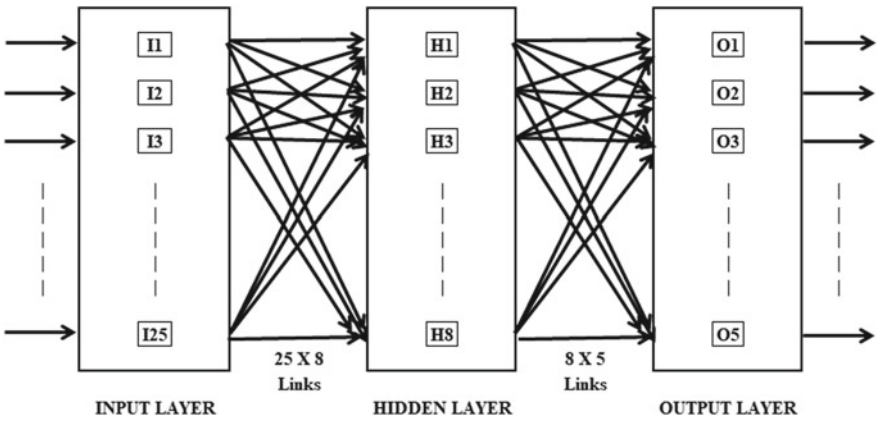

Fig. 1 Architecture of neural network [25 × 8 × 5]

4 Performance Analysis

The performance of the classifier is estimated or derived from certain metrics. These metrics justify the accuracy, effectiveness and detection rate of the classifier. The metrics meant for evaluating the performance of a classifier include Precision, Recall, Accuracy, F1 Score, Jaccard Score, and Hamming Loss etc.; however confusion matrix is most commonly used data structure, as all other performance metrics can be computed using it. An effective and efficient IDS is characterized by 'Sensitivity' and 'Specificity'. TPR of the IDS is represented by Sensitivity and True Negative Rate represented by Specificity [19]. The task of binary classifier is to predict whether an instance belongs to a class or not. Here there are two possible classes to which a sample may belong. In case of IDS the classifier will classify an unknown sample as an attack or normal, based on its training. A confusion metrics for a binary classifier has four main components, namely True Positives (TP), True Negatives (TN), False Positives (FP) and False Negatives (FN). Accuracy, Precision, Recall and F1-Score or F-Measure is computed for judging the performance of the proposed IDS as binary classifier [20]. Multiclass classification (MCC) is a problem where the classifier predicts the class for an instance where number of classes is more than two. Hamming Loss, Jaccard Accuracy and F1-Score are computed for judging the performance of the proposed IDS as Multi-Class Classifier [21].

As far as binary classification is concerned (Table 2 and Fig. 2), Dense_FR with 20 features gives 96.66 precision, 99.54 recall, 98.86 F1-Score and 98.18% accuracy; while Sparse_FR with 7 features gives 98.5 precision, 99.5 recall, 98.3 F1-Score and 97.33% accuracy. ACO_FR offers precision of 99.81%, recall of 99.83%, F1-Score of 99.82% and 99.7% accuracy. According to multiclass classification, results are also promising (Table 3 and Fig. 3). Dense_FR attains the hamming loss of 1.8, F1-Score of 98.2 and Jaccard Accuracy of 95.3; while Sparse_FR obtained hamming loss of 2.5, F1-Score of 97.5 and Jaccard Accuracy of 93.2. The most import feature of both the method is less training time. ACO_FR attains Hamming Loss of 0.3 only, F1-Score of 99.7% and Jaccard Accuracy of 99.4%. According to the results, ACO_FR is best performing classifier for both the classes.

Table 4 represents the TPR and FPR of the BPNN based IDS classifier trained using the different feature reduced datasets. Results clearly justify that the proposed feature reduction approaches enhances the TPR and reduces the FPR, which reflects

Table 2 Results for binary classification

Datasets	Precision	Recall	F1-score	Accuracy
KDD	93.63	97.34	95.45	92.54
IG_Base	80.27	99.4	89.02	80.25
Dense_FR	94.04	99.54	96.71	93.35
Sparse_FR	94.48	99.5	96.93	94.78
ACO_FR	95.74	99.7	97.68	95.87

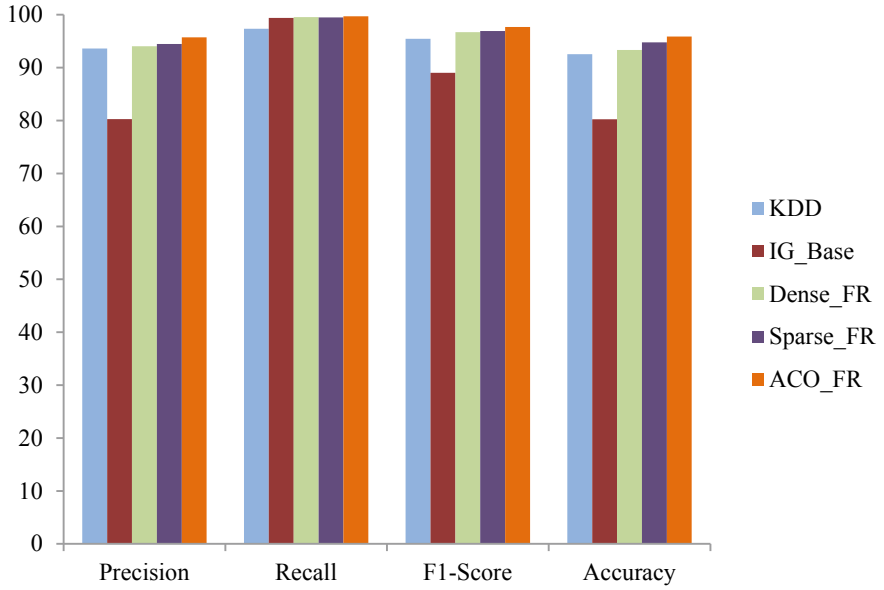

Fig. 2 Comparison for binary classification performance metrics

Table 3 Results for multi-class classification

Datasets	Hamming loss	F1-score	Jaccard accuracy
KDD	11.52	88.48	79.34
IG_Base	7.89	92.11	85.41
Dense_FR	5.78	94.22	87.01
Sparse_FR	4.75	95.25	88.32
ACO_FR	4.08	95.92	87.64

their effectiveness, compared to IG_C_3 and the original KDD dataset with 41 features.

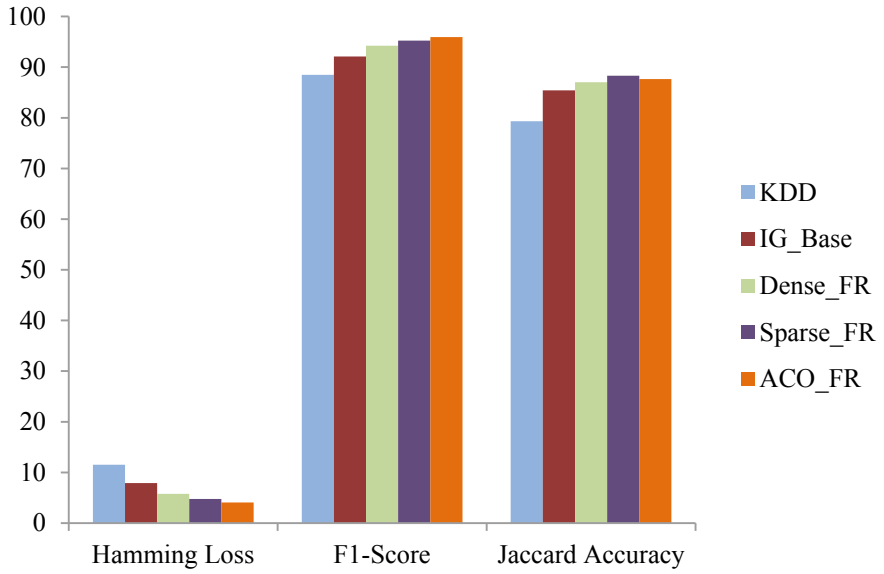

Fig. 3 Comparison for multi-class classification performance metrics

Table 4 Comparison of TPR and FPR

S.No.	Dataset	TPR	FPR
1	Original KDD	98.3	1.7
2	IG_C_3	99.4	0.6
3	Dense_FR	99.54	0.46
4	Sparse_FR	99.5	0.5
5	ACO_FR	99.7	0.3

5 Conclusion

In recent times, due to enormous increase in the amount of threats, attacks and vulnerabilities, there is a significant need of a smart security solution to ensure the confidentiality of data, availability of resources and services and identity management and authentication of users. Machine Learning techniques help in developing intelligent solutions for real-world problems; at the same time, they optimize the performance of the models being developed. This paper proposes three different approaches for constructing the feature reduced datasets for IDS. The performance of the reduced datasets is evaluated using the BPNN based IDS and compared with other datasets. The performance of the IDS is examined as Binary Classifier and Multi-Class Classifier. As Binary Classifier, the task of IDS is to predict whether the sample is Normal or an Attack. As Multi-Class Classifier, the IDS will have to

predict the type of Attack, if the sample is detected as an Attack. Attack is classified into four types, namely Denial of Service (DoS), Probe or Scan, Root to Local (R2L) and User to Root (U2R).The proposed feature reduction solution improves Accuracy and F1–Score by approx. 3% and 7% respectively. For MCC, the improvement in Hamming Loss is approximately 15%. The approximate increase in Jaccard Accuracy is approx. 7%. The future work in this regard is to implement the deep learning based IDS models or ensemble models for IDS, which further improves the performance of the IDS classifier model.

References

1. Jabez J, Muthukumar B (2015) Intrusion detection system (IDS): anomaly detection using outlier detection approach. In: Proceedings of international conference on intelligent computing, communication and convergence (ICCC-2015), published under Procedia Computer Science, vol 48, Science Direct, ELSEVIER, pp 338–346
2. Mane V, Pawar S (2016) Anomaly based IDS using back propagation neural network. Int J Comput Appl (IJCA) [0975-8887] 136(10):29–34
3. Ossowicka A, Pietrolaj M, Ruminski J (2020) A survey of neural networks usage for intrusion detection systems. J Ambient Intell Humanized Comput
4. Sharma R, Kalita H, Borah P (2016) Analysis of machine learning techniques based intrusion detection systems. In: Proceedings of 3rd international conference on advanced computing, networking and informatics, published under Smart Innovation, Systems and Technologies, vol 44. Springer, pp 485–493
5. Kumar S, Viinikainen A, Hamalainen T (2016) Machine learning classification model for network based intrusion detection system. In: Proceedings of 11th international conference for internet technology and secured transactions (ICITST-2016). IEEE, pp 242–249
6. Halimaa A, Sundarakantham K (2019) Machine learning based intrusion detection system. In: Proceedings of 3rd international conference on trends in electronics and informatics (ICOEI 2019). IEEE, pp 916–920
7. Nahar A, Sharma S (2020) Machine learning techniques for diabetes prediction: a review. Int J Emerg Technol Adv Eng 10(3):28–34. ISSN: 2250-2459
8. Aljanabi M, Ismail M, Ali A (2021) Intrusion detection systems, issues, challenges and needs. Int J Comput Intell Syst 14(1):560–571
9. Kour H, Gondhi N (2020) Machine learning techniques: a survey. In: Proceedings of ICIDCA-2019, published under LNDECT, vol 46. Springer, pp 266–275
10. Choudhary D, Malasri S (2021) Machine learning techniques for estimating amount of coolant required in shipping of temperature sensitive products. Int J Emerg Technol Adv Eng 10(10):67–70. ISSN: 2250-2459
11. Karatas G, Demir O, Sahingoz O (2018) Deep learning in intrusion detection systems. In: Proceedings of international congress on big data, deep learning and fighting cyber terrorism. IEEE, pp 113–116
12. Cai J, Luo J, Wang S, Yeng S (2018) Feature selection in machine learning: a new perspective. J Neuro-Comput 300:70–79
13. Shen P, Ding X, Ren W, Liu S (2021) A stable feature selection method based on relevancy and redundancy. In: Proceedings of SCSET 2020, published under Journal of Physics: Conference Series, vol 1732. IOP Publishing
14. Manzor AI, Kumar N (2017) A feature reduced intrusion detection system using ANN classifier. J Expert Syst Appl 88:249–257

15. Neupane N, Shakya S (2017) Comparative analysis of back propagation algorithm variants for network intrusion detection. In: Proceedings of international conference on computing, communication and automation (ICCCA). IEEE, pp 726–729
16. Lu X, Han D, Duan L, Tian Q (2020) Intrusion detection of wireless sensor networks based on IPSO algorithm and BP neural network. Int J Comput Sci Eng 22:221–232
17. Tao L, Jun Y, Qian S (2020) Intrusion detection algorithm of EPSO combined with BP neural network. In: Proceedings of international conference on intelligent transportation, big data and smart city (ICITBS). IEEE, pp 893–896
18. Miller TW (2004) Data and text mining: a business application approach. Prentice-Hall, Inc.
19. Almseidin M, Alzubi M, Kovacs S, Alkasassbeh M (2017) Evaluation of machine learning algorithms for intrusion detection system. In: Proceedings of 15th international symposium on intelligent systems and informatics (SISY). IEEE, pp 277–282
20. Sarvari S, Sani N, Hanapi Z, Abdullah M (2020) An efficient anomaly intrusion detection method with feature selection and evolutionary neural network. IEEE ACCESS, pp 70651–70663
21. Pai VD, Adesh D (2021) Comparative analysis of machine learning algorithms for intrusion detection. In: Proceedings of ICOFTIME 2020, published under IOP conference series: material science and engineering, vol 1013. IOP Publishing

Machine Learning and Sensor Roles for Improving Livestock Farming Using Big Data

S. A. Shaik Mazhar and D. Akila

Abstract A multi-user peer-to-peer relay network with a multi-channel system was examined for relay beam design. MU-MIMO solves the challenge of limiting the maximum power consumption per relay while maintaining minimal SNR. It has the potential to change the way we think about animal agriculture. On a broader scale, As a result of this research, animal producers may produce more meat and other animal products by utilising sensor technology. Sensors, big data, AI, and ML are used to help animal farmers decrease production costs, improve efficiency, improve animal welfare, and produce more animals per hectare. It also discusses the limits of devices. Various uses of animal farming devices are examined in order to see whether they may assist farmers enhance animal health, boost profitability, and reduce their environmental effect. To increase animal husbandry efficiency, we employ the Decision Tree algorithms, Support Vector Machine (SVM) and k-means.

Keywords Big data · Sensors · Machine learning · SVM · k-means · Decision Tree

1 Introduction

The use of remote monitoring devices such as GPS trackers, position sensors, proximity loggers, and accelerometers for automatic recording of both human and animal behavior has increased dramatically over the last decade. Data from accelerometers has been used to track, categorize, and infer human and animal behavior [1]. Sensor-based behavioral categorization systems, scientists to better understand wild and domestic animal behaviour, social interactions based on the use of accelerometers, gyroscopes and magnetometers. As a result of delivering crucial real-time behavioural and health data, sensor technology, particularly in cattle agriculture, can

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have a favourable influence on farm decision Animal health and well-being can be improved with the use of an automated behavioural monitoring system that detects early behavioural changes linked with health changes.

When it comes to Precision Livestock Farming (PLF) technologies, they are completely automated, continuous management systems that provide trustworthy data and warnings based on For livestock farming, PLF refers to using process engineering concepts and techniques in order to manage and monitor animal production autonomously. PLF technologies, on the other hand, translate real-time animal behaviour and reactions captured by microphones, cameras, and sensors into useable information that can be used by online automated management and monitoring systems. When it comes to management, the PLF approach is easy to use since it takes into account not just animals, but also their surroundings. It regulates feeding practises, controls growth rate, and monitors animal activity. Dairy cow metabolic problems are a significant physiological and economic issue. Ruminant activity, in particular, is regarded as an essential non-invasive quantifiable component for the early detection of metabolic disorders in ruminants. The automated assessment of ruminant chewing and activity can aid in the early diagnosis of feeding shortages, making it easier to decide whether to alter the ration. Several research have been conducted in order to create a technological or automated approach for assessing ruminant rumination and feed intake [3, 4].

Economic pressure necessitates increasing dairy production efficiency, which has resulted in high-yielding dairy cows, big herds, and a strong push toward loose housing arrangements. As a result, enhancing animal wellbeing on the farm can boost profitability since it has the potential to lower expenses associated with healthcare and poor yields, and so enhance the sustainability and efficiency of dairying. Only well-managed animals will reach the needed production levels, whereas sick animals will necessitate early culling, resulting in shorter longevity, lower profitability, and, as a result, less sustainability [5]. Using current information and computer technology (ICT), precision livestock farming (PLF) monitors and manages cattle in real time. In dairy production, PLF systems may be important instruments to help farmers monitor and analyse cow health and wellbeing. Dairy farmers may handle larger herds more effectively with PLF systems that automatic. There are automated systems that track behavioral actions in order to detect lameness and eustrus [6].

2 Related Works

Admela Jukan et al. [17] reviewed agriculture and wild animal welfare sensing technology It is a wide assessment of whether animals are healthy, pain-free, and stimulated in their daily lives. Generally speaking, a smart computing and sensing system is one that is not isolated from the outside world, but is instead connected to a communication network and capable of acquiring information. As a result of this study, in future computer science and engineering will be stimulated in their research, as well as the management in animal welfare.

Kevin Smith et al. [18] presented The gadget, which is worn by cattle, is able to capture a range of physiological and environmental data like core body temperature, heart rate and GPS position. It can also measure ambient temperature and humidity (via a 3-axis accelerometer). There is still a need for additional study in areas such as multi-parameter health assessment algorithms, information aggregation, accelerometer data analysis and heart rate detection in a collection of local/regional databases.

Gemma Lowe et al. [19] A thermal infrared picture of a calf was taken using an automated approach, and an algorithm was developed and tested to automatically recognise and evaluate the eye- and cheek-regions. Using an IR camera built into an automatic feed, thermal IR pictures were captured. A computer programme was used to determine which photos had the highest eye and cheek temperatures. Furthermore, the program calculated the highest temperature of the entire picture.

Wenyong Li et al. [20] As a result of this, a computer vision approach for detecting individual dairy cows was suggested Images of tailheads were captured on a dairy farm. This ROI white pattern was described using Zernike moments. There are two sets of Zernike moments that may be extracted from the preprocessed picture and categorised using four different classifiers: LDA, QDA, ANN, as well as (SVM) [21–23].

3 Proposed System

Sensors, big data, AI, and ML are examples of modern technology that provide farmers new options. Rather of responding to ailments as they arise or employing experts in a proactive manner, it allows for continuous monitoring of important animal health indicators like as mobility, air quality, and food and drink consumption. Farmers may now detect, anticipate, and prevent disease outbreaks even before they become widespread by collecting data on a regular basis and using strong AI and machine learning algorithms to predict deviations or abnormalities. In other words, sensors, rather than people, can continually check animal health. A system like this offers two main advantages. One benefit of this approach is that it allows fewer farmers to care for a larger number of animals, lowering production costs. Two, even if a disease is still in the pre-clinical stage. As a result, farmers will be able to take quick action to avert catastrophic losses.

3.1 Animal Monitoring Tools

Precision livestock farming includes detecting and tracking data, Images, noises, weight, biological markers and body condition, are used to identify identifiable individuals in cattle in real-time. There's a good chance that a farm will be able to identify a sickness or a The science of precision livestock farming is not a new one,

as a result of computer science skills and affordable off-label sensors from the video game sector, as well as improved computing power for recording and processing data, precision cattle farming has grown in terms of information, applications.

Other Tools involved In The Process Are.

- Sensors
- Cameras
- Microphones
- Temperature monitoring tools,
- Motion Tracking
- Livestock Identification
- Mobile Applications, WiFi and Bluetooth

3.2 Big Data

The animal is the most important and intricate component in the livestock operation. When using the PLF approach on animals, it's important to monitor their reactions on the animal itself, rather than in the surroundings surrounding the live body. real-time image analysis, Sensors, and sound analysis can be used to collect animal bio-signals in real-time. For example, physical contact is not required in these techniques, and there is no chance that an animal's response will be affected during measurement. There is no need to remove sensors from animals, and there is a reduction in costs because a single camera can monitor a large number of animals.

3.3 Machine Learning Algorithm

i) *Offline SVM*

With nonlinear input mapping into a high-dimensional space, the SVM is one of the most advanced and cutting-edge classifier A hyperplane can be used to split two classes into two sub. The distance (i.e., the margin) between the adjacent patterns of separate classes is maximized using this decision hyperplane.

Consider that where the training t may be linearly separated, given a dataset $D = (yi = x_i)$ built from pairs of instances of features-labels, with $x_i \in R^d$, y $\in -\{1, 1\}$ and I = … 1, 2, … , n. In this case, one of the several hyperplanes supplied by the equation can be used to split the two classes:

$$f(x_i) = w^t x_i + b = 0 \tag{1}$$

where w ∈ R^d and b Rare The hyperplane with the greatest margin is chosen using a support vector classifier. The following is a possible solution to this optimization problem:

$$\min_{w,b}\|\mathrm{w}\|,\ y_i\left(w^t \mathrm{x}_i + \mathrm{b}\right) - 1 \geq 0 \tag{2}$$

If the classes cannot be completely separated (due to feature space overlap), the slack variables can be used to allow certain patterns e = e1, e2, e3, … en and changing the minimization issue in Eq. (2) as follows:

$$min\_(w, b)\|w\|^2 + C\sum_{i=1}^{n} ei \tag{3}$$

$$k(x_i, x_J) = \exp(\frac{||(x_i, x_J)||^2}{2\sigma^2}) \tag{4}$$

where C denotes the regularization constant When linear equations cannot define a hyperplane, we can use a kernel function to translate data into a feature space with a lot of dimensions. The kernel is associated with the transform, and $k(x_i, x_j) = (x_i)\ (x_j)$ In this instance, the issue may be written as $f(x_i) = w^t\ (x_i) + b$, yielding an optimization problem identical to Eq. (2).

ii) *Online K-means Algorithm*

When compared to offline methods, online methods are processed an infinite number (xm) and result (ym) of possible predictors before they meet. The YS is calculated as $y's = hs - 1$ since the aim of learning is to anticipate the current input ys using the known model $HS - 1\ (xs - 1)$. Another contrast is that the training and analysis data sets are not completely separated, but that a subset of instances is utilized for model testing before being used for model training. As seen in Fig. 1, a typical online forecasting mark scheme is as follows:

$$y's = h_{s-1}(x_{s-1}). \tag{5}$$

There are several approaches available for this type of online learning, including increasing assistance vector machines, on-line random forests, progressive quantization of vectors, and stochastic gradient descent. We utilized an uncontrolled K-means algorithm in this research. The unattended online clustering technique was built using Matlab's integrated K Means function. Before performing uncontrolled k-means online clustering, the following guidelines must be followed.

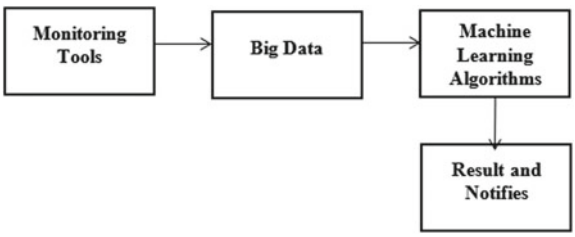

Fig. 1 Block diagram of the proposed method

ALGORITHM 1. K-means online clustering algorithm

1. Make use of previously collected data values (n = 100 points, if relevant). Using the present data set, kd= Cd1, Cd2, Cd3. k centroid number
2. Using the original centroid values, predict the new MeanAMaggg stage behavioral type. The class with the closest center to MeanAMaggg has the predicted behavioral class (as measured by Euclidean distance).
3. Connect the most recently acquired MeanAMaggg datapoint to the centroids to update them.
4. Steps 2 and 3 must be repeated until there is no more detail. At each new iteration, the classification predictor (YK) with the centroids from the previous iteration must be computed (Cd1j1, Cd2j1, Cd3j1).

MeanAMagg, an online estimate of the mean acceleration size. This variable was chosen because the SE C1000 supports real-time local variable calculation. The formula shown below was utilized.

$$MeanAmagg = \frac{\sum_{i=1}^{n} Al}{n} \tag{6}$$

where Al - acceleration degree at each sampling point. The amplitude of the acceleration was measured as follows:

$$Ai = \sqrt{A_{um}^2 + A_{ym}^2 + A_{wm}^2} \tag{7}$$

Aum, Avm, and Awm are the speed values for each specimen along the axes x, y, and z.

iii) Combined Online and Offline Algorithm

This study suggests combining classification labels with the SVM offline method and the online KM algorithm utilizing on-line MeanAMagg measurement for input, all of which are inputs into a decision roster, as previously described. The algorithm for the combined approach is shown below.

ALGORITHM 2. Combined Online K-means and Offline SVM Algorithm

1. Sensor data is obtained in its raw form, and variables are calculated.
2. MeanAMagg and other function characteristics are calculated, and a vector is created to describe them.
3. The SVM supervised classification algorithm is fed the classifier vector.
4. The unsupervised learning algorithm K-means is fed MeanAMagg.
5. The outputs of the K-means algorithms and SVM are used to characterize the three associated behaviors using a decision tree algorithm.

1. The walking cluster contains SVM samples, the specimens which are supposed to obey the SVM algorithm with a high Means MeanAMagg algorithm, Means SVM samples with a MeanAMagg algorithm, and K-means with a high MeanAMagg algorithm.
2. The standing cluster includes samples predicted to be lied to the low MeanA-Magg SVM algorithm by the k and samples predicted to support SVM algorithm.

3. The Lymng Cluster provides examples that SVM with a medium or small MeanAMagg prediction by k-means is predictable for.

Table 1 displays the Offline SVM and online K-means Accuracy of several Big Data datasets.

Figure 2 depicts the accuracy of several data sets obtained from Big Data using Offline SVM and Online K-means. The findings illustrate how the precision of the Offline SVM and K-means algorithms varies (Table 2).

Figure 3 depicts the accuracy of various data obtained from Big Data using Offline SVM, Online K-means, and Combined algorithms. The accuracy obtained from the processing of Offline SVM, online K-means, and combination method accuracy demonstrates that the combined algorithm outperforms the Offline SVM, online K-means algorithms in precision analysis of animal farming.

In this study, it is argued that sensor technology, big data, and machine learning may enhance animal health and farming. It may also assist us in moving toward a more humane and environmentally friendly agricultural future, which is a lesser-known truth. It has enormous promise to help us lessen our reliance on feed and antibiotics. As a result, there may be more considerable carbon sequestration and decreased antibiotic resistance. Furthermore, technology can assist humans in better understanding animal feelings.

Table 1 Offline SVM accuracy and online K-means algorithm accuracy

	Offline SVM accuracy (%)	Online K-means accuracy (%)
Data 1	91.00	90.93
Data 2	88.07	76.49
Data 3	93.42	69.06
Data 4	92.49	79.49

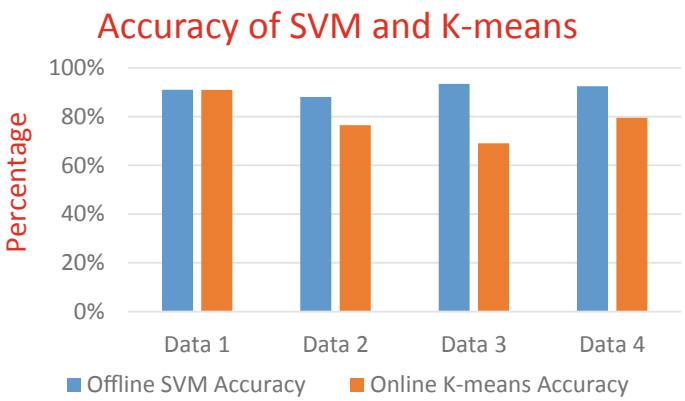

Fig. 2 Offline SVM and online K-means accuracy

Table 2 Offline SVM, online K-means and combined algorithm accuracy

	Offline SVM accuracy (%)	Online K-means accuracy (%)	Combine algorithm (%)
Data 1	91.00	90.93	92.30
Data 2	88.07	76.49	90.21
Data 3	93.42	69.06	94.63
Data 4	92.49	79.49	93.96

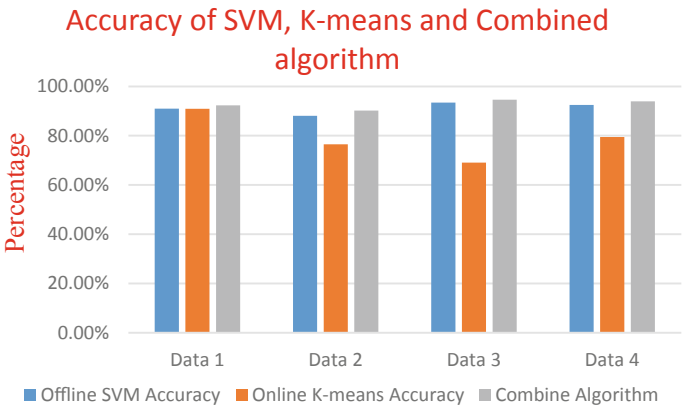

Fig. 3 Accuracy of Offline SVM, Online K-means, and Combined algorithms

4 Conclusion

Sensor technology, big data, and machine learning have become more prevalent in modern animal husbandry as a result of modern animal farming Pandemic conditions necessitate 24/7 insights in real-time into animal activity, intake, and output, especially if veterinary and nutritional professionals as well as farmers or producers can't get out and visit farms, barn Using sensing technologies can offer information that can be utilised to create data that can be accessed remotely, resulting in cheaper costs and greater performance in reacting to consumer needs. The findings of this work indicate that when faced with new and changing situations, it is feasible to properly categorize important behaviors in cattle using a combined Offline SVM, Online K-means algorithm classifier method. The Offline SVM and Online K-means algorithm combo utilizes a set of rules based on previously gathered data. This technique supplies the system with the knowledge it needs to adjust to probable alterations in distribution behaviors. Because of its adaptability, the integrated algorithm can properly categorize sheep walking, standing, and sleeping under a variety of situations (breed, age, physical condition, and habitat). As a consequence, as part of a precision livestock strategy, long-term and real-time automated monitoring is possible with this technology.

References

1. Diosdado JAV, Barker ZE, Hodges HR, Amory JR, Croft DP, Bell NJ, Codling EA (2015) Classification of behaviour in housed dairy cows using an accelerometer-based activity monitoring system. Animal Biotelemetry 3(1):1–14
2. Vázquez-Diosdado JA, Paul V, Ellis KA, Coates D, Loomba R, Kaler J (2019) A combined offline and online algorithm for real-time and long-term classification of sheep behaviour: novel approach for precision livestock farming. Sensors 19(14):3201
3. Zehner N, Niederhauser JJ, Nydegger F, Grothmann A, Keller M, Hoch M, Haeussermann, A, Schick, M (2012) Validation of a new health monitoring system (RumiWatch) for combined automatic measurement of rumination, feed intake, water intake and locomotion in dairy cows. In: Proceedings of international conference of agricultural engineering CIGR-Ageng, p. C0438
4. Tullo E, Fontana I, Diana A, Norton T, Berckmans D, Guarino M (2017) Application note: labelling, a methodology to develop reliable algorithm in PLF. Comput Electron Agric 142:424–428
5. Cockburn M (2020) Application and prospective discussion of machine learning for the management of dairy farms. Animals 10(9):1690
6. Norton T, Berckmans D (2017) Developing precision livestock farming tools for precision dairy farming. Anim Front 7(1):18–23
7. Berckmans D (2017) General introduction to precision livestock farming. Anim Front 7(1):6–11
8. Bishop JC, Falzon G, Trotter M, Kwan P, Meek PD (2019) Livestock vocalisation classification in farm soundscapes. Comput Electron Agric 162:531–542
9. Debauche O, Mahmoudi S, Andriamandroso ALH, Manneback P, Bindelle J, Lebeau F (2019) Cloud services integration for farm animals' behavior studies based on smartphones as activity sensors. J Ambient Intell Humaniz Comput 10(12):4651–4662
10. Li G (2021) Developing and applying precision animal farming tools for poultry behavior monitoring. Doctoral dissertation, Mississippi State University
11. Piette D, Norton T, Exadaktylos V, Berckmans D (2020) Individualised automated lameness detection in dairy cows and the impact of historical window length on algorithm performance. Animal 14(2):409–417
12. Benjamin M, Yik S (2019) Precision livestock farming in swine welfare: a review for swine practitioners. Animals 9(4):133
13. Arcidiacono C, Mancino M, Porto SMC (2020) Moving mean-based algorithm for dairy cow's oestrus detection from uniaxial-accelerometer data acquired in a free-stall barn. Comput Electron Agric 175:105498
14. Garcia R, Aguilar J, Toro M, Pinto A, Rodriguez P (2020) A systematic literature review on the use of machine learning in precision livestock farming. Comput Electron Agric 179:105826
15. Riaboff L, Poggi S, Madouasse A, Couvreur S, Aubin S, Bédère N, Goumand E, Chauvin A, Plantier, G (2020) Development of a methodological framework for a robust prediction of the main behaviours of dairy cows using a combination of machine learning algorithms on accelerometer data. Comput Electron Agric 169:105179
16. González C, Pardo R, Fariña J, Valdés MD, Rodríguez-Andina JJ, Portela M (2017) Real-time monitoring of poultry activity in breeding farms. In: IECON 2017–43rd annual conference of the IEEE industrial electronics society, pp 3574–3579. IEEE
17. Jukan A, Masip-Bruin X, Amla N (2017) Smart computing and sensing technologies for animal welfare: a systematic review. ACM Comput Surv (CSUR) 50(1):1–27
18. Smith K, Martinez A, Craddolph R, Erickson H, Andresen D, Warren S (2006) An integrated cattle health monitoring system. In: 2006 international conference of the IEEE engineering in medicine and biology society, pp 4659–4662. IEEE
19. Lowe G, McCane B, Sutherland M, Waas J, Schaefer A, Cox N, Stewart M (2020) Automated collection and analysis of infrared thermograms for measuring eye and cheek temperatures in calves. Animals 10(2):292
20. Li W, Ji Z, Wang L, Sun C, Yang X (2017) Automatic individual identification of Holstein dairy cows using tailhead images. Comput Electron Agric 142:622–631

21. Kiruthiga R, Akila D (2019) Phishing websites detection using machine learning. Int J Recent Technol Eng 8(2S11):111–114
22. Tamilarasi P, Akila D (2020) Task allocation and re-allocation for big data applications in cloud computing environments. In: Peng SL, Son L, Suseendran G, Balaganesh D (eds) Intelligent computing and innovation on data science. Lecture notes in networks and systems, vol 118, pp 679–686
23. Sansanwal K, Shrivastava G, Anand R, Sharma K (2019) Big data analysis and compression for indoor air quality. In: Handbook of IoT and big data, pp 1–21. CRC Press

Sentimental Analysis on E-learning Videos for Learner's Opinion Using Machine Learning Methodology - Support Vector Machine

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Abstract E-learning is today's most popular self-learning form for students and educators. There is a problem and concern in e-learning. This is the emphasis of this undeniable demand for complexities and personalization learning opportunities that increase student knowledge. In the text mining company, sentimental analysis is one of the most critical regions. The vector thoughts of several customers in each of them as a single data set are compiled and are analysed. E-learning is generally referred to as educational attempts to convey knowledge through the use of computers. In the setting of a non-traditional classroom. It's unlikely for customers to inquire if the e-courses are relaxed. Sentiment analysis helps users to easily classify using e-learning portals. The recorded emotional inputs information's are used by the e-learning methods. Of the entity, and it can be used. Analyses the actions of the customer every time. Students' anti-course feelings will serve feedback on online e-learning sites. The automatic emotional analysis allows students in the planned e-learning method to evaluate the pages on the e-portal and other input from the professors. Here for the Automated Emotional Study of Support Vector Machine.

Keywords Support vector machine · Sentimental analysis · E-learning videos

1 Introduction

Emotions have a big part to play in communicating an emotion between the human beings. Analysis of sentiment or opinion mining is the method used to analyse people's feelings, Attitudes, sentiments, judgments, moods, and views. Sentiment interpretation is the root of natural language. Methods of computation and machine learning, which is the Present trend in the field of text mining science. This is the

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Significant basis of decision-making and can be derived, listed, reviewed on-line nostalgic feedback [20]. Analysing consumer feedback requires a large amount of the sum of computational power used in the process a great deal of info. It's been really healthy. Difficult to discriminate between usable details unusual knowledge [18]. In carrying out such an analysis, there is methodological need to maintain the capacity to process anything reviews of the customer in the context of a vast volume of textual Data, extract the details and expertise found in some document Reviews and research to educate the Management of the enhancement of the service needed. Text of the Mining comes as the right strategy for extracting Knowledge from unstructured text type pattern and a huge number of data inputs [17].

Study of Twitter Emotions Uses Normal language Processing to assess a speaker, a researcher, or a speaker the attitude and feelings of the other person through the piece of text [12]. Currently, Nowadays, some form of marketing company is currently underway immerse yourself in emerging industry patterns. Apart from that, Authored surveys, businesses are now expanding their clients in order to gain a lot of info, I conducted a content study on the internet. Limited emotional interpretation trials have now been done and shown to you. Some of the experiments are geared towards tweeting on Tweets. Information on a certain area, usually product brands [13].

Random Forest is a Breiman-developed learning algorithm that fits the luggage concept. It's okay. The decision trees; any tree that is the basis; the classifier. The decision trees. Rating. Ranking. Its classification process is conducted by voting on the forecasts from persons trees trained in the sub-sets of the data generated Parent preparation package by majority vote. Together research incorporates systemically the effects of learning in a set of basic classifiers so as to deduce a single prediction, which beats one base's results. Rankings, man. Ranking, man. The idea behind it is based on the study of the views of various people in order to deduce a single opinion. Ok, sound opinion [15].

Naive Bayes uses the theory of Bayes theorem which, sir, assumes the independence of one another. Naïve Bayes, in reality, imagines that the addition of one element has no effect on appearance of all other characteristics. It's really easy to do Create and change large datasets using Naïve Model of Bayes. Basically, the theorem of Bayes is included Calculate the probabilities that follow.

2 Related Works

Tahira Mahboob et al. [1] the proposed evaluation/performance of the pupil was also addressed in the fair/transparent model. Simple parameters then defined by applying machine learning Effective testing of algorithms is carried out. In this research classifications including Naive Bayes, the RF and Decisions Trees-J48 are being used to initially eliminate the noisy data to advance excellence in student data and thereby improve predictions of accuracy. For undergraduate programmes, the scope of the paper has been established. The outcomes of the test The dowry with

a set of rules for all students who have Its poor grades. Quality monitoring has also been carried out Verification, precision and validity of the findings.

Kelly J et al. [2] Educational data mining is an area of science that Searches for the retrieval of valuable knowledge from large educational establishments Datasets, guy. We suggest a computational in this article to determine the role of dangerous college students, institutional data mining and diverse deep learning approaches were used to assess the activities of several forecasts. The environment of the University of Brazil (Decisio Trees, K-Nearest Neighbor, Neural Networks). Results of the paper Evoke decisions that minimise dropouts in schools to such algorithms as help tools.

Poornima et al. [5] This work contrasted the success of three of them Approaches to machine Training as SVM, Naïve Bayes Multinomial and logistics decreases. Regression of logistics The Bigram Model was used with approximately 86 percent accuracy. Compared to other supervised Twitter Sensation Testing machines, logistic regression performs best. The future research may explore differences in the understanding of the sentiment efficiency algorithm when many characteristics are taken into account. Additional adaptive learning approaches, including the expected errors, are used to detect and enhance Twitter, pool-based screen, insight samples etc. emotions trust of decision-makers.

P. Karthika et al. [6] Scoring This article is known as the flipkart.com online shopping website. Analysis focused on the commodity's rankings. It has been categorised as positive, negative and neutral. The suggested modification job is tested with the Called Random Forest machine learning algorithm and simulated with SPYDER. Accuracy, accuracy, estimation and recovery are our tools. The Random Forest and Support Vector have been determined. The algorithm of the machine (SVM) and the precision is as follows. Both have been designing algorithms. In which the forest of the Random supplies 97% of the Help Vector Machine with the highest accuracy.

Surya Prabha PM et al. [10] the classifier is extremely flexible, requiring a tiny one. Amount of parameters, please. A simple classifier is Naïve Bayes. This is technique. It is methodology. There are a variety of other research methods Useful research techniques; Naive Bayes is one of the most powerful alternatives. that have a higher degree of accuracy Strong results after classification [21–23]. The solution suggested any form of analysis dataset may be used. The job it may also be applied to a higher degree of input collection.

3 Proposed Method

In this proposed method we are going to use K-Nearest Neighbour, Random Forest and Support Vector Machine on e-learning web site the students using for the educational purposes. We are going to prove that SVM is better than K-Nearest Neighbour and Random Forest Algorithms.

3.1 Svm (Support Vector Machine)

To analyze data and recognize pattern used for classification and regression analysis. The A help vector can be used for the marking and the measurement of emotional constancy using Frequency as real and negative feedback vectors [5].

$$w = \sum_i a_i y_i x_i \tag{1}$$

The SVM helps to find a similar high level across groups. The SVM helps. It assists developers to strengthen the e-learning courses that periodically refresh them. Based on the dataset and the range of features listed in the previous section, supervised machine learning methods introduced for study of sentiment. Supervised learning is a Machine learning role of inferring a labelled role Training details consisting of a set of training examples [7].

The machine solution is to find the ideal hyperplane That has the greatest possible margin. It is usually referred to as a support vector for each class. The hyperplane formula can be seen in the Eq. 7.

$$f : x * x + b = 0 \tag{2}$$

where,

W = Hypeplanetary parameters between Hyperplane and Support Vector (Perpendicular Line).

x = SVM data entry (X1 = Word Index, X2 = Word Index) Pesage).

b = Parameters for a hyperplane (Bias).

F = Hyperplane Function.

Parameter (w) of the hyperplane obtained by using the formula in Equation of the (8).

$$w = \sum_{i=1}^{l} aiyixi \tag{3}$$

bias value formula (4).

$$b = \frac{b1 + b2}{N + M} \tag{4}$$

B(1), M, B(2) and N, are the products of the Eq. (5).

$$b1 = 1 - \left(\sum_{i=1}^{N} wi * xi \quad b2 = -1 - \left(\sum_{i=1}^{Ms} wi * xi\right)\right) \tag{5}$$

Explanation of:

W = Hypeplanetary parameters between Hyperplane and Support Vector (Perpendicular Line).

No-Negative Vector Lagrange Multiplier.
(a) (Alpha).
Yi = Input of data (label +1 or –1).
x = SVM data entry (X1 = Word Index, X2 = Word Index) Pesage).
b = Parameters for a hyperplane (Bias).
b(1) = Class +1 support vector.
b(2) = Class –1 support vector.
N = The number of b (1).
M = The number of b (2).

ALGORITHM. SVM

1. Create an entry term, title quantity, and a mark for the data input.
2. Determining the variable w using the equation (12)
3. Based on the equation, calculate the pattern (b (4)
4. Have a data test classification by using the equation of the (2).

Once the framework has effectively explained the feedback section on e-learning, Need a measure to assess how accurate the classification is the device has been made.

3.2 K-Nearest Neighbour Algorithm

K-NN (K-Nearest Neighbor) is a challenge to detect high-risk kids as soon as feasible in educational institutions. The time lag between recognition and real-time is risky. Early detection can greatly minimize the likelihood of failure or disconnection. Identity is simple in a short procedure, but it is impractical. Current learning management systems are stored online. With vast quantities of data and integrated learning, online can develop prediction algorithms to detect these pupils.

Let us consider a binary class classification problem:

$$p(class = 0) = \frac{\text{count}(class = 0)}{\text{count}(class = 0) + \text{count}(class = 1)} \tag{6}$$

$$p(class = 0) = \frac{\text{count}(class = 1)}{\text{count}(class = 0) + \text{count}(class = 1)} \tag{7}$$

Because it makes no assumptions about the underlying data, it is a non-parametric and instance-based learning algorithm. A feature in KNN is categorized based on the majority vote of its neighbors.

Figure 1 depicts the K-NN [14] function. k is a user-defined variable in this example. k, c1(x) of a U-outlier x, for example, denotes x's k-nearest class.

In other words, k, cmin is x's closest existing class neighborhood. Then, in equation, k-NSC of x is provided (3).

```
Review: While the content of the course is interesting and useful, the delivery
and desperately needs to be improvement. The professor speaks extremely monotonous
way, making it seem like they are reading their lines from behind the camera. Just
awful and make it hard to follow and stay interested and connected with the topic
<even when you are passionate about the subject>. I would rather have the course
in Italian, and read the subtitles, if that means a more energetic delivery.
SVM classifier prediction: Positive

Review: hope there will be some sequel courses! So interesting and
inspirational! Thank you Universita Bocconi!
SVM classifier prediction: Positive
Total Positive Prediction: 50589
Total Negative Prediction: 10479
Total neutral Prediction: 4376
Dimension of dataset :< 65444, 4 >
SVM algorithm Accuracy: 0.98
SVM algorithm Re-call:0.97
SVM algorithm Precision_Score:0.95
```

Fig. 1 The result of the SVM algorithm

$$K - NSC(x) = \frac{D_{cmin,q}(x) - D_{cout,q}(x)}{\max(D_{cmin,q}(x), D_{cout,q}(x))} \tag{8}$$

3.3 Random Forest

A directed learning algorithm, Random Forest. Used with issues in regression and grouping. The simply wild random forests and plants are called the treetops. It is segregated. It is isolated. Decide several trees and then blend them to make a difference. Absolute and stable meaning, primarily used for preparation and class results [6]. This is a tree indicator combination. Each tree has a random vector value, each of which is independently sampled and used for the same function. The wild forest has many 'm' trees {T1(x), and T2(x)}, of which x = {×1}, xn} represents a dimensional vector of each arboreal tree's properties.

$$\text{Collection of the m outputs of the Products is } Y' = T1(x) \ldots Y'm = Tm(x)\} \tag{9}$$

where Y is true M is a forecast for properties of the tree.

Finally, the output of all predictors is summed to produce the final output.

For the Classifier Set {h1(x), (h2)(x)…, hm(x) and a training range obtained by The marginal function can be set as random collection from random Y, X, vector distribution

$$mg(x, y) = avkI(hk(x) - y)maxavkI(hk(x) - j) \tag{10}$$

where I am the role of the indication. The wider the margin, the greater the outcome of the grouping. In the RF the hm(x) = h (X, atom) where the independent tree is the same. Random vector distributed.

Algorithm 2. **RANDOM FOREST ALGORITHM**

1. Load the flipkart dataset and add it randomly It's a forest algorithm.
2. The requisite documents were chosen and the created the decision trees accordingly.
3. The decision-making method is based on the value of class.
4. If the class value is below the threshold, it is assumed to be false, or false, otherwise. Very considered.
5. Algorithms are equal to an SVM algorithm consistency Random forest production. measures such as precision, Precision, F-measuring and recollection.

The above algorithm working principle as follows:

1. Picks N Random Algorithm Random Forest algorithm Records from the appropriate data set. Depending on the number of N documents mounted on the tree.
2. The decision tree is constructed on the basis of the N documents
3. Based on the data collection available, the number of trees was calculated
4. Each node on the tree forest foresees the Y value for a new record in the event of a regression problem.
5. All calculated the sum of all values. The forest trees calculate the final importance of When it comes to the identification issue, every tree in the forest knows which group it belongs to. Finally, the most recent performance was assigned to the Class category.

```
Review: While the content of the course is interesting and useful, the delivery
and desperately needs to be improvement. The professor speaks extremely monotonous
way, making it seem like they are reading their lines from behind the camera. Just
awful and make it hard to follow and stay interested and connected with the topic
<even when you are passionate about the subject>. I would rather have the course
in Italian, and read the subtitles, if that means a more energetic delivery.
RF classifier prediction: Positive

Review: hope there will be some sequel courses! So interesting and
inspirational! Thank you Universita Bocconi!
RF classifier prediction: Positive
Total Positive Prediction: 39876
Total Negative Prediction: 18654
Total neutral Prediction: 6914
Dimension of dataset :< 65444, 4 >
RF algorithm Accuracy: 0.78
RF algorithm Re-call:0.74
RF algorithm Precision_Score:0.71
```

Fig. 2 The result of the RF algorithm

3.4 Experimentation

The Fig. 1 shows the result of the proposed method from one of the Fig. 1. The precision, accuracy and recall are resulted from the picture in Fig. 3. The KNN and SVM Algorithm Results are Shown above (Fig. 2).

From Table 1 and Fig. 4 the Accuracy, Precision and recall value from the output taken from the Fig. 1 is calculated with KNNm RF and SVM.

```
Review: While the content of the course is interesting and useful, the delivery
and desperately needs to be improvement. The professor speaks extremely monotonous
way, making it seem like they are reading their lines from behind the camera. Just
awful and make it hard to follow and stay interested and connected with the topic
<even when you are passionate about the subject>. I would rather have the course
in Italian, and read the subtitles, if that means a more energetic delivery.
KNN classifier prediction: Positive

Review: hope there will be some sequel courses! So interesting and
inspirational! Thank you Universita Bocconi!
KNN classifier prediction: Positive
Total Positive Prediction: 45467
Total Negative Prediction: 13578
Total neutral Prediction: 6399
Dimension of dataset :< 65444, 4 >
KNN algorithm Accuracy: 0.87
KNN algorithm Re-call:0.82
KNN algorithm Precision_Score:0.79
```

Fig. 3 The result of the KNN algorithm

Table 1 The recall algorithm values from the output

	Accuracy	Precision	Recall
SVM	0.98	0.97	0.95
KNN	0.87	0.82	0.79
RF	0.78	0.74	0.71

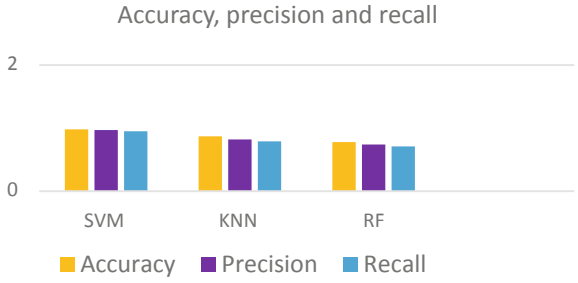

Fig. 4 The recall algorithm values from the output

From the below Figs. 4, shows the results of the Fig. 1. The recall, precision and accuracy results are finalized for the K-Nearest Neighbor, It is shown in figures below as a random forest and help system algorithm. From the above results, we can infer that the Vector Machine Algorithm supports the sentimental analysis for the student on the e-learning website it is taken as input and resulted value shows that Support Vector Machine Algorithm is better than K-Nearest Neighbor and Random Forest Algorithm.

4 Conclusion

The result of the new system will be assistance to the creator and the instructor in classifying the most oriented e-learning sites gateways. We evaluated the sentiment of consumer feedback in this article. Over the student feedback in the e-learning portal. We evaluated the SVM Algorithm, KNN and RF Algorithm on the comments seen in Fig. 1 student reviews the dataset to search Accuracy of the various views, etc. On the basis of the study of the result found that the support vector machine had the High precision rate among the different KNN Algorithms and RF Algorithm. From the above performance data, we can infer that support Vector Machine Algorithm for sentimental analysis on the student's e-learning website for research purposes is taken as input and the resulting value shows that support Vector Machine Algorithm is stronger than KNN and RF Algorithm.

References

1. Mahboob T, Irfan S, Karamat A (2016) A machine learning approach for student assessment in E-learning using Quinlan's C4. 5, Naive Bayes and random forest algorithms. In: 2016 19th International Multi-Topic Conference (INMIC), pp 1–8. IEEE, December 2016
2. Kelly JDO, Menezes AG, De Carvalho AB, Montesco CA (2019) Supervised learning in the context of educational data mining to avoid university students dropout. In: 2019 IEEE 19th International Conference on Advanced Learning Technologies (ICALT), vol 2161, pp 207–208. IEEE, July 2019
3. Anantharaman H, Mubarak A, Shobana BT (2018) Modelling an adaptive e-learning system using LSTM and random forest classification. In: 2018 IEEE Conference on e-Learning, e-Management and e-Services (IC3e), pp 29–34. IEEE, November 2018
4. Gong W, Wang W (2011) Application research of support vector machine in E-Learning for personality. In: 2011 IEEE International Conference on Cloud Computing and Intelligence Systems, pp 638–642. IEEE, September 2011
5. Priya KS (2020) A comparative sentiment analysis of sentence embedding using machine learning techniques. In: 2020 6th International Conference on Advanced Computing and Communication Systems (ICACCS), pp 493–496. IEEE, March 2020
6. Karthika P, Murugeswari R, Manoranjithem R (2019) Sentiment analysis of social media network using random forest algorithm. In: 2019 IEEE International Conference on Intelligent Techniques in Control, Optimization and Signal Processing (INCOS), pp 1–5. IEEE, April 2019

7. Zhang X, Zheng X (2016) Comparison of text sentiment analysis based on machine learning. In: 2016 15th International Symposium on Parallel and Distributed Computing (ISPDC), pp 230–233. IEEE, July 2016
8. Han KX, Chiu CC, Chien W (2019) The application of support vector machine (SVM) on the sentiment analysis of internet posts. In: 2019 IEEE Eurasia Conference on IOT, Communication and Engineering (ECICE), pp 154–155. IEEE, October 2019
9. Sabariah MK, Effendy V (2015) Sentiment analysis on Twitter using the combination of lexicon-based and support vector machine for assessing the performance of a television program. In: 2015 3rd International Conference on Information and Communication Technology (ICoICT), pp 386–390. IEEE, May 2015
10. Surya PP, Subbulakshmi B (2019) Sentimental analysis using Naive Bayes classifier. In: 2019 International Conference on Vision Towards Emerging Trends in Communication and Networking (ViTECoN), pp 1–5. IEEE, March 2019
11. Fei Y (2016) Simultaneous support vector selection and parameter optimization using support vector machines for sentiment classification. In: 2016 7th IEEE International Conference on Software Engineering and Service Science (ICSESS), pp 59–62. IEEE, August 2016
12. Mandloi L, Patel R (2020) Twitter sentiments analysis using machine learning methods. In: 2020 International Conference for Emerging Technology (INCET), pp 1–5. IEEE, June 2020
13. Troussas C, Virvou M, Espinosa KJ, Llaguno K, Caro J (2013) Sentiment analysis of Facebook statuses using Naive Bayes classifier for language learning. In: IISA 2013, pp 1–6. IEEE, July 2013
14. Kaur VD (2018) Sentimental analysis of book reviews using unsupervised semantic orientation and supervised machine learning approaches. In: Second International Conference on Green Computing and Internet of Things (ICGCIoT)
15. Bader-El-Den M, Teitei E, Perry T (2018) Biased random forest for dealing with the class imbalance problem. IEEE Trans Neural Netw Learn Syst 30(7):2163–2172
16. Liu B, Hao ZF, Lu J, Liu SQ (2007). Apply support vector machine for CRM problem. In: 2007 International Conference on Machine Learning and Cybernetics, vol 6, pp 3288–3292. IEEE, August 2007
17. Wu YX, Guo L, Li Y, Shen XQ, Yan WL (2006) Multi-layer support vector machine and its application. In: 2006 International Conference on Machine Learning and Cybernetics, pp 3627–3631. IEEE, August 2006
18. Guo J, Chen Y, Wang S, Liu X (2009). A learning approach for fast training of support vector machines. In: 2009 International Conference on E-Learning, E-Business, Enterprise Information Systems, and E-Government, pp 122–125. IEEE, December 2009
19. He LM, Yang XB, Lu HJ (2007) A comparison of support vector machines ensemble for classification. In: 2007 International Conference on Machine Learning and Cybernetics, vol 6, pp 3613–3617. IEEE, August 2007
20. Ji AB, Pang JH, Qiu HJ (2010) Support vector machine for classification based on fuzzy training data. Expert Syst Appl 37(4):3495–3498
21. Juneja A, Bajaj S, Anand R, Sindhwani N (2019) Improvising green computing using multi-criterion decision making. J Adv Res Dyn Control Syst 12(SP3):1161–1165
22. Akila D, Pal S, Jayakarthik R, Chattopadhyay S, Obaid AJ (2021) Deep learning enhancing performance using support vector machine HTM cortical learning algorithm. J Phys Conf Ser 1963(1):012144. IOP Publishing
23. Nagarathinam T, Elangovan VR, Obaid AJ, Akila D, Tuyen, DQ (2021) E-learning in data analytics on basis of rule mining prediction in DM environment. J Phys Conf Ser 1963(1):012166. IOP Publishing

TLRNN: Two-Level RNN Based Personalized Recommendation in Tourism Domain

M. Nanthini and K. Pradeep Mohan Kumar

Abstract Nowadays people's interactions in social media are getting increased gradually due to their usage of various gadgets and the evolution of technology. Lifestyle changes play a vital role in everyday life and people started consuming food outside rather than home and travel more than usual practice. Information related to location and the user check-in data is huge and it is difficult for the system to identify the individual user interests for good service. Recommendation helps users to narrow down their choices in social networks and provides them personalized service. A novel Two Level Recurrent Neural Network (TLRNN) has been used to provide a personalized recommendation in the tourism domain and it uses the user's profile, search history, and user interests in the first level of the neural network to classify the places. By comparing the user profile and search history against the predefined table, user preferences in the category of place have been ranked. Later, it considers the category, time, and distance for top n recommendation of places to the users. This technique overcomes the cold-start user problem in a tourism domain and provides the top-ranked recommendation list to the user. Results of RNN by training with time and distance have been compared with the results of RNN without time and distance. The final results show that the proposed technique narrows down the user's preference places in the tourism domain.

Keywords Recommender system · Tourism domain · Recurrent neural network · Cross-domain recommendation · Cold-start

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1 Introduction

In today's world, large volumes of data are generated from online social websites due to the increasing usage of social networks by users. That information in the websites can take different forms such as feedbacks, ratings, reviews, opinions, etc. It is very hard to find the user's needs and interests among the huge volumes of information. Recommender System (RS) helps the producer and the consumer to filter the information and narrow down the options for their decision making and better prediction. The traditional RS is a collaborative, content, and knowledge-based system. The collaborative technique is used to make predictions according to the same kind of user's interests and it involves a greater number of users, products, and resources for a recommendation. Collaborative Filtering (CF) [1–3] is of two different types memory and model-based techniques, where the memory-based approach uses the rating information about the user and enables prediction based on the user's similarity or item's similarity. Model-based techniques use various machine learning and data mining algorithms to make predictions.

Content filtering will not use the user's information for recommendation instead uses the features about a particular item to recommend another item to the user based on the previous history of users, the common nature of the items, implicit and explicit feedback. Both the collaborative technique [4, 5] and content-based technique have their advantages and disadvantages, to address the problems faced by the previous techniques, hybrid RS has been introduced. It combines two or more filtering methods to complement the RS performance. Hybris RS has various levels of algorithm based on the implementation. Figure 1 represents the monolithic hybridization that combines two recommender systems in one algorithm.

The new user problem is a serious issue in RS where the system has no information about the user for prediction. Knowledge-based technique comes into existence and uses the queries posted by the user in social media, expert's opinions about the domain [6, 7] for making recommendations instead of ratings and user history. Each attribute has two important aspects as the comparative need of the data and the function that defines the likeness of the two values and it is very easy as computing the difference between the two values. With web 2.0, an enormous amount of content is generated and distributed among different networks. Collecting and exploiting information generated by the user from social networks gives the complete solution to improve

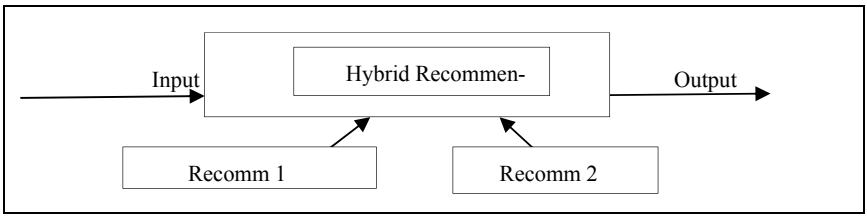

Fig. 1 Monolithic hybridization design

the performance of recommendations in various applications such as advertisement, searching, web surfing, etc. From the listed applications, tourism recommendation is one of the interesting applications to explore for researchers since it is very much related to the daily interaction of users in social media. On many travel websites, users were sharing their interests, check-in information, feedbacks, reviews, and ratings. It is very helpful for the travel companies to provide recommendations to increase their income as well as satisfy the user needs by providing them more attractive destinations and it leads to an increase in the demand for travel recommendations.

2 Related Work

In our daily life, social networks play an important role in the daily activities and lifestyle changes of users. One of the interesting applications is tourism application where the users are getting sufficient information about the tourist places from the social networks. Due to the increasing requirements of data about the tourist places to satisfy the user needs, various online websites are generating a large volume of location-aware information and related check-in data for providing recommendations in tourism. Most of the traditional RS are rarely using the user's check-in data from social media for future processing. This scenario provides a new path to researchers as well as the tourism industry for data exploration. User preferences for better recommendations can be extracted from the location-aware information. A dynamic check-in data-based RS [2, 8, 9] for tourism is developed to provide recommendations and also to address the cold start problem by collecting friends' information from Facebook activities. The proposed system understands the user check-in data dynamically and improves the overall recommendation performance and reduces the new user problem in the tourism field.

A novel graph-based probabilistic modal has been developed by extracting the data from social media to provide personalized recommendations to travelers and also to extract the latent features from traveling websites for better prediction. Compared to the traditional methods, this proposed work extracts the knowledge from tourist places and attractions separately for a better understanding of both domains. Along with the above information, it explores the sentiments of the users who are involved in tourism and obtain their interests over various tourist spots that enable recommendation according to the themes and sentiment analysis [10]. The proposed method compares the tourism and attractive places separately and extracts the common features from the two domains [8] to create the latent features information for personalized recommendation in the tourism domain. This work enables both the individual domain and cross-level domain recommendation in the field of tourism.

In the new era of research, tourism and its recommendation are popular due to users' lifestyle changes and their interests in the field. Various techniques are used to provide recommendations based on the user's check-in data and location-aware information from online social networks by combining the data from various resources based on the user's interests. This proposed work presented the related work

on various RS for the tourism domain based on location information and summarizes recent trends in this area of research. The first part of this paper discussed various journals in the tourism domain for more than 18 years. Later, the journal papers are grouped based on problem definitions, data gathering, proposed methodologies, and the final results. Finally, data sources are grouped in location-aware RS in the tourism domain [11, 12]. Various applications of location-based RS and the accomplishments in this field were discussed. Future enhancements and their scope were explored for better prediction in RS.

Introducing intelligence into tourism is a challenging task in the real-time scenario due to the increasing needs and expectations of users. So, the traditional RS is not enough to make intelligence into it. Most of the tourism-based RS faced problems insights and tourist routes prediction. To address the mentioned issue, a text mining-based RS is developed to analyze the user's interest in tourism for better recommendations. Initially, it analyses the various problem on tourism RS and developed the algorithm using clustering and text mining techniques [13] and it extracts the information at the maximum level. Later, it addresses the various impacts on the mode of transportation in the tourism domain and the developed algorithm is used to find out the extreme information movement in the network. Three developed algorithms were compared with each other for the efficiency of the system. The proposed algorithms outperformed the traditional methods by finding the user interests with the help of a real-world dataset in the field of tourism recommendation.

Due to the increasing rate of technology, communication between the devices, and data generation, the tourism domain gained new popularity in RS in all perspectives such as transportation, events related to tourism [14–16], hotels, etc. The collection of options provided by the tourism domain for the users is very useful to avoid noisy data and irrelevant information. Many traditional techniques have been developed to help the users with their scheduling in tourism. This work summarizes the different RS in the tourism domain and various hybrid recommendation techniques and it explores the tourist places and user preferences. The system will act as a tourism planning application that contains multiple tourism information for traveling time-based recommendations. The main objective is to implement RS for big data techniques and other related fields.

Most of the RS for the tourism domain uses location-based information and the user's check-in data [17, 18] that will help to group the likely-minded users for a collaborative recommendation. The tourist place preferences differ from one user to another user, place to place, and the user's preferences. Due to the lifestyle changes of users, RS failed to find their interests and provide recommendations accordingly. People's traditions, ages, places, and environments play a vital role in lifestyle changes and trends. A collection of location-aware information is needed for a better recommendation. Various traditional techniques have combined the places based on their group or nature with the help of collaborative filtering but it does not address the group recommendation in the tourism domain. An efficient RS based on Hierarchical location information considers the user preferences as well as multiple location information for a recommendation. The hierarchy consists of users at the root level and preferences at the subsequent levels. The proposed system outperforms

the existing techniques in real-world data set by exploring the grouping of places in location-based RS.

3 TLRNN: Two-Level Recurrent Neural Network

This section discusses the proposed technique and the two-level neural network working methodology with different input features.

3.1 Recurrent Neural Network

A Recurrent Neural Network (RNN) is a special case of artificial neural networks that consider the results of the previous iteration as an input to the current iteration. In most of the neural networks [19, 20], the inputs and the results are self-regulating terms but, in some scenarios, it is mandatory to consider the previous computation's results for the current computation. RNN addresses the issue in the traditional neural network [21, 22] with the hidden layers. The important feature of RNN is a hidden layer that stores the information of previous computation.

RNN consists of Long Short-Term Memory (LSTM) which stores all the information to be considered for current iteration from the previous results. The same features are used for all the inputs to perform the same kind of tasks for all the inputs and hidden states to generate the results and also decrease the complexity of the network for better performance. RNN reduces the number of multiple hidden layers into one hidden layer by converting different weights and biases into the same for all the layers. So, the autonomous activation functions are converted into dependent functions. RNN is using two different approaches to perform the computation, one is unidirectional and the other one is bidirectional. The unidirectional network considers the previous computational results for current state prediction whereas the bidirectional network extracts the future results to improve the performance of the overall network.

3.2 System Architecture

Location-aware data is collected from various resources such as search history, user's profile, and current location. Raw data are pre-processed for feature selection and fed into the neural network for further processing. The attributes considered for the

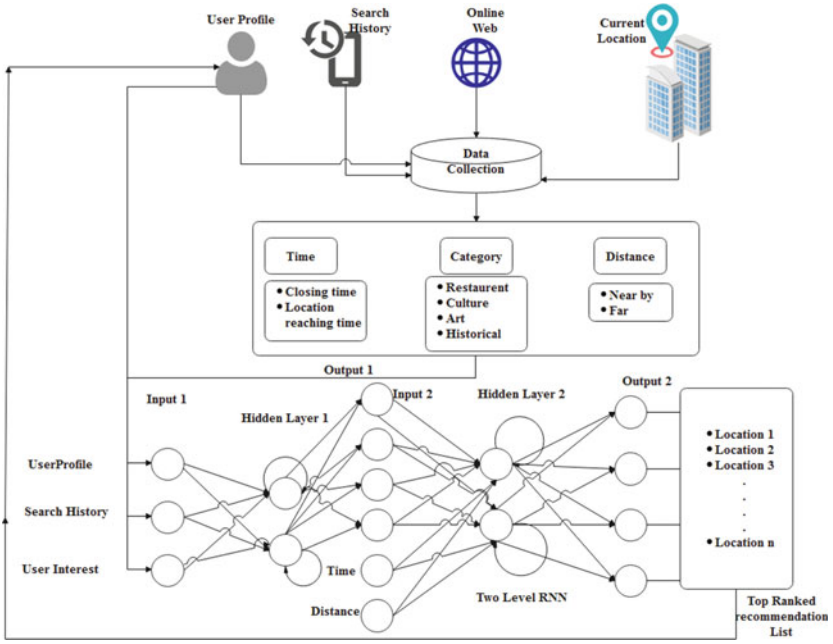

Fig. 2 System architecture

first level of training are user interests, user profile, and search history. One hidden layer is used to process the information and categorize the output as four different labels. So, the user's choices in the tourism domain are narrowed down to a certain extent from a vast number of places in different locations. Along with the category of places, duration and distance have been added for the next level of training. During the second phase, people's interests are predicted in a specific manner along with the previously predicted results. The top-ranked recommendation list is provided to the users in a personalized way. Figure 2 represents the system architecture of personalized recommendation in the tourism domain.

Distance feature is used to find out the nearby places and faraway places in the tourism domain with the latitude and longitude values of the location. So, the places are categorized as either nearer to the user's location or far from the user's current location. This feature helps the system to find out the locations nearer to the user's place and suggests them more attractions within a city limit. Algorithm 1 is derived to find out the nearer location N or far from the user's location, F. D is the distance by calculating the difference between region R_k and location L_i, where k and I are the iterating variables for computing the distance for n and m number of times. la represents the latitude and lo represents the longitude. The distance and the time will be added as the input to the neural network in the second level of training for a better recommendation.

Algorithm 1: Distance Calculation

Input: Locations L_i i → 1 to n, Region R_k k → 1 to m
Output: Nearby N or Far F
Description:
1: Assign Latitude → la, Longitude → lo and Distance → D
2: Begin
3: for(k=1; k<=m; k++)
4: {Give the L_i in R_k
5: for i in the range(1,n)
6: {Calculate the la and lo value of L_i// Using the url}
7: Calculate the la1 and lo1 value of a R
8: D = (la1 and lo1) – (la and lo)// kilometers
9: if(D is small)
10: {return N}
11: else
12: {return F}
13: }
14: End

4 Experimental Evaluation

This section discusses the dataset and its features. The dataset was created using Kaggle (Find Open Datasets and Machine Learning Projects|Kaggle) [23] using trip advisor for Chennai city (Tripadvisor Official Site) [24] and the above-mentioned features were extracted using a web crawler in a standard format. The experiment is conducted using 1000 records collected from the trip advisor. It is having 100 user profiles, search history, and visited locations in Chennai city.

Table 1 shows the list of top 4 recommendations list contains a restaurant, culture, art, and historical for places category for n users and ranking the category for each user based on their interest, search history, and the profile. L1, L2, L3, and L4 represent the top four classification labels for four different categories of places. Table 2 represents the list of top-ranked locations for each user along with previous classified results. For the second level of learning, input parameters are taken from the first level by reducing the top n recommendation list to the top n/2 list along with distance and time. For the cold-start user [25], the system uses the search history and compared it with the predefined table to find out their interests. When a user is intended to select the specific category, time and distance are considered to predict the locations rather than fetching the data from a predefined table. TL, ML, and RL represent the Tourist Location, Museum Location, and Restaurant Location respectively.

Table 1 RNN Classification for the category of places

Input features	L1	L2	L3	L4
User profile1	Restaurant	Culture	Art	Historical
User search history1				
User interest1				
User profile2	Culture	Art	Restaurant	Historical
User search history2				
User interest2				
User profile3	Art	Restaurant	Historical	Culture
User search history3				
User interest3				
⋮	⋮	⋮	⋮	⋮
User profile n	Historical	Restaurant	Culture	Art
User search history n				
User interest n				

5 Results and Discussion

Table 3 shows that the recommendation of several locations to the user based on three different metrics listed in the table. The first recommendation list is based on without including time and distance, the second recommendation list is generated with distance and without the time and the third list is generated to the user by considering time and distance in the classification algorithm.

Recommendation with distance and time narrow down the choices of customers in the location recommendation compared to the above two cases. Figure 3 shows the performance comparison of three different cases for Top N location recommendation to the user.

Table 2 RNN Classification for specific location recommendation

Users	Input data	Location 1	Location 2	Location 3	Location 4
User 1	Restaurant	RL1	RL2	RL3	RL4
	Time				
	Distance				
	Culture	TL1	TL2	TL3	TL4
	Time				
	Distance				
User 2	Culture	TL1	TL2	TL3	TL4
	Time				
	Distance				
	Art	ML1	ML2	ML3	ML 4
	Time				
	Distance				
User 3	Art	ML1	ML2	ML3	ML 4
	Time				
	Distance				
	Restaurant	RL1	RL2	RL3	RL4
	Time				
	Distance				
⋮	⋮	⋮	⋮	⋮	⋮
User n	Restaurant	RL1	RL2	RL3	RL4
	Time				
	Distance				
	Art	ML 1	ML2	ML3	ML 4
	Time				
	Distance				

Table 3 Number of locations to the user

	User1	User2	User3	User4	User5
Without distance and time	100	90	85	99	95
With distance	55	40	35	51	45
With distance and time	20	22	15	18	12

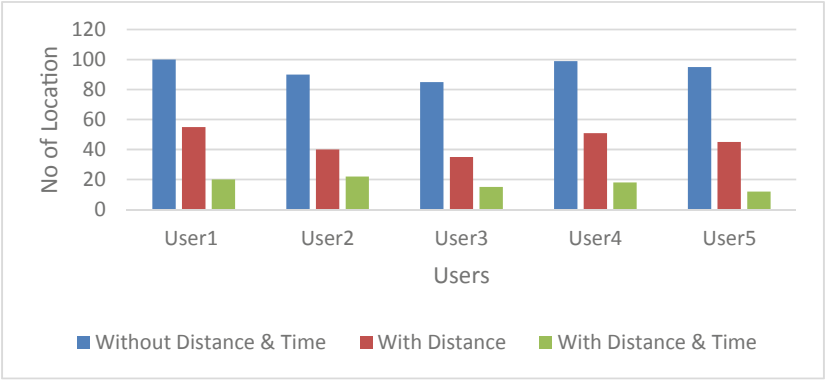

Fig. 3 Performance comparison for top N recommendation

6 Conclusion

This paper uses a two-level RNN algorithm to generate the top-ranked recommendation list in the tourism domain based on the individual user preferences. The learning process is divided into two levels with selected location-based attributes from various resources. User's individual preferences are considered in each classification level for better prediction. With the proposed technique, users' choices are narrowed down in a personalized way and ranking their preferred places with the top n recommendation list. In the first level, three different attributes are selected and four different labels were defined for RNN classification. During the second level, the top n recommendation list is reduced into the top n/2 recommendation list. Along with reduced results from the first level, two more attributes have been added to provide the next level of top-ranked places in the form of recommendations to the users. The proposed method reduces the cold start problem by comparing the search history of users with a predefined table and also narrowing down the user preferences from the recommendation list.

References

1. Yin C, Shi L, Sun R, Wang J (2019) Improved collaborative filtering recommendation algorithm based on differential privacy protection. J Supercomput 5161–5174
2. Go YJ, Park H, Han S (2015) Using online media sharing behaviors implicit feedback for collaborative filtering. In: IEEE international conference on social computer, pp 439–445
3. Jiang L, Cheng Y, Yang L, Li J, Yan H, Wang X (2018) A trust-based collaborative filtering algorithm for E-commerce recommendation system. J Ambient Intell Humanized Comput 3023–3034
4. Chatti MA, Dakova S, Thus H, Schroeder U (2014) Tag-based collaborative filtering, the recommendation in personal learning environments. IEEE Trans Learn Technol 6:337–349

5. Kumar P, Kumar V, Thakur RS (2018) A new approach for rating prediction system using collaborative filtering. Iran J Comput Sci 81–87
6. Cremonesi P, Tripodi A, Turrin R (2014) Cross-domain recommender systems. In: Proceedings IEEE 11th international conference on data mining workshops (ICDMW), Vancouver, BC, Canada, pp 496–503
7. Cantador I, Cremonesi P (2014) Cross-domain recommender systems. In: Association for computing machinery (ACM) conference on recommender systems, Foster City, Silicon Valley, California, USA
8. Enrich M, Braunhofer R (2013) Cold-start management with cross domain collaborative filtering and tags. In: The fourteenth international conference on E-commerce and web technologies, pp 101–112
9. Kesorn K, Juraphanthong W, Salaiwarakul A (2017) Personalized attraction recommendation system for tourists through check-in data. IEEE Access 5:26703–26721
10. Shao X, Tang G, Bao B-K (2019) Personalized travel recommendation based on sentiment-aware multimodal topic model. IEEE Access 7:113043–113052
11. Yochum P, Chang L, Gu T, Zhu M (2020) Linked open data in location-based recommendation system on tourism domain: a survey. IEEE Access 8:16409–16439
12. Gao S, Luo H, Chen D, Li S, Gallinari P (2020) A cross-domain recommendation model for cyber-physical systems. IEEE Trans Emerg Topics Comput 1:384–393
13. Zhou X, Su M, Feng G, Zhou X (2019) Intelligent tourism recommendation algorithm based on text mining and MP nerve cell model of multivariate transportation modes. IEEE Access 7:113043–113052
14. Garcia I, Sebastia L, Onaindia E (2011) On the design of individual and group recommender systems for tourism. Expert Syst Appl 38:7683–7692
15. Esmaeilia L, Mardania S, Alireza S, Golpayegania H, Madar ZZ (2020) A novel tourism recommender system in the context of social commerce. Expert Syst Appl
16. Nilashi M, Bagherifard K, Rahmani M, Rafe V (2017) A recommender system for tourism industry using cluster ensemble and prediction machine learning techniques. Comput Ind Eng 109:357–368
17. Sarwat M, Levandoski JJ, Eldawy A, Mokbel MF (2014) LARS*: an efficient and scalable location-aware recommender system. IEEE Trans Knowl Data Eng 26(6):384–1399
18. Ma X, Li H, Ma J, Jiang Q, Gao S, Xi N, Lu D (2017) APPLET: a privacy-preserving framework for location-aware recommender system. Sci China Inf Sci 60
19. Tahmasebi H, Ravanmehr R, Mohamadrezaei R (2021) Social movie recommender system based on deep autoencoder network using Twitter data. Neural Comput Appl 33:1607–1623
20. Kwon MH, Chang DS, Choi YS (2018) Improving RNN based recommendation by embedding-weight tying. In: IEEE international conference on systems, man, and cybernetics (SMC)
21. Bouzas D, Arvanitopoulos N, Tefas A (2015) Graph embedded nonparametric mutual information for supervised dimensionality reduction. IEEE Trans Neural Netw Learn Syst 26:951–963
22. Gönen M (2013) Bayesian supervised dimensionality reduction. IEEE Trans Cybern 43:2179–2189
23. https://www.kaggle.com/datasets. Last accessed 2021/09/18
24. https://www.tripadvisor.in/. Last accessed 2021/09/19
25. Zhang D, Hsu C-H, Chen M, Chen Q, Xiong N (2014) Jaime lloret: cold-start recommendation using bi-clustering and fusion for large-scale social recommender systems. IEEE Trans Emerg Top Comput 2:239–250

RTHMs—Real Time Health Monitoring System

R. Aishwarya, G. Mathivanan, and G. Nagarajan

Abstract The population is increasing daily in both social world and Old Age Homes to care the elderly citizens and monitor health system of people in the home. In elderly citizens health which is the essential part who's health changes unnoticedly. Internet on Things (IoT) is the concept through which connecting any device to the Internet enabling networking into other connected devices. Sensors or Things are frontend were as information from them is backend in Internet on Things (IoT). Sensors are connected to system through wire or Bluetooth with in a range. Within the range of wiring and Bluetooth the data has to be transferred from sensors to applicable systems. As Old age homes population increasing everyone must be carefully monitored. Wiring has more disadvantages whereas Bluetooth has merits and demerits equally which are cost and range respectively. ZigBee transceiver has more advantages when compared with wired systems and Bluetooth. It provides a wide range of communication of data from sensors to the system. So the Volunteers or Gardens can monitor the elderly people from a wide range. Through our system Multi sensors are connected to Arduino which is connected to ZigBee transceiver which communicates with which also connected to ZigBee. Data from sensors transferred to ZigBee then to another ZigBee on other end. Both transceivers transfer data wirelessly which is an advantage. The designed system enables in Real Time Monitoring System with Multi Sensors using ZigBee transceiver for our experienced and beloved Senior Citizens.

Keywords Senior Citizens · Internet on Things · Sensors · Bluetooth · ZigBee transceiver · Monitoring system

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1 Introduction

A thing that get life through network and learn to report the performance and activities outcome in order to analyze, survey, record etc., Internet on Things has a predominant in leading path to a smart global at ubiquitous computing making the task and functionality much easier and simple like monitoring and other. Through monitoring many things are hand-pick in health sectors [1–5]. Through Health Monitoring became a interface for both patients and doctors to depend on. Real Time Monitoring also establishes a circumstance in assisting of elderly people in Old age-homes. Providing a standard for communicating data from people. Object-to-object work with a range wirelessly. Transceiver are used for transferring data at secure range around 20–100 m. The ZigBee is transceiver used in communication used to create a personalized networking system which provides a in boundary set of objects to communicate in network with signaling set of differential ranges small-medium, these are also a low- powered digital signals. IEEE 802.15.4 specified development and management are controlled by transceiver for application that are key in industrial, scientific and also in medical sectors [6–10]. Helping in low data rate of transferring between the subjects, which bystander when compared to cost efficient material in communication and less expensive in networking range of about 20–90 m. Among objects the data rate is accurate and protected from middle-man or exploiting of unknown parties [11–13].

2 Role of IOT

As ZigBee itself is a technology that provides a peer-to-peer communication of data whereas Internet on Things is other technology that provides both peer-to-peer and peer-to-many communications. As everyone known Internet on Things is a cloud-based technology and providing standard way of storing and performing in the real Time. IoT will connect heterogenous (other) devices and well-known server setting architecture that looks like a rocket science with a very dense equipment's, through connecting billions of objects. An Internet protocol, which among IP or TCP/IP are well known security settings that are built in order to protect data through the internet and are security-based model stands at the center of the IoT. Through IoT services enabling of the data at any point of location is other aspect by building a user-friendly interface to the end user of application [13–15].

3 Different Wireless Architecture

Communication between any mediums defines the share of resources although communication has integrated to many standards some among are Bluetooth technology a wide known and is cheap available that allows you to get connected to any subject able at functioning electronically enabling of various gadgets that communication organization exchange data within model. The transferring and sending of the information, is primary subject in Cellular devices which have become a fundamental to human race. In order to reduce wiring system for devices to get connected and architecture for imputing. A diminished ideology to refer for improved and efficient performance each other authorization headphone, wireless cavicapture, slide to palmtops by phishing as it sending data from peer-to-peer one to another device.

Signaling way of transferring data has evolved to which is known Infrared technology of communication this Infrared way is a medium transmitter that shares/pass on statistics in integrated Signaling format through light emitting diodes or optical masers, signal frequency to transfer from a tip to tip a source to targeted system in frequently in the 100 GHz to 1000 THz. Speed range at which data rates from 100 Kbps to a 16 Mbps.

Microwave is other type of wireless communication. An electromagnetic radiation transmission that is base idea that brought a radar technology through which WW2 has changed hands. Although these are mostly used in geostationary systems which pass straight through the earth atmosphere for distinct objects. Spacecrafts that orbit 22,300 miles above the sea level has to communicate information using two methods. Terrestrial procedure, other type through which two microwave towers with in a line of sight between them are used to provide without hurdles so signaling don't get interloop or escape into atmosphere.

Wi-Fi is well known and understood materialism among. Wireless communication that builds networking environment among devices. The network without direct wired connections. Basically, a line wire that is connected to router and to the router every device is connected through WiFi. In order to access to WiFi there is always login security which only known devices get connected. Fundamental requirement for a Wi-Fi is that a device that can transfer the signals wirelessly and like a router, phone, or computer. Wi-Fi, from the user's perspective and it is just internet access from a wireless-capable device like a phone, tablet or palmtop. Mostly the available devices support Wi-Fi so that objects can get access to the network to get internet access and share assets in it.

ZigBee a non-wire/wirelessly devices are itself a technology that defines them. When compared to other technologies every communication system provides like WiFi, cloud etc., Are bonded each other directly or indirectly but Zigbee is itself a technology on one way stream of information. That means these systems communicate to identical receiver at standard rate. The consumption of battery is at a rate that replacement of it is only once in 2–3 years. In outcome ZigBee-enabled equipment's are capable of being operational for several days, years before their batteries need to

be replaced. To variable conditions this system stands for Patient's health conditions like blood pressure and heart rate.

4 Key Stage

In order to connect Arduino UNO and Zigbee code and When subject's body temperature rises Arduino calls this function given below,

```
/* this is a Arduino side setup code that is excited in Arduino studio void setup()
{/*setting up connection in Arduino*/ Serial.begin(9600);
}
void loop()
{/* brings the data on to respective records */ while (Serial.available() ) { Serial.write(Serial.read()); /

}
}*//

if(device 1>40)
{
Serial.println("HIGH TEMPERATURE"); Serial.println("");
iot.println("*HIGH TEMPERATURE be alert#"); mySerial.println("AT+CMGF=1");
delay(1000); // Delay of 1000 milli seconds or 1 second mySerial.println("AT+CMGS=\"8*********9");
mySerial.write(0x22);
mySerial.write(0x0D); mySerial.write(0x0A); delay(2000);
mySerial.println("HIGH TEMPERATURE alert"); delay(500);
mySerial.println((char)26); delay(1000);
delay(5000);
}
```

5 Components

Arduino Uno is standard open-source technology that enables the geezers to build a microcontroller board. When the Arduino Uno has different perspective to control the electronic objects for this in view of the ATmega328P. It has been a 14 advanced tele (communication) pins, other six are simple data sources to share a common housing shows in Fig. 1.

Fig. 1 Arduino Board

Fig. 2 Temperature sensor

In Fig. 2 shows that the sensing of the level of heat from the body will be sensed and be generate the data accordingly. Pulse Sensor is a low cost and nail sized equipment that communicates pulse readings to respective connected devices. This little size sensor for heart rate by Arduino and Arduino boards. Well in technology dependence this pulse sensing object are faster at reading data from the subjects enables to reliable respective values. As every sensing object are with working either of a 3 or 5 V Arduino.

Low-rate wireless network solution best for homely network. These systems are designed at technologies. Technologies provide on long-life battery normally measurable in 2&3 years for replacement, Data rates from 20 to 250 Kbps. To bring scope of this system is to create a system that communicates at very battery level and in cost efficient on single stream with multiple sensors. The achievement is providing affordable and understandable system alternatively to existing systems. Available ZigBee modules are created equal. ZigBee is a complicated specification with many integrated cases the resultant tool for predicting health condition by sensing finger and health data are shows in Figs. 3 and 4.

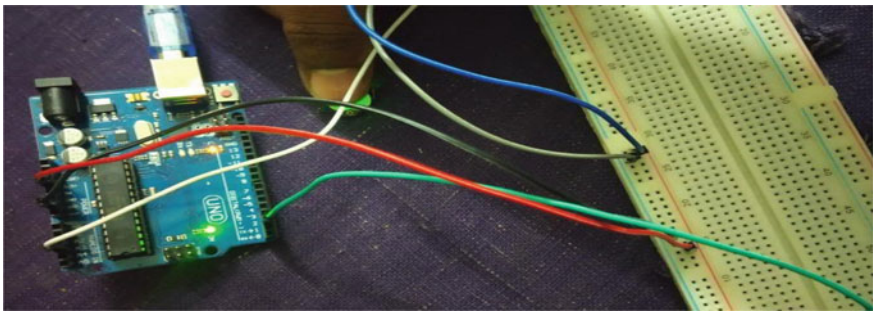

Fig. 3 RTHMs Kit predicting health condition by sensing finger

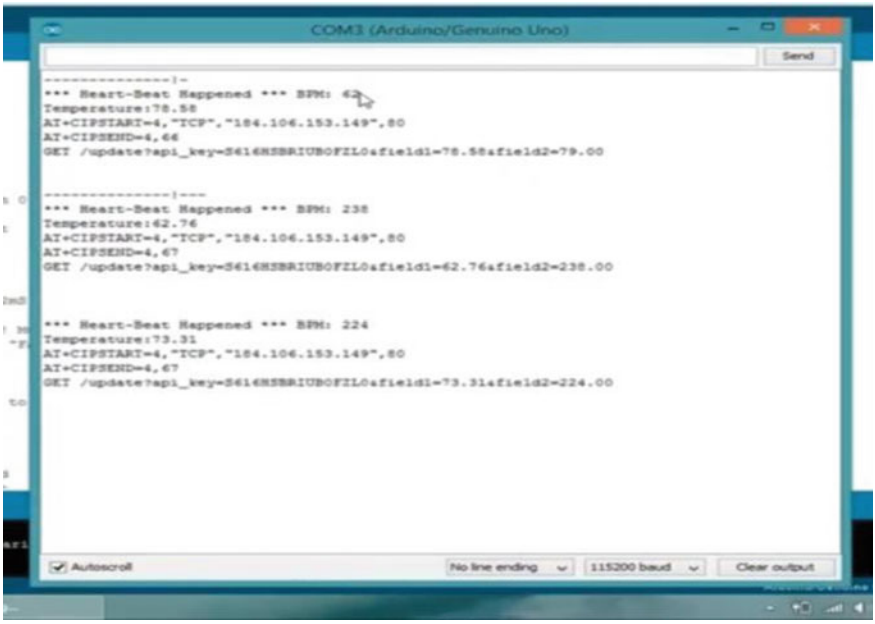

Fig. 4 Sensed health data

6 Conclusion

From the above idea and implementation population is increasing daily in both social world and Old Age Homes to care the elderly citizens and monitor health system of people in the home. In elderly citizens health which is the essential part who's health changes unnoticedly. Internet on Things (IoT) is the concept through which connecting any device to the Internet enabling networking into other connected devices. Sensors or Things are frontend were as information from them is backend in Internet on Things (IoT). Sensors are connected to system through wire or Bluetooth with in a range. Within the range of wiring and Bluetooth the data has to be transferred from sensors to applicable systems. As Old age homes population increasing everyone must be carefully monitored.

References

1. Islam SMR, (Member, Ieee), Kwak D, Kabir MDH, Hossain M, Kwak K-S (2015) The Internet of Things for health care: a comprehensive survey. Digital Object Identifier https://doi.org/10.1109/ACCESS.2015.2437951S
2. Shah MH, Khan S, Sidek KA, Kazmi SA, Kadir KA (2015) From measurement of photoplythsmography signal for heart rate variability and comparison of two different age groups

3. Kumar SP, Samson VRR, Sai UB, Rao PLSDM, Kedar Eswar K (2017) From smart health monitoring system of patient through IoT. In: International conference on I-SMAC, pp 551–556
4. Cirani S, Picone M (2015) From wearable computing for the Internet of Things. IEEE Comput Soc 35–41
5. Maria AR, Pasca S, Strungaru R (2017) From heart rate monitoring by using non-invasive wearable sensor. In: 6th IEEE international conference on E-health and bioengineering-EHB 2017, pp 587–590
6. Kamisalic A, Fister I, Turkanovic M, Karakatic S (2018) From sensors and functionalities of non-invasive wrist wearable devices: a review. https://doi.org/10.3390/s18061714
7. Chen M, Ma Y, Song J, Lai CF, Hu B (2016) Smart clothing: connecting human with clouds and big data for sustainable health monitoring. Mobile Netw Appl 21(5):825–845
8. Huh J (2016) A framework and test bed for the single-living senior citizens care: access and grave site monitorings. In: 2016 16th international conference on control, automation and systems (ICCAS), Gyeongju, pp 512–517
9. Kristoffersson A, Lindén M (2020) A systematic review on the use of wearable body sensors for health monitoring: a qualitative synthesis. Sensors 20:1502
10. Lorenz A, Oppermann R (2009) Mobile health monitoring for the elderly: designing for diversity. Pervasive Mobile Comput 5(5):478–495
11. Aishwarya R, Yogitha R, Kiruthiga V (2019) Smart road surface monitoring with privacy preserved scheme for vehicle crowd Sensing. Proc J Comput Theor Nanosci 16(8):3204–3210(7)
12. Aishwarya R, Deepika S, Sowjenya K (2020) Assessment & forecast of air quality data based on neural network. Int J Pharm Res 12(1):1397–1402
13. Nagarajan G, Minu RI, Jayanthiladevi A (2019) Brain computer interface for smart hardware device. Int J RF Technol 10(3–4):131–139
14. Nirmalraj S, Nagarajan G (2021) Biomedical image compression using fuzzy transform and deterministic binary compressive sensing matrix. J Ambient Intell Humaniz Comput 12(6):5733–5741
15. Nirmalraj S, Nagarajan G (2019) An adaptive fusion of infrared and visible image based on learning of sparse fuzzy cognitive maps on compressive sensing. J Ambient Intell Humaniz Comput 1–11

Deployment of Cellular Application Using Flutter for Covid-19 Visualization

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Abstract Coronavirus disease 2019 (COVID-19) is caused by a new virus called SARS-CoV-2. Its impact on public health creates adverse effects. Because it is a brand-new virus, scientists are getting to know more every day. Although the majority who've COVID-19 have slight symptoms, COVID- 19 can also cause intense infection or even demise. a few corporations, together with older adults and those who've certain underlying scientific conditions, are at accelerated risk of extreme contamination So monitoring and Visualization of COVID-19 cases and simply representing the information for a higher understanding of the COVID-19 instances around the world helps humans recognize the present-day state of affairs and to try this a cellular application is a fine way. In this paper, We summarize and illustrate with examples the way to amass and Visualize the statistics of the COVID-19 cases in a cellular application using Flutter.

Keywords COVID-19 · CNN · Tracking · Visualization · Data gathering · Data manipulation · Data visualization

1 Introduction

In this dynamic changing world, COVID-19 outbreak has made life around the world in an unprecedented difficult situation. People suffering from corona virus are reported to develop symptoms ranging from mild to severe illness. One of the most preferred method to follow COVID-19 cases is based on open-source site for data collection such as Covid19 India.org(India), disease.sh(World), covid19. who.int(world). Complimentary services can be get from RapidAPI website.

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In this paper, we have applied flutter for developing the app. Flutter being released in 2017 by Google resembles Dart language. Dart resembles JavaScript and it is flexible and include features which are easy to learn. Currently released version of Flutter, Flutter 2.0 has salient features like Cross-platform, Truly-native, Widgets, Hot reload, Sound Null Safety, Support from Google, etc.

2 Related Work

Gumaei et al. [1] have proposed a fusion technique that combines three ensemble classifiers such as Random Forest (RF) methods. The authors have incorporated COVID-19 patent's information such as geographical, travel, health and demographic data. The efficiency of the model is evaluated using metrics such as Accuracy, Precision, Recall and F1-Score. The accuracy of the model with fusion approach has reached 97.24%. Vankipuram et al. [2] have used Electronic Healthcare Record (HER) data and medical equipment logs as input and the data is transformed into 3 stages such as transformation, analysis and visualization.

Mandayam et al. [3] have adopted Linear Regression and Support Vector Machine for COVID-19 Prediction using time series dataset. The performance of the model is evaluated using metrics such as R-Squared (R2), Mean Squared Error (MSE) and Mean Absolute Error (MAE) and Linear Regression has shown up to 90% accuracy.

Irmak [4] have applied Convolutional Neural Network (CNN) architecture for classification, to check whether a given chest X-ray image of a patent has COVID-19 or not using publicly available datasets. The performance is evaluated with confusion matrix with metrics such as Accuracy, Specificity, Sensitivity and Precision. The hyperparameters of CNN were determined using Grid Search Optimization method and accuracy is found to be 98.92%.

Bahri et al. [5] have extracted clinical demographic datasets related to COVID-19 and LSTM method is applied for prediction. LSTM method is known to be sensitive for normalization and hence for data scaling MinMaxScaler function is adopted and the performance of prediction is evaluated with Mean Absolute Error, Root Mean Squared Error and Mean Absolute Percentage Error. Shaikh et al. [6] have applied Linear, Polynomial and Time series forecasting using Tableau. Evaluation is done using Mean Absolute Percentage Error (MAPE) and accuracy is shown to be 95%.

Liu [7] has applied 3 prediction models such as Linear Regression, Logistic Regression and Recurrent Neural Networks for Prediction. The model uses the pre processing steps such as Data Cleaning, Data Transformation, Feature selection and Feature Extraction. The experiments results have shown RNN can avoid the inaccuracies caused by Linear and Logistic Regression.

Currently the Indian Government has deployed an Android and IOS based application in the name of "Arogya Setu". This app keep track of cases within the range of 500 m to 10 km around the user and depicts the data of confirmed cases over all states in India. It doesn't show the district data, world cases data and UI is not modern UI with interaction. Although there are many websites for tracking and visualizing corona virus cases there are only a few mobile applications available most of them lack interactive UI and contain fewer data [8–11].

3 Proposed Methodology

A system is proposed with an Interactive UI and contains all the data on corona virus cases all over India along with its states and districts. The proposed app can run on Android, IOS and can be made as a web application. The major feature of IOS, Android and web application requires cross-platform functionality and this is provided by the Sync fusion which offers more than 1600 components. Data visualization for creating elegant, animated and high-performance charts is created with Flutter charts package.

In order to get started, install the latest Android SDK, latest android studio and start an android emulator. Also install Flutter and Dart plug-in for Android Studio. The architecture adopted for the model is shown in Fig. 1.

As depicted in Fig. 1, the initial stage is the data gathering stage. Once the data is gathered it will be sent for data preprocessing. Missing values and incompleteness in data will be rectified at this stage. This in turn will be fed as input to Feature extraction in which salient features such as Confirmed, Recovered, Active and Dead cases are extracted and given for visualization.

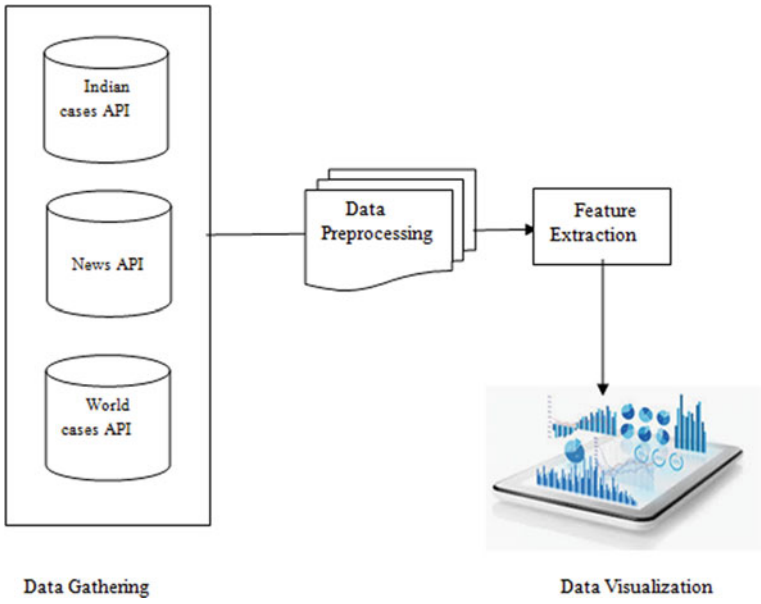

Fig. 1 System architecture

4 Results and Discussion

COVID-19INDIA API is a non-official internet site for tracking covid-19 instances in India. They extract information such as affected person's courting with other sufferers to perceive local and network transmissions, travel records and status. Figure 2 shows the API services website. Once the database icon is clicked, the website will be redirected to a page containing CSV and JSON files as shown in Fig. 3.

State_district_wise.json gives the district level details of states that includes the total of all categories and details for the current day. Data Visualization converts data into charts and graphs for better understanding as shown in Figs. 4 and 5.

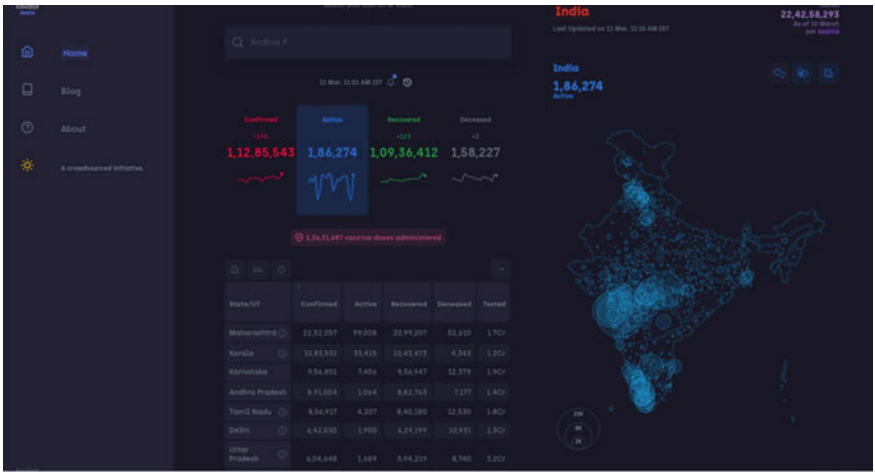

Fig. 2 COVID-19 India Website

Raw Data

Status	Sheet Name	Link to CSV	Description
💚	raw_data1	https://api.covid19india.org/csv/latest/raw_data1.csv	Till Apr 19th
💚	raw_data2	https://api.covid19india.org/csv/latest/raw_data2.csv	Apr 20th to Apr 26th
💚	raw_data3	https://api.covid19india.org/csv/latest/raw_data3.csv	Apr 27th to May 9th
💚	raw_data4	https://api.covid19india.org/csv/latest/raw_data4.csv	May 10th to May 23rd
💚	raw_data5	https://api.covid19india.org/csv/latest/raw_data5.csv	May 24th to Jun 4th
💚	raw_data6	https://api.covid19india.org/csv/latest/raw_data6.csv	Jun 05th to Jun 19th
💚	raw_data7	https://api.covid19india.org/csv/latest/raw_data7.csv	Jun 20th to Jun 30th
💚	raw_data8	https://api.covid19india.org/csv/latest/raw_data8.csv	Jul 01st to Jul 7th
💚	raw_data9	https://api.covid19india.org/csv/latest/raw_data9.csv	Jul 08th to Jul 13th
💚	raw_data10	https://api.covid19india.org/csv/latest/raw_data10.csv	Jul 14th to Jul 17th
💚	raw_data11	https://api.covid19india.org/csv/latest/raw_data11.csv	Jul 18th to Jul 22nd
💚	raw_data12	https://api.covid19india.org/csv/latest/raw_data12.csv	Jul 23th to Aug 06th
💚	raw_data13	https://api.covid19india.org/csv/latest/raw_data13.csv	Aug 07th to Aug 21st
💚	raw_data14	https://api.covid19india.org/csv/latest/raw_data14.csv	Aug 22nd to Sep 05th
💚	raw_data15	https://api.covid19india.org/csv/latest/raw_data15.csv	Sep 06th to Sep 21st
💚	raw_data16	https://api.covid19india.org/csv/latest/raw_data16.csv	Sep 22nd to Oct 08th
💚	raw_data17	https://api.covid19india.org/csv/latest/raw_data17.csv	Oct 09th to Oct 26th

Fig. 3 COVID-19 India CSV API's

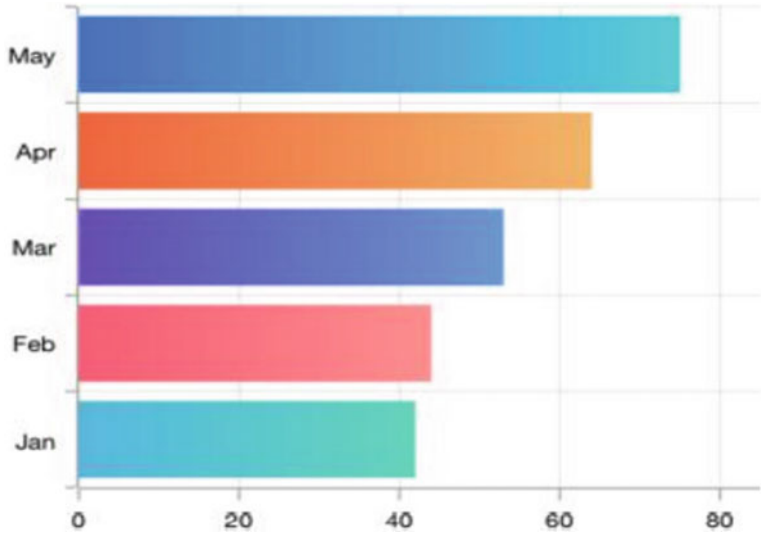

Fig. 4 Bar chart

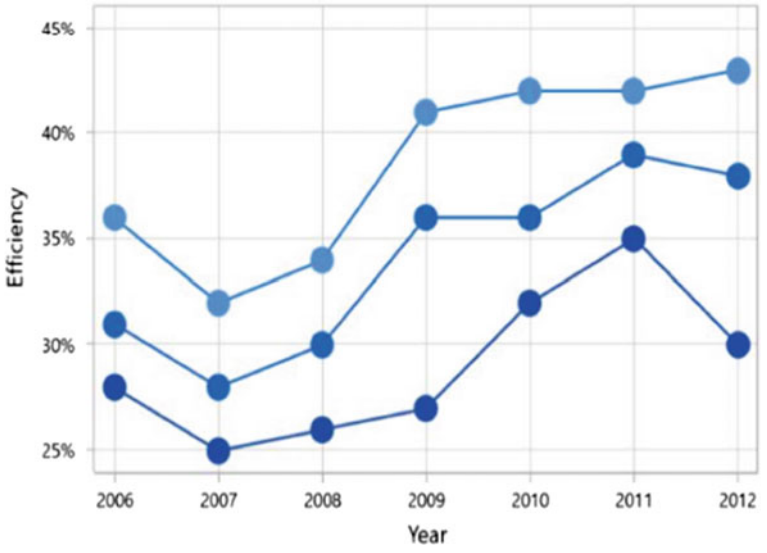

Fig. 5 Line graph

5 Conclusion

COVID-19 is spreading faster and more deadly than ever before which makes the world a more dangerous place to live as there are no proper vaccines available, it's

not recommended using them, and also following rules like maintaining distance, wearing a mask, sanitizing the hands time to time, etc. can prevent the people from being infected by the deadly disease. One of the ways to control people from breaking the rules and doing whatever they want is by showing them the current situation of the deadly disease around the world which might help the people understand the situation and follow the rules for them and also other people.

References

1. Gumaei A, Ismail WN, Hassan MDR, Hassan MM, Mohamed E, Fortino AAG (2022) A decision-level fusion method for COVID-19 patient health prediction. Big Data Res 27
2. Vankipuram A, Traub S, Patel VL (2018) A method for the analysis and visualization of clinical workflow in dynamic environments. J Biomed Inform 79:20–31
3. Mandayam AU, Siddesha RACS, Niranjan SK (2020) Prediction of Covid-19 pandemic based on Regression. In: 2020 fifth international conference on research in computational intelligence and communication networks (ICRCICN), pp 1–5. https://doi.org/10.1109/ICRCICN50933.2020.9296175
4. Irmak E (2020) A novel deep convolutional neural network model for COVID-19 disease detection. In: 2020 Medical Technologies Congress (TIPTEKNO), pp 1–4. https://doi.org/10.1109/TIPTEKNO50054.2020.9299286
5. Bahri S, Kdayem M, Zoghlami N (2020) Deep learning for COVID-19 prediction. In: 4th international conference on advanced systems and emergent technologies, pp 406–411
6. Shaikh S, Gala J, Jain A, Advani S, Jaidhara S, Roja Edinburgh M (2021) Analysis and prediction of COVID-19 using regression models and time series forecasting. In: 2021 11th international conference on cloud computing, data science & engineering (Confluence), pp 989–995. https://doi.org/10.1109/Confluence51648.2021.9377137
7. Liu T (2020) U.S. pandemic prediction using regression and neural network models. In: 2020 international conference on intelligent computing and human-computer interaction (ICHCI), pp 351–354. https://doi.org/10.1109/ICHCI51889.2020.00080
8. Nagarajan G, Minu RI, Jayanthiladevi A (2019) Brain computer interface for smart hardware device. Int J RF Technol 10(3–4):131–139
9. Nirmalraj S, Nagarajan G (2021) Biomedical image compression using fuzzy transform and deterministic binary compressive sensing matrix. J Ambient Intell Humaniz Comput 12(6):5733–5741
10. Nirmalraj S, Nagarajan G (2019) An adaptive fusion of infrared and visible image based on learning of sparse fuzzy cognitive maps on compressive sensing. J Ambient Intell Humaniz Comput 1–11
11. Marin BG, Aghagoli G, Lavine K, Yang L, Siff EJ, Chiang SS, Salazar-Mather TP, Dumenco L, Savaria MC, Aung SuN, Flanigan T, Michelow IC (2021) Predictors of COVID-19 severity: a literature review. Rev Med Virol 31(1):1–10

Enhancing Agricultural System and Agro Food Transportation Management Using IoT

T. Anandhi, P. Malathi, D. Deepa, M. S. Roobini, and G. Nagarajan

Abstract In Internet of Things is an global data composed of web-related objects or things that are embedded with apps, electronic devices are now an important part of the internet of the future. Field based work has established a device to track both the agricultural field and the agriculture field efficiently. Using idea of IoT, transportation and produce alerts/alarms or make intelligent decisions. Live camera output Streaming, via raspberry pi camera, for live Checking the agricultural field through the internet itself. The Agricultural Business The fields are under the live stream for the heat of the climate, humidity and moisture. The fields are tested for environment, humidity sensor device and soil moisture and temperatures. Automated irrigation will be carried out on the basis of the temp sensor device, humidity device and soil moisture sensor set points. In IoT, the data obtained from the field is tracked, the data is then analyzed, and appropriate information is transferred for countermeasures by the field owners. The maintenance of Agro Food Transport is carried out by tracking the temperature of the product being shipped and updating the status on the site page and ensuring the supplier's on-time distribution of the product.

Keywords Wi-Fi · Raspberry pi. IoT · Streaming of material

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1 Introduction

The basic principle of the ITU is that IoT Device primarily addresses the problems of interconnection. Integrated of various innovations, live data monitoring, artificial intelligence, typical science, and graphical interfaces, things are different.

2 Evaluating the Device

Established Scheme for controlling agricultural.

- Wireless Technology: Almost in every area, as well as the agriculture sector, it is used. A platform Digital Multimedia was suggested Have sent different seasons, at this to landowners about commodity specifics and weather updates [1–3].
- Big-data intelligence: The information will be recorded, achieved paired with antique brass sustained timeframes, also including wearable sensors, popular social data, and market information, from different sources. Capturing, storage, review is the greatest obstacle. In the agricultural field, large-scale data were used to minimize cost of production for the business process production of food goods [4–6].
- Data Processing, Research and Designing Expertise: In order to evaluate them, data mining has been used to distinguish soil types and properties. Soil data mining is also useful with the current soil nutrient information dependent on planting date sequencing in the same farmland for crop prediction and the assessment of the best field period [7, 8].

3 Application Designed

The Internet and sensor nodes primarily help in minimize commitment to operate in the agricultural sector. IoT also prevents the depletion of the database of agricultural criteria and preserves them for a long life in the computing system or server. In all locations, including sensitive regions, it also offers constant surveillance. The tracking method should have low labor costs, quicker reaction times and effective quality control of the harvest. In order to satisfy needs of the growing population and also have a justifiable crop yields, it is necessary to implement viable methodologies that has to be extra stable to sustain rising climate shocks as well as air temperature. Water quality as water temperature, soil pH, temperature etc. impact on agricultural products [9–11] (Fig. 1).

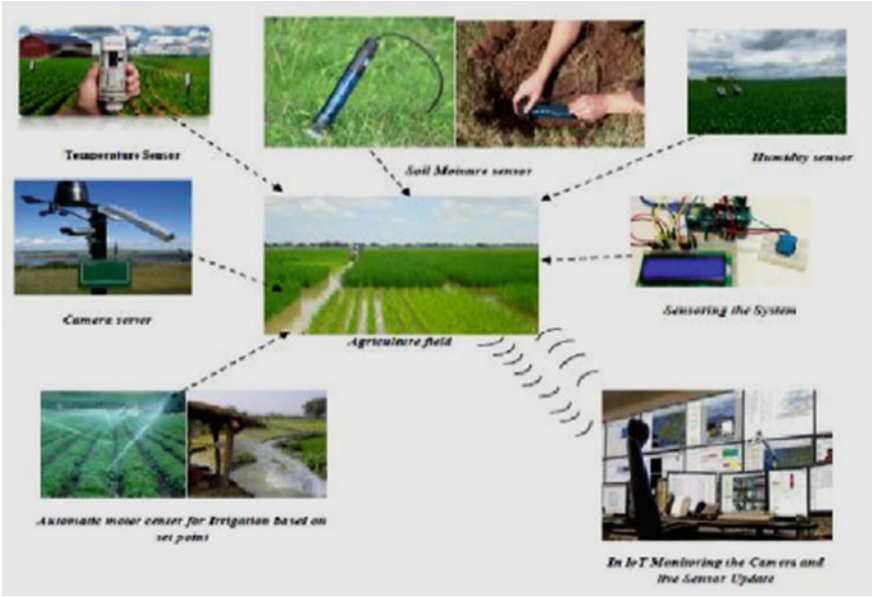

Fig. 1 Controlling device for irrigation

4 Process of Agricultural Food Processing

Food production is better supported by strong urban and international demand, both consistently high. This is best accomplished by an effective, high capacity, delivery and advertising system in which the cost of the transport and marketing units is minimal. Faster delivery cycles, global procurement, and greater product diversity have increased the expense and difficulty of agricultural transportation. The supply chains of so many companies are joined together that, instead of individual companies, the strategic edge can be focused on whole agro transportation. Control of transportation refers to the close relation and organization of actions engaged in the procurement, processing and movement of a commodity. In order to minimize time, redundant effort, and inventory costs, it incorporates business processes to speed up data, stock, and fund flows up and down agro transport. Processes of Agro Transportation to help enterprises better understand problems of Agro Transportation management and set targets for developing agro transportation. The five main agro-transport processes are: preparation, source, development, supply, and return. During the preparation and transport of perishable goods, the temperature sensor constantly detects the cabin temperature. In Fig. 2, the proposed Agro Food Transportation system.

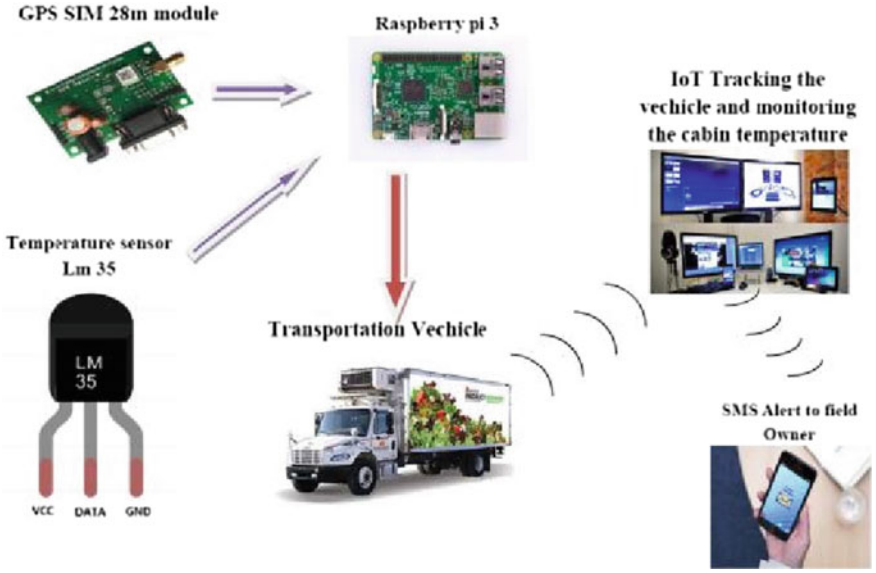

Fig. 2 Agro food transportation system

5 Effective Farming Features

Organic farming is what increases the ecological quality and energy that farming relies on. Ecologically sustainable strategies provide a habitat for the agriculture of crop production without disruption to the plant, including impacts on soil, water quality and other resource characteristics. [11, 12] However, a farm that stresses short-term gains gives up an environmental efficiency that will not be affordable for most people. In all the other side, pursuing the quality of the ecosystem without ensuring the profitability of short-term gains will therefore be impractical, shielding it sustainably from natural resources and avoiding the deterioration of the condition of the air, soil and water, thus allowing use of existing ecological systems and processes.

6 Development of Devices

6.1 IOT-Based Agriculture System

Figure 4 displays the smart agricultural system. Diagram illustrates how the hardware devices are attached to the microcontroller of the Raspberry pi3 and working on motor. In the agricultural sector, the temp sensor, water level sensor, live camera, Automatic motor and Bluetooth are mounted to the pi3. Field database is transmitted via IoT to the remote server (Fig. 3).

Fig. 3 Flow chart of system is based

6.2 System for Integrated Entire Board

This work is specifically aimed at providing an agricultural surveillance device through IoT. In Cultivation, which contains of both the Raspberry pi controller water activity, soil level sensor, water sensor level, Automatic Engine and pi3, the integrated device level is placed.

6.3 Server for IoT

The area of agriculture is controlled by a computer. There is monitoring of the device information from the database itself.

7 Agro Food Design of Logistics IoT-Based

Agro food transport control "Fig. 4" will be carried out by tracking the temperature of the product being shipped and updating the status on the web page and also ensuring the arrival of the product to the distributor on schedule. The field owner will be sent a warning notice about the location of the vehicle and the cabin temperature. Monitored and regulated by IoT, the Agro food transport vehicle.

Figure 5 illustrates Figure 6 Design of Agro Processing Of food. Displays Design of Transportation Section Linked to Pc. "Figure 7" Displays a server-side reading of

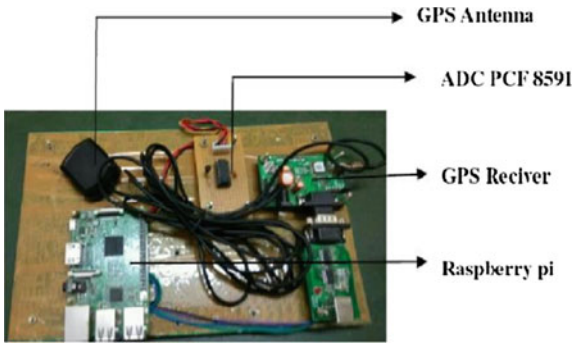

Fig. 4 Prototype of Agro food transportation

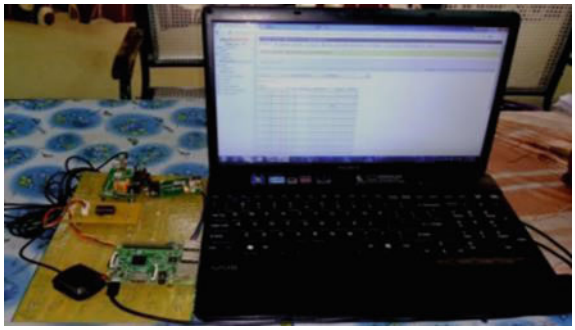

Fig. 5 Transportation part prototype connected to Pc

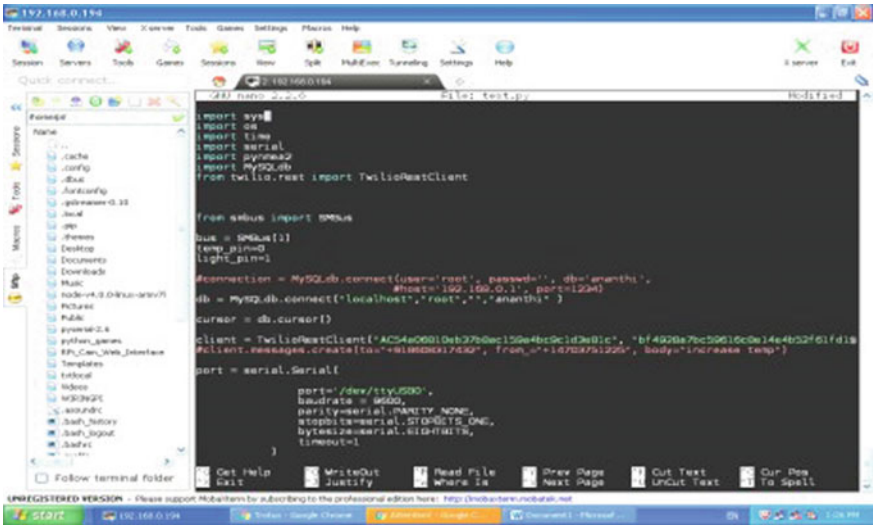

Fig. 6 Transportation sensors reading at the server side

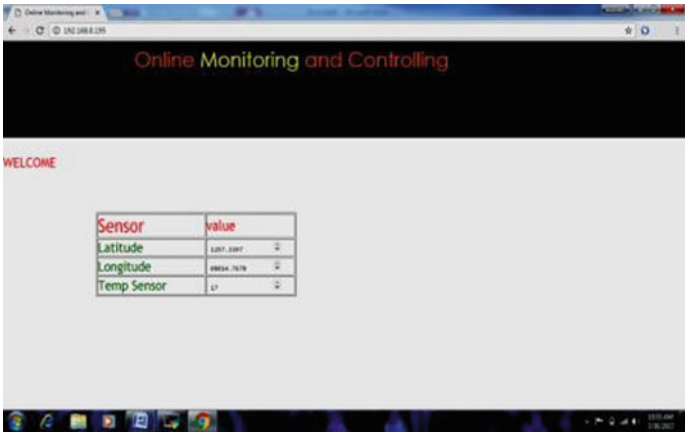

Fig. 7 GPS and temperature sensor value

Transportation Sensors. Figure 8 "Displays the home screen including specifications such as the temperature controller as well as the value of the GPS." Figure 8 "Shows the GPS Database Update. "Figure 9" Shows the Transportation Live Sensor Update. "Figure 10" Shows Alert SMS Send by Server. "Figure 11" Shows Prototype of my full agriculture and transportation part of work. "Figure 11" Screenshot of my agriculture and transportation of full part work through mobile (Fig. 12).

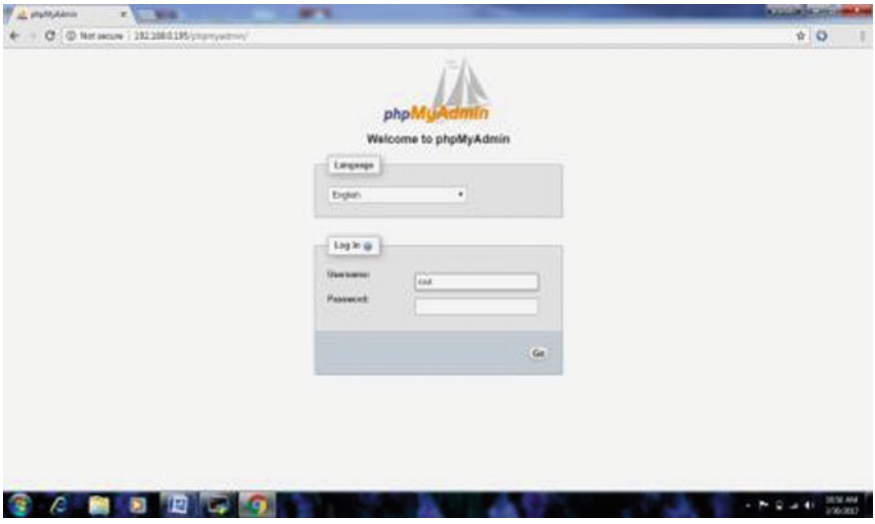

Fig. 8 Database update for GPS

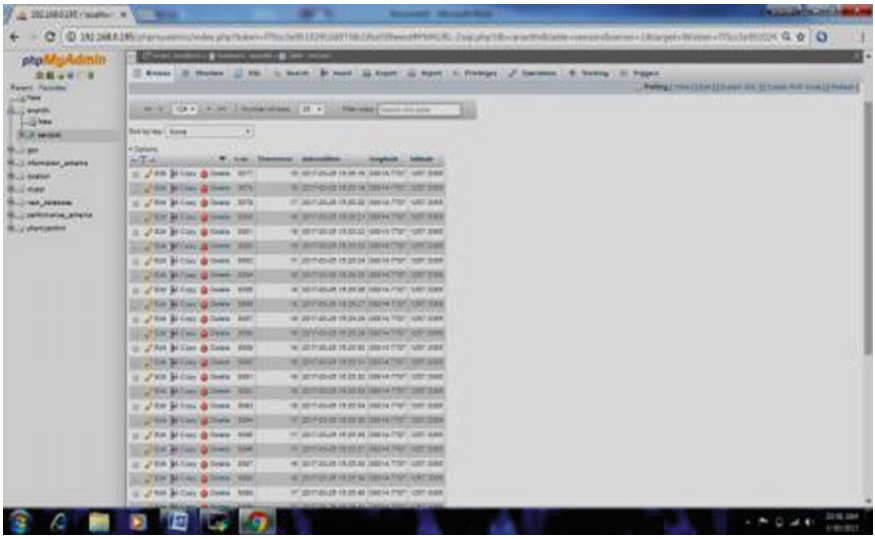

Fig. 9 Live sensor update for transportation

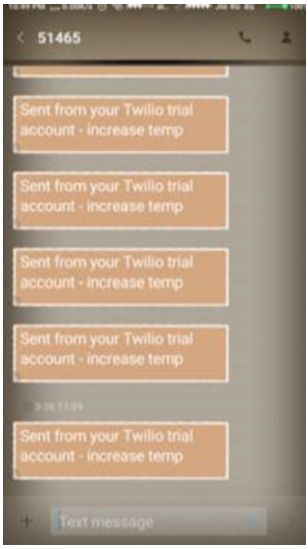

Fig. 10 Transportation sensor alert SMS send by server

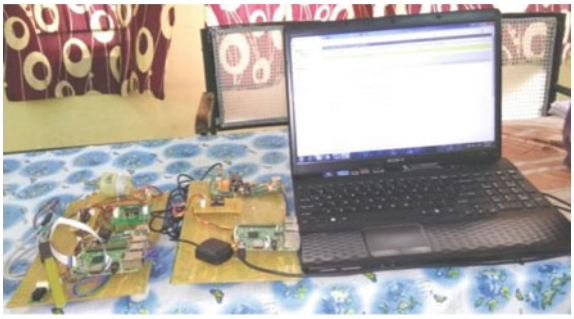

Fig. 11 Prototype of agriculture and transportation full part of work

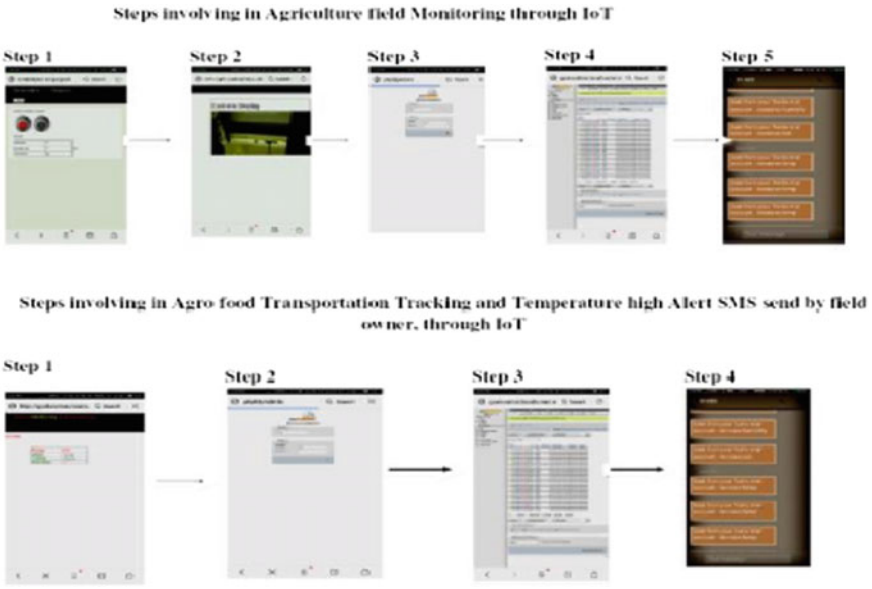

Fig. 12 Screenshot of agriculture and transportation full part of work through mobile

8 Conclusion

Essentially, the research analysis was performed used appropriate technology to sense heat, humidity and moisture inside the Smart grid Rpi also in Farming Processing centre. To maximize agricultural productivity Through recording as well as supplying the landowner with sustainability impacts, with the necessary information remotely, the IoT-based farming tracking device has also been used. The system suggested is designed specifically for agriculture can develop. The Raspberry Pi operates and

controls recording devices for remote sensing and tracking. To monitor the agricultural field, live video streaming will be carried out from the server itself, from the Raspberry Pi camera. Agro food transportation management will be carried out by monitoring the temperature of the product being transported and status are updated in web page and also ensures the on-time product delivery to the vendor. An alert message about the vehicle location and cabin temperature will be given to the field owner. The proposed system helps to reduce the time and efforts required for monitoring the agriculture environment.

References

1. Sarkar PJ, Chanagala S (2016) A survey on IOT based digital agriculture monitoring system and their impact on optimal utilization of resources. IOSR J Electron Commun Eng 11(1), Ver.II
2. Łukasz B, Sławomir D (2016) A Monitoring System for Temperature data coming from IOT Agents. Studia Informatica 37(2)
3. Lee M, Hwang J, Yoe H (2013) Agricultural production system based on IoT. In: IEEE 16th international conference on computational science and engineering
4. Gondchawar N, Kawitkar RS (2016) IoT based Smart Agriculture . Int J Adv Res Comput Commun Eng 5(6)
5. Sherly J, Somasundareswari D (2015) Internet Of Things based smart transportation systems. Int Res J Eng Technol (IRJET) 02(07)
6. Wang Y, Zhang X, Wang H (2010) Study of the Internet-based supply chain management application. In: International conference on computer application and system modeling, vol 08, Oct 2010
7. Maksimovi M, Vujovi V, Omanovic-Miklicanin E (2015) A low cost Internet of Things solution for traceability and monitoring food safety during transportation. In: International conference on information and communication technology in agriculture, food and environment, vol 17–20, Sept 2015
8. Sharma V, Giri S, Rai SS (2013) Supply chain management of rice in India: a rice processing company's perspective, Int J Manag Value Supply Chains 4(1)
9. Nagarajan G, Minu RI, Jayanthiladevi A (2019) Brain computer interface for smart hardware device. Int J RF Technol 10(3–4):131–139
10. Nirmalraj S, Nagarajan G (2021) Biomedical image compression using fuzzy transform and deterministic binary compressive sensing matrix. J Ambient Intell Humaniz Comput 12(6):5733–5741
11. Nirmalraj S, Nagarajan G (2019) An adaptive fusion of infrared and visible image based on learning of sparse fuzzy cognitive maps on compressive sensing. J Ambient Intell Humaniz Comput 1

Dynamic and Unified Approach to Distinguish Malicious URL Using LSTM

A. Velmurugan, J. Albert Mayan, and G. Nagarajan

Abstract Hackers can embed malwares in the pages to take client data and procure cash illicitly. Actually, it is noticed that near 33% of all sites are conceivably malicious in nature. In this manner, It bodes well to rapidly distinguish malicious URLs on the Internet. Unique in relation to the vast majority of past strategies, right now, propose a strategy for online malicious URL identification dependent on versatile learning. By gathering the network traffic from spine networks, we train neural network models to recognize malicious URLs. Yet, there is a difficult issue in powerfully changing conditions where the factual properties of target variable change after some time, which is known as idea float. To address this issue, we apply a nonparametric test to effectively distinguish idea floats in versatile learning. Malicious URLs are destructive to each part of PC clients. Identifying of the malicious URL is significant. As of now, location of malicious website pages strategies incorporates boycott and white-list procedure and AI order algorithms are utilized. In any case, the boycott and white-list innovation is pointless if a specific URL isn't in list. In the proposed framework, a calculation dependent on the Convolutional Neural Network-LSTM model is developed to address this issue.

Keywords Component · LSTM model · Malicious code · Malicious URL

1 Introduction

Previously, malicious code journalists were transcendently seen as socially distanced nerds who jumped at the chance to have a type of feeling of achievement. Yet, presently numerous malicious code essayists are spammers who use caught machines to dispatch email crusades. Others are composed wrong doing bunches from Eastern Europe that subjugate machines to dispatch for swearing of administration assaults

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on the frameworks of associations that will not pay blackmail cash. At that point there are the fraud posses that take usernames, passwords, and monetary record data on a revenue driven premise [1–4].

Aggressors can utilize an assortment of off-the-rack instruments to enter or upset frameworks. Malicious code is just one of their ordinary devices. There are generous monetary results of PC wrongdoings that include malicious code assaults, unapproved interruption into networks and PC frameworks, and refusal of-administration assaults [5–8].

On February 11, 2003, the National Infrastructure Protection Center gave a warning on an expansion in worldwide hacking exercises because of the rising pressures between the United States and Iraq. This warning noticed that during a period of universal pressure, unlawful cyber activity frequently heightens. This incorporates spamming, Web page ruinations, and disavowal of-administration assaults. The warning called attention to that assaults may have one of a few goals, including political activism focusing on Iraq or those thoughtful to Iraq without anyone else depicted nationalist programmers. Different purposes might be politically arranged assaults focusing on U.S. frameworks by those contradicted to any potential clash with Iraq. The assaults could likewise be crime disguising or utilizing the present emergency to assist individual objectives [9–11].

In November 2002, a British PC executive was arraigned on charges that included breaking into 92 PC networks that had a place with the Pentagon, privately owned businesses, and the National Aeronautics and Space Administration [12]. The break-ins happened over a time of one year and caused about $900,000 in harm. As per the Justice Department, these assaults were perhaps the biggest hack at any point executed against the U.S. military. The aggressor utilized his home PC and mechanized programming accessible on the Internet to filter a huge number of PCs on military networks searching for ones that had known vulnerabilities [13, 14].

2 Challenges in Data Loading

More associations implies that our networks have more parameters to improve, and this necessary the blast in processing power that happened in the course of recent years. These advances gave the establishment to work cutting edge neural networks equipped for removing highlights for themselves in a progressively savvy design. This permitted profound networks to demonstrate progressively complex issue spaces (e.g., picture acknowledgment propels) than already conceivable.

2.1 Parameters

Parameters identify with the x parameter vector in the condition Ax = b in fundamental AI. Parameters in neural networks relate legitimately to the loads on the

associations in the network. The closer our result vector b is to the genuine qualities in the preparation information, the better our model is. We use techniques for optimization, for example, gradient descent to discover great qualities for the parameter vector to limit loss over our preparation dataset. In profound networks, we despite everything have a parameter vector speaking to the association in the network model we're attempting to improve. The greatest change in profound networks regarding parameters is the manner by which the layers are associated in the various structures. In DBNs, we see two equal arrangements of feed- forward associations with two separate networks. One network's layers are made out of RBMs used to separate highlights for the other network.

2.2 Layers

Layers additionally can be spoken to by sub networks in specific designs, too. In the past segment, we utilized the case of DBNs having layers made out of RBMs. Layers are a key compositional unit in profound networks. In DL4J we redo a layer by changing the sort of activation work it utilizes (or sub network type on account of RBMs). We'll likewise take a gander at how you can utilize blends of layers to accomplish an objective (e.g., grouping or relapse). At last, we'll additionally investigate how each sort of layer requires diverse hyper parameters (explicit to the engineering) to get our network to adapt at first.

2.3 Activation Functions

The fundamental activation functions utilized in feed- forward neural networks. Right now, start to represent how activation functions are utilized in explicit models to drive include extraction. The higher-request highlights gained from the information in profound networks are a nonlinear change applied to the yield of the past layer. This permits the network to learn designs in the information inside an obliged space. Contingent upon the activation work you pick, you will locate that some target functions are increasingly proper for various types of information (e.g., thick versus meager). We bunch these plan choices for network engineering into two primary territories over all designs: Hidden layers Output layers Hidden layers are worried about separating continuously higher-request highlights from the crude information. Contingent upon the design we're working with, we will in general utilize certain subsets of layer activation functions.

2.4 Loss Functions

Loss functions measure the understanding between the anticipated yield (or mark) and the ground truth yield. We use loss functions to decide the punishment for an off base grouping of an information vector. Up until this point, we've presented the accompanying loss functions: 1. Squared loss 2. Calculated loss 3. Pivot loss 4. Negative log probability.

2.5 Optimization Algorithms

Training a model in AI includes finding the best arrangement of qualities for the parameter vector of the model. We can consider AI as an optimization issue in which we limit the loss work concerning the parameters of our forecast work.

Gradient descent is an individual from this way discovering class of algorithms. Varieties of gradient descent exist, yet at its center, it finds the subsequent stage the correct way as for a goal at every cycle. Those means push us toward a world-wide least blunder or most extreme probability. Stochastic gradient descent (SGD) is AI's workhorse optimization calculation. SGD trains a few sets of size quicker than strategies, for example, cluster gradient better than average, with no loss of model precision.

3 Proposed System

In the proposed framework, the dataset lattices grids are then passed to an implanting layer with group size 128. An installing layer maps each character onto a 128 length genuine esteemed vector. This can be considered as one hyper parameter, we pick 128 to give further degree of opportunity to the profound learning designs. This cooperatively works with different layers in the profound network during backpropogation. This encourages URL character bunching and comparable characters group together. This sort of character grouping encourages different layers to handily identify the semantics and logical similitude structures of area names.

To get familiar with the spatial co-connections among the characters, Convolution Neural Network is utilized. It has two layers; in first layer with the assistance of different convolution1D activities neighborhood highlights are extricated and went to the maxpooling1D. A convolution1D layer utilizes 128 channels with channel length 5 that slide over the character implanting vectors succession and yields a nonstop incentive at each progression. This is really a portrayal of how much the example coordinated in the character inserting vectors sub- succession. This contains a pool length of 4. Next, the maxpooling1D yield is smoothed to a vector and went to the repetitive layer of the network.

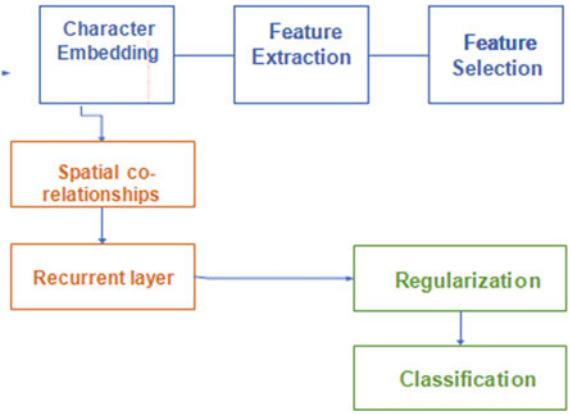

Fig. 1 Convolutional neural network LSTM

Figure 1 The proposed framework is a profound layer Convolution Neural Network and a half and half network, for example, Convolution Neural Network LSTM for include portrayal. Repetitive layer LSTM separate consecutive data and Convolution Neural Network assists with extricating spatial data among the characters. Profound learning models catch the ideal component portrayal and its layers yield a nonstop worth that speaks to how a lot of the example coordinated.

4 Results and Discussion

Layer size is characterized by the quantity of neurons in a given layer. Info and yield layers are moderately simple to make sense of in light of the fact that they compare straightforwardly to how our demonstrating issue handles input and outputs. For the information layer, this will coordinate to the quantity of highlights in the information vector.

For the yield layer, this will either be a solitary yield neuron or various neurons coordinating the quantity of classes we are attempting to anticipate. Settling on neuron means each concealed layer is the place hyper parameter tuning turns into a test. As depicted in Figs. 2 and 3. Train Data Domain and Validation Data Sub Domain.

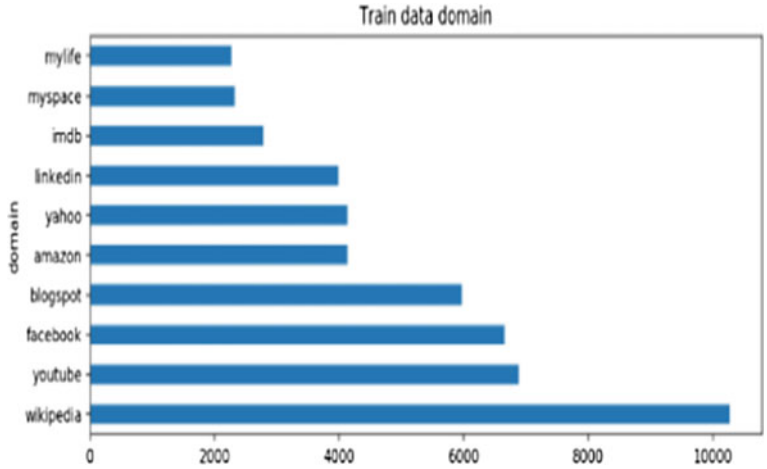

Fig. 2 Train data domain

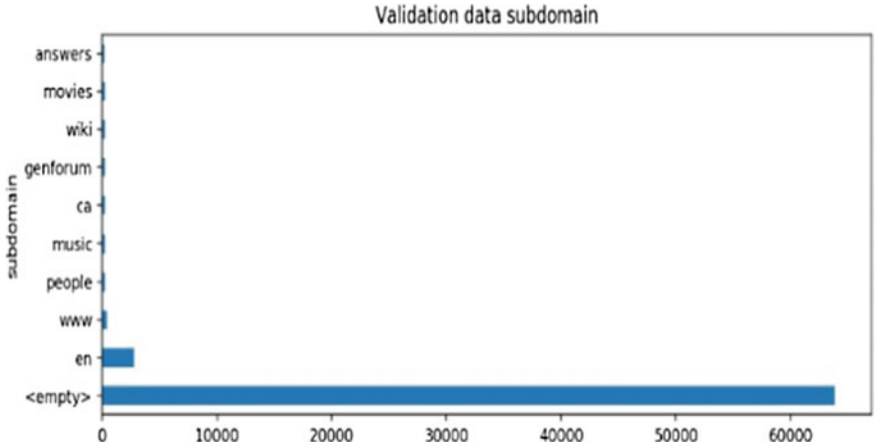

Fig. 3 Validation data sub domain

5 Conclusion

Profound learning strategies like CNN and CNN LSTM are ideal over AI techniques as they have the capacity to acquire ideal element portrayal themselves by accepting the crude URLs as their info. We can guarantee hooked in to the outcomes we tend to uninheritable that, the AI and pro-found learning based mostly malicious computer address recognition will abandon discovery frameworks made-up utilizing boycotting and customary articulation methods. to arrange the model we've

done irregular half on the informational index that we tend to got from a number of assets.

References

1. Mohan Prasad K, Nagendra Goru Rajeev S, Vamsi D, Albert Mayan MJ (2019) Automated payroll using GPS tracking and image capture. In: IOP conference series: materials science and engineering, vol 590, 012026, pp 1–6
2. Velmurugan A, Albert Mayan J, Mohana Prasad R, Yovan Felix A (2019) Implementing health care center using Hadoop for analysis and prediction of diseases. Int J Eng Adv Technol (IJEAT) 8(6):3456–3459
3. Sahoo D, Liu C, Hoi SCH (2017) Malicious URL detection using machine learning: a survey. arXiv:1701.07179 [cs.LG]
4. Sun B, Akiyama M, Yagi T, Hatada M, Mori T (2016) Automating url blacklist generation with similarity search approach. IEICE Trans Inf Syst 99(4):873–882
5. Velmurugan A, Ravi T (2017) Optimal symptom diagnosis for efficient disease identification using somars approach. J Comput Theor Nanosci 14(2):1157–1162
6. Dhamodaran S, Albert Mayan J, Saibharath N, Nagendra N, Sundarrajan M (2020) Spatial interpolation of meteorological data and forecasting rainfall using ensemble techniques. In: AIP conference proceedings 2207, p 050005
7. Bahnsen C, Bohorquez EC, Villegas S, Vargas J, González FA (2017) Classifying phishing urls using recurrent neural networks. In: Electronic crime research (eCrime), 2017 APWG symposium on. IEEE, 2017, pp 1–8
8. Velmurugan A, Albert Mayan J, Niranjana P, Francis R (2020) Expense manager application. J Phys: Conf Ser ICCPET 1712:1–8
9. Zhang X, Zhao J, LeCun Y (2015) Character-level convolutional networks for text classification. In: Advances in neural information processing systems, 2015, pp 649–657
10. Mary Posonia A, Vigneshwari S, Albert Mayan J, Jamunarani D (2019) Service direct : platform that Incorporates Service Providers and Consumers Directly. Int J Eng Adv Technol (IJEAT) 8(6)
11. Kamalesh MD, Albert Mayan J, Felix Y, Dhamodaran S, Prasad M (2020) Automation of blood donation by data integration using data mining. In: 2020 4th international conference on trends in electronics and informatics (ICOEI)(48184), Tirunelveli, India, 2020, pp 944–948
12. Nagarajan G, Minu RI, Jayanthiladevi A (2019) Brain computer interface for smart hardware device. Int J RF Technol 10(3–4):131–139
13. Nirmalraj S, Nagarajan G (2021) Biomedical image compression using fuzzy transform and deterministic binary compressive sensing matrix. J Ambient Intell Humaniz Comput 12(6):5733–5741
14. Nirmalraj S, Nagarajan G (2019) An adaptive fusion of infrared and visible image based on learning of sparse fuzzy cognitive maps on compressive sensing. J Ambient Intell Humaniz Comput 1–10

Deep Learning for Performance Enhancement Robust Underwater Acoustic Communication Network

Syed Mohtashim Mian and Rajeev Kumar

Abstract Underwater Acoustic Sensor Network are suitable and defenseless toward numeral of usual additionally to technological features that use large quality of power and make an impression for life time. Several methods are invented up to now for the development of fulltime and recital factor of acoustic networks, but now it is seen that enormous scope of research in process. In this paper, an effectual incorporation and replacement of deep learning for power optimization and recital improvement is introduced to be executed. The proposed method is describing the effectual and enhances the mixed parameters. Cloud technologies is the main approach for this paper which focuses the entire log of communication is in a position to setup, performed and last extrapolative define in position to be completed.

Keywords Underwater acoustic communication (UAC) · Autonomous underwater vehicle (AUVs) · Remotely operated vehicles (ROVs) · Mobile robots · Navigation

1 History

In 1957, the first Autonomous Underwater Vehicles was developed by Stan Murphy and Bob Francois at the Applied Physics Lab in University of Washington. Firstly, it was used to study for submarine wakes, acoustic transmission and diffusion. Later on, AUV were developed by Terry Ewart. AUV is a robotic device which work in to the water autonomously and move from one point to another without requiring input from an operator. This is piloted and controlled by an onboard computer, also maneuverable in three dimensions. There is another underwater vehicle called ROV (Remotely operated vehicle) which work on perform by an operator using remote control. These underwater vehicles help us learn more about our oceans, Military application as well as

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Fig. 1 Deployment of AUV

Disaster prevention [1]. After the successful research of SPURV (Special Purpose Underwater Research Vehicle) there are many countries was want to develop the underwater vehicles. In 1970s AUVs were developed at the Massachusetts Institute of Technology and display in Hart Nautical Gallery in MIT [2].

UWASNs allow a wide range of purposes, comprising (Fig. 1):

- Disaster Prevention
- Surveillance & Navigation
- Ocean Mapping
- Oil & Mineral Exploration
- Environment Control
- Military Application
- Mine Reconnaissance
- Deep Learning
- Seismic Monitoring

AUV have the ability to move from one point to another point in their surrounding and they aren't stable at one position (Fig. 2).

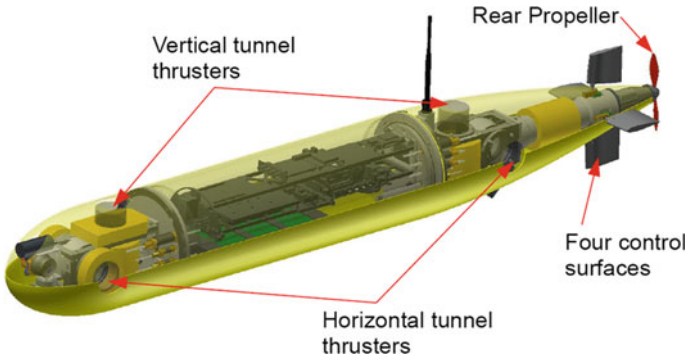

Fig. 2 Internal of AUV

2 Introduction

Generally, underwater acoustic communication suffers from varied constraints such as multipath transmission path loss, fading, noise, Doppler spread and more importantly varying delay. These network conditions as cumulative constraint from the spatial and temporal dynamism of the acoustic network and associated channel conditions. In practice, long range communication system might have the resource or the high frequency of merely a some KHz, on the country less range system might have more than a hundred KHz bandwidth [3].

One of the well-known approaches having communications in underwater in the ocean is Underwater Acoustic Communications (UAC) [4]. It requires to arrange the acoustic communication between the submarines base station toward for military and security purpose for normal communication. Military base can able to detect any of motion of opponents [5]. The precious and suitable is able to be taken through this method. The key problems are energy and power optimization, so it is needed to expand the effectual approached in order that the life span is able to be enhanced and communication is able to be established for long period.

3 Acoustic Communication Device

In terrestrial communication, majority of sensors that are usually stable and hence it becomes feasible for nodes to communicate to confined so many nodes. In comparison to the unchanged network, mobile acoustic network signifies a self-organized type network, where the sensor moves from one place to another autonomously in underwater. Once undergoing such phenomenon, the sensor node must be reorganized as a network to enable intact and reliable communication [6] (Fig. 3).

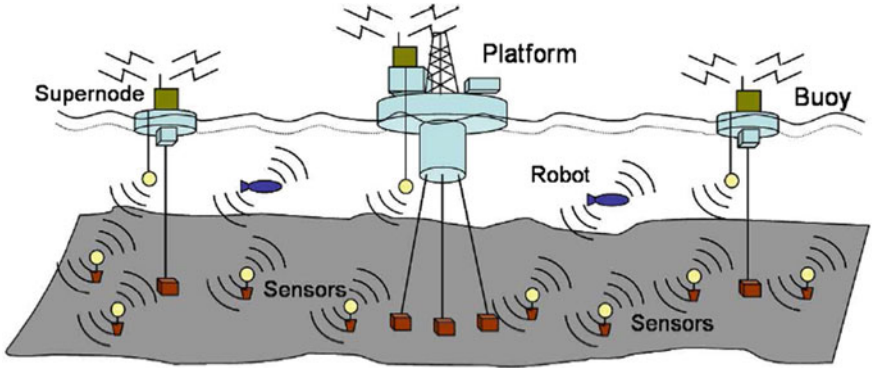

Fig. 3 Classical dimension of acoustic UWSN

4 Module with UWSNs

For an opaque UWSN, through the UAC system of a node, the subsequent features must be given [7].

Low Cost—There are hundreds of nodes in an opaque UWSN, and every sensor deploy in underwater mainly costly module. It's significant cause that power available underwater modems cannot be petition in an opaque UWSN extensively.

Less Power utilization—Most of the node power used by the underwater acoustic modem. Therefore, small power utilization is vital for the architecture of the sensor node which is merely provided through the battery power.

Attractive design—Via the underwater mobile mechanism, a few static nodes require to be positioned and repossesses.

Software and hardware are the two kinds where underwater acoustic communication scheme can be executed. Signal modulation and demodulation are executed through microprocessor in software modem and it has tough signal processing capability. Via special incorporated circuits, modulation and demodulation are executed through special incorporated in hardware modem.

5 Microcontroller Module

For UWSN, center of the node is microcontroller, which has to be low-power, elevated effectiveness, and which is accountable for node manages schedule producing, sensor sampling and communication among the nodes. Embedded working scheme running in MCU decides the major features of the node, for example real-time, power management effectiveness, communications effectiveness. A dense minute embedded control scheme is planned for this node, which completes four responsibilities [8] (Fig. 4).

- Acoustic communication

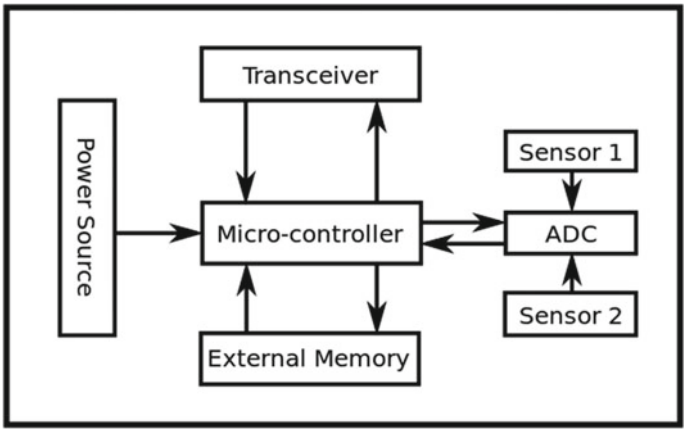

Fig. 4 Internal in UWSN

- Sensor information
- Memory management
- Power management

In general design of underwater acoustic network, they have many sensor nodes with reference of IoT (Internet of Things).

There are one traditional methods is modulation and it is employed for filtering, broadcast and effectual transmission with UWSN. For the incorporation of modulation with UAC, number of approaches is involved [8].

6 Proposed Work and Results

This proposed method, mainly focused on assorted technologies together with deep learning and cloud technology [9] with the intention that previous and effectual analytics can be completed. By means of the incorporation of effective based cloud, the recital of AUC is able to be raised lots. In this present period, the key domains of the research are Cloud Computing and Distributed Applications from previous decade and numeral of algorithms and methods invented until now in sub domains of multiprocessor designs and elevated recital calculating [9]. A variety of algorithms and methods along with environment inspired algorithms are developed and executed to deal with the problems of recital and efficiency [10].

Some regions where the cloud designs are given bellow:

- Memory Management
- Energy Optimization
- Task Scheduling
- Arrangement of Nodes (Figs. 5, 6 and 7; Table 1)

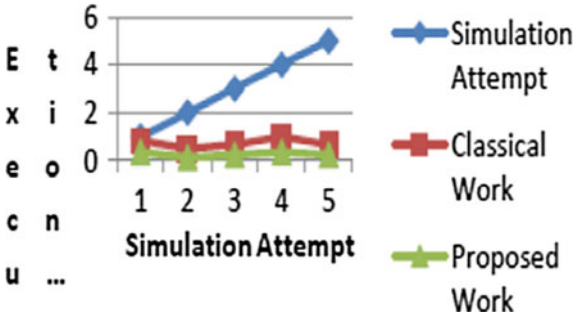

Fig. 5 Classical and proposed approach

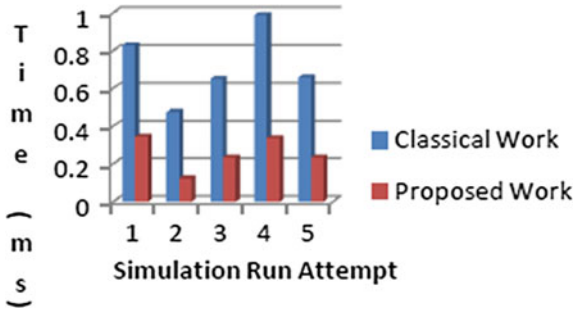

Fig. 6 Classical and proposed approach BAR GRAPH

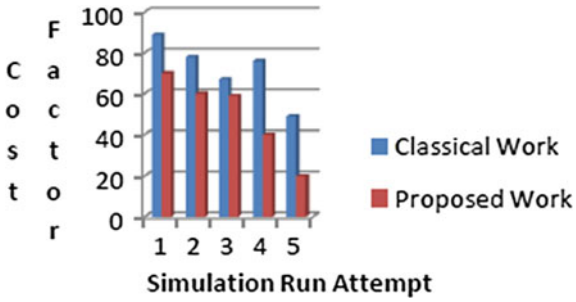

Fig. 7 Analysis of cost factor between the classical and proposed approach

Table 1 Comparison between the proposed and classical work

Attempt	Classical_work	Proposed_work
1	90	71
2	79	61
3	68	60
4	75	41
5	50	21

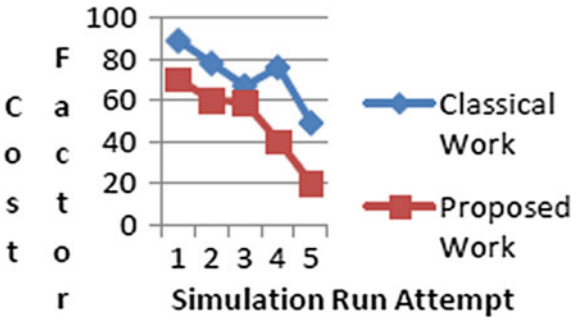

Fig. 8 Line graph analysis cost factor

The ANN (Proposed Work) having more effectiveness and efficiency than the existing approach. The classical work is used as the execution with no incorporation simulation [11] (Fig. 8).

By analyzing graphical representation, the proposed method has minimum cost factor comparing to the existing algorithms approach. The implementation time in the classical work is taking superior units as contrasted to the proposed work.

Task implemented without ANN and after that with the incorporation of ANN to calculate the effectiveness and connected cost factor (Fig. 9; Table 2).

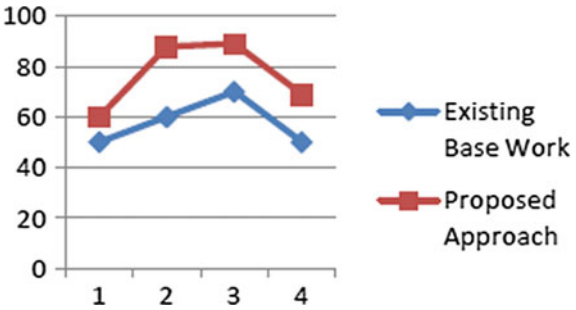

Fig. 9 Comparison between classical and proposed algorithm

Table 2 Difference between classical and improved approach

Classical approach	Improve or effectiveness approach (proposed)
51	61
61	89
71	90
51	70

7 Conclusion

In this paper, the algorithm presented and executed and the outcomes are effective and enhanced than the existed technique. By means of the environment enthused algorithms, the proposed method is able to be extra improved, which is able to provide the overall optimization outcomes. Deep learning is one of the ingredient of soft computing having center job linked to categorization, identification which is commonly connected with the artificial intelligence. Usually, these functioning are done by means of meta heuristic method which is global optimization or effective outcomes are able to be obtained from a large search gap of result.

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References

1. Mohtashim Mian S, Kumar R (2020) Reduced time application (RTA) in distributed underwater wireless sensor in multipath routing network.In: 2020 international conference on computation, automation and knowledge management (ICCAKM), Dubai, United Arab Emirates, 2020, pp14–17.:https://doi.org/10.1109/ICCAKM46823.2020.9051480.
2. "Autonomous Underwater Vehicles"—Stefan Ericson et.al., Bluefin Robotics, Cambridge, U.S.A
3. Akyildiz IF, Pompili D, Melodia T (2005) Underwater acoustic sensor networks: research challenges. Ad Hoc Network 3(3):257–279
4. Mian SM, Kumar R (2019) Review on intend adaptive algorithms for time critical applications in underwater weless sensor auditory and multipath networ. In: 2019 international conference on automation, computational and technology management (ICACTM), London, UK, pp. 469–472 (2019). https://doi.org/10.1109/ICACTM.2019.8776782
5. Watt AJ, Campbell CE, Hole S, Wells I, Phillips MR (2016) A comparative assessment of floating and submerged sensor network deployments for monitoring underwater sediment transport processes, pp 41–46, May 2016
6. Heinzelman WR, Chandrakasan A, Balakrishnan H (2000) Energy-efficient communication protocol for wireless microsensor networks. In: Proc. 33rd annu. Hawaii int. conf. syst. sci., vol 00(c), pp 3005–3014
7. "Underwater Imaging, AUVs"—Dr. Steve Tetlow, Cranfield University—Cranfield, U.K.
8. "Sonar for underwater inspection"—Morten Lind, Technical University of Denmark—Lyngby, Denmark
9. Shen J, Tan H, Wang J, Wang J, Lee S (2015) A novel routing protocol providing good transmission reliability in underwater sensor networks. J Internet Technol 16(1):171–178
10. Lee U, Wang P, Noh Y, Vieira LFM, Gerla M, Cui JH (2010) Pressure routing for underwater sensor networks. Proc IEEE INFOCOM 1–15
11. Mohapatra AK, Gautam N, Gibson RL (2013) Combined routing and node replacement in energy-efficient underwater sensor networks for seismic monitoring. IEEE J Ocean Eng 38(1):80–90

Modeling and Control of FOPDT Modeled Processes—A Review

Neha Belwal, Pradeep Kumar Juneja, Sandeep Kumar Sunori, Govind Singh Jethi, and Sudhanshu Maurya

Abstract When the inputs and outputs are known, system may be recognized as a close replica of the process in the form of a model using system identification techniques. Step response of most of the industrial processes may be found identical to that of first order system along with some delay. Such a model is First Order with Dead Time model. In actual practice, sometimes, it is very complex to design controllers for a real process even if its dynamics is known. Its corresponding FOPDT model simplifies this task by applying well established controller tuning techniques. Many of the industrial sub-processes may be modeled by the use of this model as it has inherent delay and resembles to first order response. This paper reviews such processes and the controller designed for its corresponding model. Although no model is perfect, but it is well accepted for the purpose of improvement in its set-point tracking capabilities.

Keywords FOPDT · Ziegler Nicholas · Tyreus Luyben · Smith predictor · PID controller

1 Introduction

The robustness of the plant often varies with large dead time of plants. Therefore, it presents a challenge to the control engine. A first order process containing dead time may be represented as:

$$H(s) = \frac{Ke^{-\theta s}}{(1+\tau s)} \tag{1}$$

where θ represents transportation lag, K denotes gain, and τ denotes time constant.

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When the process has a delay, incorporating predictor can enhance the performance of feedback system. In spite of many advances in the area of process control engineering, classical controller design and implementation remain the primary choice to control it owing to its modest structure and extensive application in various areas.

2 Literature Review

Pathiran et al. [1] designed a PID controller using the predictive control scheme and dead time approximation by using the several standards of desired closed loop time constants. Further the result of approximating the dead time on controller performance has been analyzed for a FOPDT model. The controller equations of both PPI and PID has been compared and it has been analyzed that PPI controller gain is converse to that of the process gain but gain of PID controller is a function of time constant (closed loop).

Juneja et al. [2] proposed a process model to analyse the concept of equations of mass balance in paper industry specifically in thick stock wet end method, in which both the significant variables are maintained to form a section of the paper machine and the thick stock's basis weight.

Indirapriyadharshini et al. [3] uses a PID controller based on Ziegler Nicholas settings for designing of Internal Modal Controller (IMC) and modified Internal Model controller for an FOPDT model. The performance of designed Internal Modal controller and modified Internal Model controller has been compared also the performance comparison of PID Controller, (IMC) and modified Internal Model controller has been done and the output has been compared for various parameters.

Patel et al. [4] proposed a TOPDT model for controller designing using Integral Error base tuning techniques. A third-order transfer function basically consist of processes of first three orders connected in sequence with each other with the delay function. In the present work a TOPDT model is first converted into a SOPDT model and then to FOPDT model and the set-point tracking capacity has been analyzed for the subsequent designed controller.

Patel et al. [5], in her present work, converted a TOPDT model into an FOPDT model by using two approximation methods i.e. Skogestad and Taylor series. Further a PI controller has been designed for the resultant FOPDT model and the set point tracking capability has been compared for both the controllers.

Chaturvedi et al. [6] has modelled a FOPDT model which can be used in various chemical processes in process industry. In his work he had designed PID controllers by using the transfer function for the particular process model via several tuning methods and the dead time effect is remunerated by the use of Smith predictor.

Baruah et al. [7] proposed an online alteration of FOPID controller. In her study he had considered the limits of an unknown plant which is modelled into a corresponding FOPDT model by means of an online method in which an ideal relay is linked in analogous to a FOPID controller. The obtained corresponding model is obtained after

re-tuning of FOPDT model. This online tuning technique in turn help the controller to always works in loop which has been tested by simulating certain process models.

Gopi Krishna Rao et al. [8] compared the controller parameters based on various tuning methods and tuned PID controller including IMC method for tracking the set point & disturbance rejection for the proposed FOPDT model. For the simulation process a 500 MW boiler of superheated steam temperature is used for measuring the mean arterial blood pressure system. The observations shows that IMC– PID offers more flexibility for chosen performance in contrast with the other tuning methods.

Laware et al. [9] done a significant work via using SCADA (HC-900 Honeywell) controller for expanding the presentation of closed loop response by means of PID controller. Further the PID controller performance has been examined for various performance metrics such as (ISE), Integral Absolute Error (IAE), ITAE, and ITSE. Further after formulating the various PID built-in schemes in order to control the temperature UT_321 laboratory, the results shows that the PID based schemes gives pleasing results for numerous dynamics like small and big dead time, and monotonic, oscillatory feedback**.**

Xu et al. [10] proposed a systematic modified strategy for MacPID Controller pertaining to FOPDT model for the two different overshoots which are broadly used in typical controller tuning and which relates the filter time constant and limitations of FOPDT system. The method aims to achieve the desired effect by adjusting or by simplifying the process PID parameters. Further with the help of proposed rule the value of filter time $\boldsymbol{\lambda}$ constant can be calculated more efficiently and which inturn simplifies the tuning of PID controller.

Sun et al. [11] projected a nonlinear FOPDT system for which an on-line iterative scheme of system identification is used. The measured non-linear FOPDT model is the allowance of the ordinary FOPDT model in terms of dead time and the other parameters are also time dependent. In his proposed work firstly the measured system is discretised then the problem of identification is formulated for non-linear FOPDT model as a non-linear programming problem, and the algorithm for identification is planned by uniting the Branch-and-Bound technique & Mean Least Square method.

Tan et al. [12] compares various known PID tuning formulas and projected a simple method for analysing the robustness and performance of the system. Various criteria has been proposed on the basis of disturbance rejection and robustness of the system to evaluate the PID controllers performance. The analysis of various PID tuning formulas reveals that in command to have decent cooperation among performance and robustness the robustness degree should be in between 3 and 5.

Roy et al. [13] uses the solidity outline of Hermite-Biehler theorem for the PID steadiness of FOPDT model. The resultant simulation outcomes illustrates that this context can be efficiently used for the synthesis of PID controller of the FOPDT model. In his paper he also suggested an algorithm for the synthesis of PID controller. The proposed method gives comparably more superior results over traditional PID tuning approaches in terms of its simplification and flexibility for balance as well as unbalance processes.

Tavakoli et al. [14] proposed a finest method for FOPDT models for modifying PI controller parameters. Various examples has been taken for the simulation study,

which shows that with a wide range of τ_d/T projected method could meet the requirement of the FOPDT models. The projected method is then related with the other well-known techniques and the results shows that the projected scheme was more beneficial to them such as Ziegler-Nichols and Cohen-Coon methods. In count, with that the studies done for robustness demonstrated that PI controller specified by the given methods was acceptably robust than that of the model uncertainties.

Kealy et al. [15] used a response data for closed loop system for estimating the parameters of a FOPDT process model under (PI) control. The chosen PI controller displays an under-damped response in closed loop step response. The resultant statistics of response shows that there are 5 characteristic points which in turn help in determining a SOPDT model and subsequently the frequency response of closed loop system may also be obtained. After obtaining the dynamics of the controller, the process dynamics of the open loop can also be obtained by just unraveling the dynamics of the closed loop from the controller.

Bi et al. [16] in his work projected a robust identification technique that has been derived from a step test for a linear monotonic procedure. Further he also derived a linear regression equation, through the FOPDT model parameters can be attained directly with the help of the instrumental variable least-squares method. The resultant method gives improved identification result then that of the prevailing method under step testing and can be easily applied to PID autotuning.

Consistency of thick stock in the wet end machine can be adequately embodied as a FOPDT model [17]. It is considered as one of the significant variables of paper machine [18]. There is a detectable effect of dead time on stability of an FOPDT model [19]. PSO based classical PI controller is designed for steadiness of stock in the headbox, which is a FOPDT modeled process [20]. Finding the best set of PID parameters has become the center of attraction for several researchers. A method has been proposed to finding the PID parameters set that is relatively suitable for the system as compared to Ziegler-Nichols method [21].

A blending process may be characterized as FOPDT model is analyzed for the performance with a PID controller using Ziegler Nichols (ZN) & Tyreus Luyben (TL) tuning techniques [2] and with PI controller [22]. One of the key factors which is to be considered while designing controller for any industrial process is the dead time. Hydraulic control system utilized in position control application can be modeled as IPDT process model [23].

Heat exchanger process is selected for control system design. PI controllers are designed and compared based on Integral Error performance criteria for a delayed process model [24].

Zhisheng Duan, Lin Huang, Long Wang performed robustness analysis and synthesis problem by perturbing the parameters of the controller and the plant [6]. The integral error performance indices are compared for a selected FOPDT model [25].

Sometimes multiple transfer functions may exist for same parameter as in case of consistency of headbox because of different inputs and outputs due to different sensor locations. Presence of multiple transfer functions for the same parameter along with

presence of delay term challenge the situation further [26]. PID controller is designed and Smith Predictor is used to minimise the effect of dead time [27].

A SOPDT model is converted in to FOPDT model by the use of Taylor's Series & Skogestad dead time approximation methods for further control system analysis [28]. In a process industry, in order to achieve the required response even in the presence of disturbances one should have a desirable robust controller [25].

Modelling of headbox becomes easy once its consistency is controlled. In present study, it has been inspected that which model will effectively modelling the headbox consistency [29].

3 Conclusion

Present paper deals with exhaustive literature survey of various industrial processes prevalent in chemical process industries. It focuses on those processes which can be modelled using FOPDT model. Their corresponding transfer function models available in literature are also presented along with their controller tuning methods. From the survey, it can be concluded that there exists a large variety of processes in sugar, paper, ceramic, plastics, drugs, leather, textile etc. which have an inherent dead time and can be easily and conveniently modelled as FOPDT.

References

1. Pathiran AR et al (2020) Effect of dead-time approximation on controller performance/robustness designed for a first order plus dead-time model. J Electr Eng
2. Juneja PK et al (2016) Controller capability comparison for a delayed first order process model. In: Proceedings of the (ICSNCS) lecture notes in electrical engineering 396. https://doi.org/10.1007/978-81-322-3589-7_28 © Springer India
3. Indirapriyadharshini J (2018) Improved performance of first order system with dead time process using internal model controller. (IJPAM) 118(11):647–653. ISSN: 1311-8080
4. Patel A et al (2016) Controller design for a TOPDT process model using integral error based tuning techniques. In: ICSNCS 2016, February 25–27, proceedings in IEEE Conference
5. Patel A et al (2016) Integral error based controller design & performance analysis for a TOPDT process. (ICACCA 2016). 978-1-5090-0673-1/16/$31.00©2016
6. Chaturvedi M et al (2016) Design of time delay compensator for a FOPDT Process model. (ICSNCS 2016). In: February 25–27 2016, proceedings of IEEE conference
7. Baruah G et al (2015) Fractional Order PID Controller design for an FOPDT Model by Online Tuning Method. (ICIC) 2015 978-1-4799-7165-7/15/$31.00 ©2015 IEEE
8. Gopi Krishna Rao PV et al (2014) Study on PID controller design performance based on tuning techniques. (ICCICCT) 978-1-4799-4190-2/14/$31.00 ©2014 IEEE
9. Laware AR et al (2013) Real time temperature control system using PID controller and supervisory control and data acquistion system (SCADA). (IJAIEM) 2(2). ISSN 2319–4847
10. Xu Y et al (2011) A simple PID controller tuning strategy for first order plus dead time model. 978-1-4577-0321-8/11/$26.00 ©2011 IEEE
11. Sun Z et al (2011) System identification for nonlinear FOPDT model with input-dependent dead-time. (ICSTC) IEEE 2011 978-1-4577-1173-2

12. Tan W et al (2006) Comparison of some Well-known PID tuning Formulas. Comput Chem Eng 30(2006):1416–1423
13. Roy A et al (2005) PID Controller tuning for the first-order-plus-dead-time process model via Hermite-Biehler theorem. ISA Trans 44(2005):363–378
14. Tavakoli S et al (2003) Optimal tuning of PID controllers for first order plus dead time/long dead time models using dimensional analysis. In: European control conference
15. Kealy T et al (2002) Closed identification of a first order plus dead time model under PI control. ISSC 2002, Cork. June 25–26
16. Bi Q et al (1999) Robust Identification of first-order plus dead-time model from step response. 0967–0661/99/$ Ð see front matter ©1999 Elsevier Science Ltd. PII: S0967-0661 (9 8) 00166-X
17. Juneja P et al (2010) Dead time modeling for first order plus dead time process in a process industry. (IJCSC) 1(2):167–169. ISSN: 0973-7391
18. Juneja P et al (2013) Robustness analysis of various controllers designed for consistency of a headbox. J Forest Products Ind 2(6):14–17. ISSN: 2325–4513(PRINT) ISSN 2325–453X (ONLINE), nov. 2013, California, USA
19. Chauhan N et al (2014) Simulation studies for delay effect on stability of a FOPDT model. (ICSCTET), August 7–8
20. Saini P et al (2019) Design of PI controller for consistency of stock in paper machine headbox using Particle Swarm Optimization (PSO). CISCT
21. Juneja PK et al (2015) Modified PID design formulae for FOPDT system. IJAER. Print ISSN: 0974-6846, Volume 10, Number 24 (2015) pp 43939–43941
22. Juneja P et al (2016) Set-point tracking capability comparison of PI and PID controllers for a FOPDT process model. IEEE Xplore**.** 978-1-5090-0673-1/16/$31.00
23. Kholia P (2018) Effect of Padè first order delay approximation on controller capability designed for IPDT process model. PEEIC 2018(April):13–14
24. Naithani D et al (2016) Controller performance analysis for a delayed process based on Integral Error performance Indices. OJC J 32(3). ISSN: 0970-020 X CODEN: OJCHEG
25. Uniyal J et al (2016) Modeling error effect on performance of a second order delayed process model. (ETCT 2016), GEU November 18–19, IEEE Explore
26. Juneja PK et al (2019) Control of stock consistency in headbox approach flow system. CISCT
27. Chauhaan P et al (2014) Controller Design and its performance analysis for a delayed industrial process. (ICSCTET-2014), August 7–8. 978-1-4799-3080-7114/$31.00 ©2014 IEEE
28. Chaturvedi M et al (2013) Effect of dead time approximation on controller performance designed for a second order delayed model. (ICAES-2013), September 21–23, 2013. 978-1-4799-1441–8/13/$31.00 ©2013 IEEE
29. Naithani D (2017) Integral error based controller performance comparison for a FOPDT model. (ICIIP-2017), December 21–23

Early Detection of Autistic Children Using Wrapper-Based Feature Selection Technique

C. Radhika and N. Priya

Abstract Selection of features is a crucial technique in ML classifiers, especially for datasets with a lot of dimensions. Feature selection is a popular machine learning method in which subsets of the data's available features are chosen for use in a learning algorithm. The remaining, insignificant dimensions are removed from the most excellent feature, which has the fewest number of dimensions that contribute the most to precision. The goal of the selection of features is to choose a subset of info factors by eliminating characteristics that have practically or no prognostic value. Strategies for choosing elements can be partitioned into three categories. Filter strategies are one, Wrapper techniques are another, and Embedded strategies are the third. Our main goal is to develop a subset feature for autism spectrum disorder premature prediction using several wrapper-based feature selection algorithms. Autistic is a group of neuro-developmental disorders characterized by societal communiqué difficulties, restricted interests and activities, and abnormal tactile sensitivities. This study looks into the use of wrapper features selection techniques such as sequential forward selection (SFS), sequential backward selection (SBS), Sequential Backward Floating Selection (SBFS), Sequential Forward Floating Selection (SFFS), and Recursive Feature Elimination (RFE) as well as optimal selection approaches based on classifiers like RF, GBC, and CART. According to this study, the search methodology employing RFE based on the RF algorithm outperformed other methods in terms of average accuracy of 87%. The advantage of selecting feature subsets is that they are more accurate and take less time to run.

Keywords Feature selection · Wrapper-based technique · ASD

1 Introduction

Autism is a lifelong disorder with a wide range of intensity and severity of prodrome, with early warning signs appearing in childhood and varying developmental path

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[1, 2]. Autism is a brain developmental disorder that includes a variety of symptoms such as social difficulties, repetitive activities, aphasia, and gesture, as well as distinct strengths and distinctions [3, 4]. ASD affects one out of every 66 children in Canada. Aside from the behavioral abnormalities, there are no other symptoms that can be used to diagnose ASD. Patients with ASD have usually been required to undergo behavioral observation or questioning, such as Autism Schedule of Diagnostic Observations [5].

2 Related Works

Benjamin Wingfield, et al. [6] proposed a new ASD test app installs a clever AI model and uses a list of clinically approved manifestation agenda to screen and recognize ASD issue in low-and middle-earnings nations [7]. To increase performance, the GLCM technique is employed to extract a feature, followed by a forward selection of features. For 5-sMRI and fMRI with 9-K-fold = 15, the K-NN has the highest accuracy of 85.71%. Because the merged image has the features of both source images, combining sMRI and fMRI images can produce better findings [8]. The authors used computer intellect and ML techniques to improve Q-categorization CHAT's accuracy and investigate the superlative subset of things capable of properly distinguishing between immature autistic youngsters and those who are not [9]. The author suggests excellent and effective features to overcome the barriers to learning and boosting the learning ability of autistic children using PCA and Particle Swarm Optimization via SVM [10]. Autism is taken into consideration as one of the quickest growing developmental sicknesses in youngsters, which is why premature prognosis with the help of class models will sincerely make contributions significantly, in resolve the trouble of building a correct evaluation [11]. The authors of this study devised cerebrum network-based components for the conclusion of autistic disorder. They have developed a cerebrum network using a mind utilitarian attractive reverberation imaging using the 264 districts-based parcellation plan in particular (fMRI). The 264 Eigen values of the Laplacian grid of the cerebrum organization were then used to generate 264 primitive mind highlights, with three extra components determined by network centrality. We obtained 64 segregate features using an attribute selection technique. Furthermore, using the ABIDE dataset, we have developed a few AI models for detecting ASD. LDA has accomplished the classification precision of 77.7% [12]. The Author reviewed the size and capabilities of analysis of data-driven activities in the automatic diagnosis of autism. In this case, finally, authors have reviewed the mechanisms underlying modern data on the diagnosis of ASD through work analysis, such as repetitive conduct, atypical gait patterns, and uncommon visible saliency. Other than that, this paper provided a different analysis of machine learning and deep learning algorithms and results obtained from ASD/TD diagnosis [13]. Proposed SVMAttributeEval method assigns weight to attributes and ranks them in order of importance. For reduced subsets chosen in the form of the wrapper, the RFE approach is utilized, and the performance of the classifier algorithms Lib

Table 1 Attribute descriptions of Autistic dataset [15–17]

Name of the attributes	Interpretation of the feature	Category
QA1-QA10	Societal Explanation, Sensorial-Aspects, Behaviours-Prototype, Intellectual-Disorder	Numerical values(0,1)
Ethnic background	List of nation	Categorical variables
Jaundice	Whether or not the case had jaundice when it was born	Categorical variables (Y/N)Y-288, N-766
A family member has a history of ASD	Whether any members of your immediate family have a PDD or have a history of ASD	Categorical variable (Y/N)Y-170, N-884
Relationship	Blood relation, Self, therapist, etc	Categorical variables
Score	Integer value based on the attributes A1-A10	Numerical values (1–10)
Age	Era	12–36 month
Gender	M/F	Categorical variables M-735, F-319
Class	Y/N	Categorical variables

SVM, IBk, and NaiveBayes is measured. When compared to the initial feature set, the artistic findings demonstrate progress in classifier performance when the least significant functions are eliminated, with a 60% reduction rate.

3 Data Collection

The Kaggle Repository [14] provided the Autistic dataset. There are 1054 instants in the collection, each with 18 different data types. Table 1 lists the features of the Autistic Dataset.

4 Research Methodological

Data pre-processing includes things like data standardization, missing value replacement, one-hot encoding, partition and scaling, and selection of features. Some of the variables in the dataset aren't relevant to our study. The attributes Ethnicity, Who took the test, and Class/ASD features have been deleted for better analysis. Then, on the ASD dataset, use the Handle Missing Value technique to transform all missing occurrences to the 'unknown' esteem. Following the imputing of missing values, each value of the nominal feature column is encoded with a new dummy feature using the one-hot encoding approach. Parting a data-set into training and test sets, as well as selecting features that are on the same scale, are required for best performance.

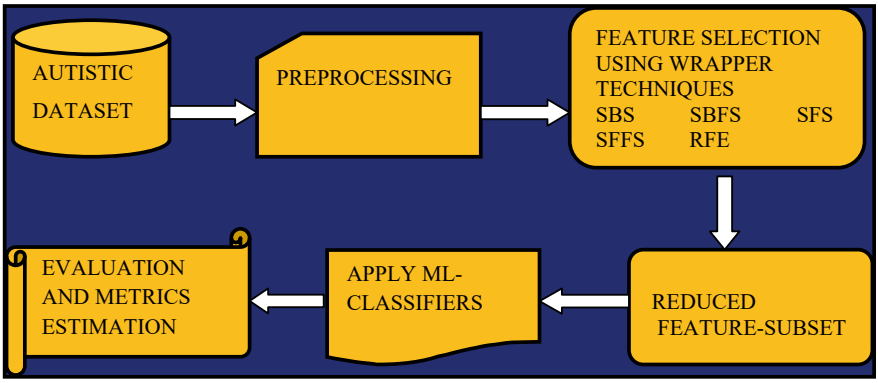

Fig. 1 The framework of wrapper based feature selection techniques

The training set will receive one-third of the data, while the test set will receive the remaining. Feature choice is a technique for picking a subcategory of variables from a multifaceted data-set to progress classification performance across a variety of data-sets. Feature selection is one of the most important and widely used procedures in data pre-processing. It reduces the number of features by removing redundant or irrelevant facts and improves the computation speed and forecast accuracy of the machine learning system [18].

An evaluation approach assesses a subset of characteristics' discriminate ability to discriminate between multiple class labels. Based on different features, the evaluation step is separated into three broad techniques: filter technique, wrapper technique, and hybrid technique. The Filter technique employs independent criteria, but the Wrapper approach is constrained by specified learning algorithms. Independent criteria and preset learning algorithms are used in a hybrid method. In the feature selection process, each strategy has its own set of advantages and disadvantages [19–22]. Filter models describe features in order, which is based on intrinsic measures' ranks, Gain Ratio, Information Gain, etc. The wrapper model uses search strategies such as sequential, complete, and random search to identify a subcategory of features from the feature space [23]. Hybrid- It uses a filter strategy to remove very redundant features. The other features are deployed in a wrapper method after that. Wrapper time complexity is reduced by a smaller quantity of attributes [23]. The framework of the feature variety approach is shown in Fig. 1.

4.1 Feature Selection Using Wrapper Techniques

SFS- In each cycle, SFS begins with an empty-set of characteristics and provides every unused characteristic from the given instance set. Cross-validation is used to

estimate the performance of every delivered characteristic. Within the object characteristic selection, simplest the attribute with great performance is covered. The updated selection is subsequently used to start a brand new spherical. As a result, the SFS algorithm includes qualities that provide a high value to the objective function [24]. SBS- In each round, SBS begins with the complete set of attributes and removes each remaining attribute from the given example set. For each iteration or attribute elimination, the overall performance is calculated using internal operators such as cross-validation [24]. The SBFS is a top-down search approach that eliminates features by first performing the standard SBS procedure to the current feature set, then conditionally including the most significant feature from the available features if the prior sets can be improved [25]. SFFS-The SFFS is a bottom-up search strategy that incorporates innovative features by starting with the current feature set and executing the basic SFS procedure, then conditionally excluding the worst feature in the recently modernized set if the prior sets can be improved further [25]. Multiple classifiers are trained on smaller subsets of features in RFE (Recursive Feature Elimination). The time it takes to train a classifier increases in direct proportion to the number of classifiers to train [26]. The purpose of recursive feature elimination (RFE) is to pick features by looking at fewer and smaller groups of characteristics in a recurrent manner. To begin, the estimator is trained on a small collection of features, and the relevance of each feature is determined using any attribute. Then, given the existing set of features, the least significant features are trimmed. On the pruned set, this approach is continued recursively awaiting the desired number of the attribute to elect to pick is attained [27].

5 Experimental Result

The autistic toddler dataset is reduced to a minimal subset based on social interaction, behavioral patterns, cognitive dysfunction, and sensory features. Figure 2 depicts the autistic dataset's most important feature and accuracy using several wrapper-based feature selection strategies. The data were arbitrarily partitioned into 70% training and 30% testing sets in our proposed method. Vital features are chosen from among the 18 most effective six based on their core domain—verbal communication communique, facial features displayed in Table2 and applied to the attribute selection and provided as input to every classifier. The accuracy, recall, precision, F1-score, and log loss of the classifier will be classified into a few metric metrics acquired from the confusion matrix [28, 29]. In terms of accuracy, the correct forecast generated based on the total number of tests may be shown and recognized. The recall metric, which is defined as the ratio of genuine positive ASD tests, reveals how any valid predictions were generated based on the test instances. Precision is defined as the ratio of ASD-diagnosed tests to true positive rates, which indicates how many people we classified as having ASD actually do. It's excellent if the F1 Score has some sort of balance between precision and recall. If the system has a good balance of precision and recall, the F1 Score is outstanding. The log loss displays the number of

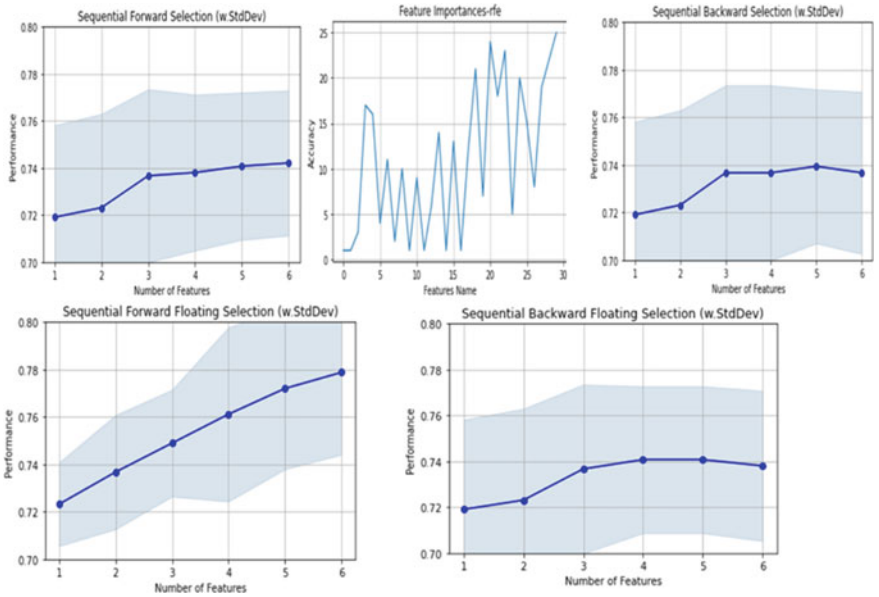

Fig. 2 Feature Importance of autistic dataset using various Feature selection techniques

Table 2 Most significant feature of toddler's dataset

Feature-selection	CART	GBC	RF
SBS	QA1,QA2,QA5, QA6,QA7,QA9	QA1,QA2,QA3, QA5,QA6,QA10	QA2, QA3,QA7, QA8,QA9,QA10
SFS	QA2,QA3,QA4, QA5,QA7,QA9	QA3,QA2,QA6, QA7,QA8,QA9	QA1,QA3,QA2, QA5,QA6,QA9
SBFS	QA1,QA2,QA4, QA6,QA7,QA9	QA4,QA5,QA7, QA9,QA10,QA2	QA2,QA4,QA5, QA6,QA7,QA9
SFFS	QA2,QA3,QA5, QA7,QA8,QA6	QA2,QA5,QA6, QA7,QA8,QA9	QA1,QA4,QA5, QA6,QA7,QA9
RFE	QA2,QA3,QA5, QA6,QA7,QA8	QA1,QA3,QA5, QA6,QA8,QA10	QA4,QA3,QA5, QA6,QA2,QA10

Feature description
QA1—Cognitive Problems- Lack of attention, QA2—Impaired Social Interaction-Eye Contact
QA3—Behaviors Pattern-Goals specification, QA4—Cognitive Problems-Hobby
QA5—Sensory Aspects-Imaginary, QA6—Cognitive Problems-Lack of attention/Concentration
QA7—Cognitive Problems-No response to queries, QA8—Cognitive Problems-Unusual Rhythm
QA9—Impaired Social Interaction-Gestures, QA10—Sensory Aspects-Unusual Vision

incorrect predictions based on the test instances. In terms of search strategy, SFS and RFE outperform other feature selection strategies with an autistic dataset. As a result, cross-validation and the confusion matrix are utilized to assess the overall performance of the classifiers. The results reveal that when the Random forest model

Table 3 Accuracy of different wrapper-based feature selection techniques with classifiers

Wrapper-techniques	CART (%)	GBC (%)	RF (%)
SBS	80	82	81
SFS	77	79	83
SBFS	76	77	79
SFFS	78	79	82
RFE	83	86	87

Table 4 Performance and evaluation metrics of autistic dataset

Evaluation metrics	F1	Recall	Precision	Log_Loss
CART + SBS	0.83	0.86	0.81	0.20
CART + SFS	0.79	0.74	0.87	0.23
CART + SBFS	0.77	0.74	0.81	0.24
CART + SFFS	0.79	0.74	0.86	0.22
CART + RFE	0.71	0.60	0.88	0.17
GBC + SBS	0.83	0.79	0.86	0.18
GBC + SFS	0.80	0.75	0.85	0.21
GBC + SBFS	0.77	0.74	0.79	0.23
GBC + SFFS	0.79	0.74	0.86	0.21
GBC + RFE	0.67	0.54	0.89	0.14
RF + SBS	0.84	0.86	0.82	0.19
RF + SFS	0.82	0.79	0.81	0.17
RF + SBFS	0.78	0.76	0.79	0.21
RF + SFFS	0.83	0.78	0.87	0.18
RF + RFE	0.80	0.77	0.83	0.13

is used with other classifiers, the results are better. To undertake a comparison evaluation, machine learning classifiers are utilized, and the accuracy of different feature selections is displayed in Tables 3 and 4.

6 Conclusion

In this work, we compared multiple feature selection techniques to predicting autism spectrum disorder. ASD awareness is limited in economically backward nations due to cultural factors. Due to a lack of resources, patients with ASD are frequently left untreated for long periods. It is critical to identify and diagnose ASD in young children as early as possible to enhance clinical outcomes. The indispensable job of the proposed model of component choice is to get significant elements without diminishing the precision of portrayal. In this study, different ML techniques were

used to try to detect autistic patients. The results of the experiment demonstrate that random forest based on RFE has the best exhibition when compared to other tactics. In the future, we want to work with a variety of feature selections that, in general, include element appraisal and class for better execution. The most significant hindrance to the investigation is a lack of sufficiently large data to create the forecast model. Another limitation is that the screening software isn't intended for era groups under three years old because open-source information isn't available to them.

References

1. Diagnostic and Statistical Manual of Mental Disorders: DSM-5,5th ed.; American Psychiatric Association: Washington, DC, USA, (2013), ISBN 978-0-89042-554-1
2. Elsabbagh M, Johnson MH (2010) Getting answers from babies about autism. Trends Cogn Sci 14:81–87
3. Geschwind D, Sowinski J, Lord C, Iversen P, Shestack J, Jones P et al (2001) The autism genetic resource exchange: a resource for the study of autism and related neuropsychiatric conditions. Am J Hum Genet 69:463–466
4. Wiggins L, Reynolds A, Rice C, Moody E, Bernal P, Blaskey L, Rosenberg S, Lee L, Levy S (2014) Using standardized diagnostic instruments to classify children with autism in the study to explore early development. J Autism Dev Disord 45(5):1271–1280
5. Lord C, Rutter M, Goode S, Heemsbergen J, Jordan H, Mawhood L, Schopler E (1989) Autism diagnostic observation schedule: a standardized observation of communicative and social behavior. J Autism Dev Disord 19(2):185–212. https://doi.org/10.1007/BF02211841 PMID: 2745388
6. Wingfield B, Miller S, Yogarajah P, Kerr D, Gardiner B, Seneviratne S, Samarasinghe P, Coleman S (2020) A Predictive model for paediatric autism screening. Health Inform J 26(4):2538–2553. https://doi.org/10.1177/1460458219887823 Epub 2020 Mar 19 PMID: 32191164
7. Mamata VL, Suvarna SC (2020) Detection of autism spectrum disorder (ASD) using machine learning techniques: a review. Int J Future Gener Commun Netw 13(1):426–438
8. Tartarisco G, Cicceri G, Di Pietro D, Leonardi E, Aiello S, Marino F, Chiarotti F, Gagliano A, Arduino GM, Apicella F, Muratori F, Bruneo D, Allison C, Cohen SB, Vagni D, Pioggia G, Rutta L (2021) Use of machine learning to investigate the quantitative checklist for autism in toddlers (Q-CHAT) towards early autism screening. Diagnostics 11(3):574. https://doi.org/10.3390/diagnostics11030574
9. Mythili MS, Shanavas M (2015) A new hybrid algorithm for detecting autistic children learning skills. Int J Eng Technol 7:1505–1513
10. Kanimozhiselvi CS, Jayaprakash D, Kalaivani KS (2019) Grading autism children using machine learning techniques. Int J Appl Eng Res 14(5):1186–1188. ISSN 0973-4562
11. Mostafa S, Tang L, wu F (2019) Diagnosis of autism spectrum disorder based on eigenvalues of brain networks. IEEE Access 7:128474–128486. https://doi.org/10.1109/ACCESS.2019.2940198
12. Shahid O, Rahman S, Arrafi MA, Ahad M (2020) Data-driven automated detection of autism spectrum disorder using activity analysis: a review. Preprints 2020100388. https://doi.org/10.20944/preprints202010.0388v1
13. Mohan P, Paramasivam I (2020) Feature reduction using SVM-RFE technique to detect autism spectrum disorder. Evol Intell 14(2):989–997. https://doi.org/10.1007/s12065-020-00498-2
14. Kaggle Repository. Retrieved https://www.kaggle.com/fabdelja/autism-screening-for-toddlers
15. Thabtah F (2017) Autism spectrum disorder screening: machine learning adaptation and DSM-5 fulfillment. In: ICMHI 17 proceedings of the 1st international conference on medical and health informatics. https://doi.org/10.1145/3107514.3107515

16. Thabtah F (2019) An accessible and efficient autism screening method for behavioral data and predictive analyses. Health Inform J 25(4):1739–1755. https://doi.org/10.1177/1460458218796636
17. Thabath F (2017) ASDTests. A mobile app for ASD screening. [Internet]. (2017)[cited 2018 Dec 20]. Available from www.asdtests.com
18. Ding J, Fu L (2018) A Hybrid feature selection algorithm based on information gain and sequential forward floating search. J Intell Comput 9(3):93–101. https://doi.org/10.6025/jic/2018/9/3/93-101
19. Shroff KP, Maheta HH (2015) A comparative study of various feature selection techniques in high-dimensional data set to improve classification accuracy. In: International conference on computer communication and informatics, pp 1–6. https://doi.org/10.1109/ICCCI.2015.7218098
20. Huan L., Lei Y (2005) Toward integrating feature selection algorithms for classification and clustering. IEEE Trans Knowl Data Eng 17:491–502. https://doi.org/10.1109/TKDE.2005.66
21. Dash M, Huan L (2003) Consistency-based search in feature selection. Artif Intell 151:155–176
22. Dash M, Huan L (1997) Feature selection for classification. Intell Data Anal 131–156
23. Kohavi R, George HJ (1997) Wrappers for feature subset selection. Artif Intell 97:273–324
24. Panthong , Srivihok A (2015) Wrapper feature subset selection for dimension reduction based on ensemble learning algorithm. Procedia Comput Sci 72:162–169. https://doi.org/10.1016/j.procs.2015.12.117
25. Pudil P, Novovicova J, Kittler J (1994) Floating search methods in feature selection. Pattern Recogn Lett 15(11):1119–1125. https://doi.org/10.1016/0167-8655(94)90127-9
26. Guyon I, Weston J, Barnhill S, Vapnik V (2002) Gene selection for cancer classification using support vector machine. Mach Learn 46:389–422
27. Pedregosa et al (2011) Scikit-learn: machine learning in python. J Mach Learn Res 12:2825–2830
28. Sebastian R (2015) Python machine learning. ISBN: 978-1-78355-513-0. www.packtpub.com
29. https://towardsdatascience.com/accuracy-recall-precision-f-score-specificity-which-to-optimize-on-867d3f11124

Medical Insurance Cost Prediction Using Machine Learning Algorithms

Anmol, Shruti Aggarwal, and Afroj Jahan Badhon

Abstract Medical Insurance cost prediction is prime distress. A Medical Insurance company can only make money if it collects quite it spends on the medical aid of its beneficiaries. Medical Insurance companies are troublesome task as determining premiums for his or her customers. Mechanism Knowledge stands a part of Reproduction Intellect and computing which spotlight the consumption of data also controls to imitate the method that persons absorb, increasingly employed on the situation exactness. Prediction means affecting the produce of estimation afterwards the situation consumes be situated arranged on a documented dataset, in addition, original data though computing the likelihood of a particular outcome like whether a customer will mix in thirty days. Comparative analysis of Machine Learning Algorithms. Compare new techniques with existing techniques using various outputs. We will use the dataset for training the model. Which regression gives the best accuracy and who will take less time.

Keywords Machine learning · Prediction · Medical · Algorithms

1 Introduction

Machine Learning (ML) is the investigation of PC calculations that can learn and create all alone with experience and information. The issue is observed through a kind of artificial intelligence. artificial intelligence also called AI intentions to make a prototypical reliant on example data, is alluded to as "Preparing information," for making forecasts otherwise decisions deprived of existence specifically programmed. Mechanism knowledge intentions are used in popular of extensive scope of utilization, including medication, electronic mail sifting, necessary assignment is troublesome or unthinkable. Nonetheless, not all AI is measurable learning. A subsection of machine learning is resolutely recognized through computational understandings, that middle everywhere manufacture opportunities exploiting Processers [1].

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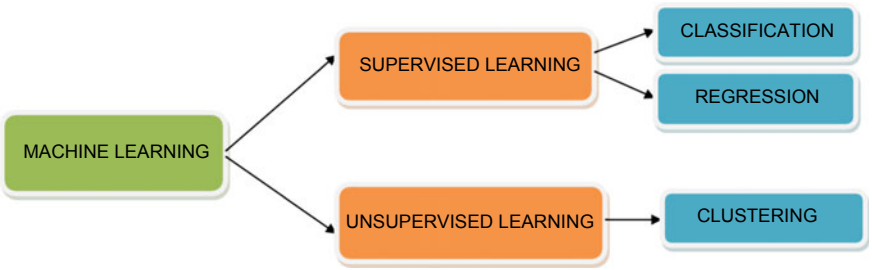

Fig. 1 Types of machine learning

Machine learning is otherwise called prescient investigation when it is utilized to tackle business challenges (Fig. 1).

When predicting the likelihood of a given outcome, like whether a client would agitate in 30 days, "expectation" mentions towards the profit of a scheming afterwards the situation consume remained organized happening a past information conventional addition practical to new-fangled material. For every passage popular the original data, the control determination yield reason is potentially intended form incomprehensibly adjustable, authorizing the prototypical designer to figure out about what is a price that determination unquestionably be. Machine learning model forecasts empower the association to produce exceptionally exact conjectures about the logical results of a question dependent on a piece of authentic information, which may be tied in with anything from client wearing down to conceivable extortion. these stockpiles the organization with data has a quantifiable business value. Intended for example, uncertainty prototypical forecasts that a customer is perhaps profitable to stir, then the organization may contact with those organization through customized informing also determined to keep the customer from leaving (Fig. 2).

Presently, medical insurance is a requirement, and practically everyone is covered by a government or private health insurance organization. The factors that go into deciding the quantity of insurance differ from one business to the next. Rural residents are also uninformed that the Indian government provides free health insurance to individuals who fall below the poverty level [2]. It is a complicated system, and some rural residents either choose private health insurance or do not purchase health insurance at all. A part from that, people are easily duped when it comes to the cost of insurance and may mistakenly purchase pricey health insurance [3]. Private, or wilful,

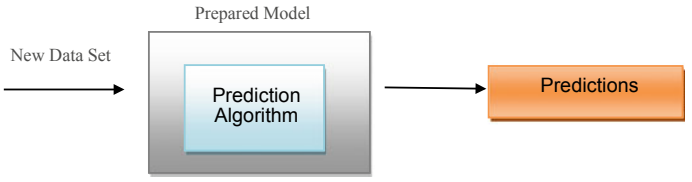

Fig. 2 Prediction algorithm

clinical protection is an arrangement of clinical Protection that is coordinated and regulated by an insurance agency or other private association under the particulars of an agreement. Albeit most private clinical protection plans are financed on a gathering premise, most plan additionally gives individual policies. Private gathering plans are regularly supported by gatherings of workers whose instalments are sponsored by their organization and kept into a different asset.

2 Importance of Machine Learning and Prediction

Reference [4] Predictive analysis is the study of past data as well as existing external data to discover patterns and behaviours, whereas machine learning is an AI approach in which computers are given data and instructed to analyse it without a preconceived set of rules and laws. Machine learning algorithms are taught to learn from their mistakes in improving future efficiency, whereas predictive analysis makes briefed predictions about future events historic data [5]. Machine learning is a new generation technology that relies on better algorithms and volumes of data, whereas predictive analysis is a study rather than a specific technology. During World War II, Alan Turing had already employed this technique to decrypt signals [3]. Machine learning and predictive modelling are both used to create future predictions based on a set of data. Predictive analytics entails the application of predictive modelling, which may incorporate machine learning. The goal of predictive statistics is to use previous data to estimate the likelihood of a future result.

3 Bibliographic Analysis of Research Trend in Medical Insurance Cost Papers from Prediction Using Machine Learning Algorithms

In Table 1, we have shown the yearly publication and the percentage rate from 2010 to 2021 total of thirteen years. As we can see at first in 2010 working rate that means percentage is so low but now in 2021the rating is getting higher than means on this field there a real o to f work happening nows days.

Reference [4] We can see that the publications on this topic are increasing year to year. In 2021, we can see that we have 207 publications, it's a great job. We compared the last 10 years of papers. In 2010, we were 5 publications on this topic, in 2011 it was increased by 7 now we can see its increasing year to year. We can also think in 2022 we have more publications on this topic (Fig. 3).

We can see that increasing year to year. In future, we can see more publications. Blue colour shows its actual publication, and other colours show we compared it's with different years of publications. In 2011 the publication is less the 20. But then in 2012 to 2013, in these years that number was getting low. Then from 2014 to 2017,

Table 1 Publication year analysed data

Sr. No	Publication year	Record count	% of 758
1	2021	207	27.309
2	2020	192	25.330
3	2019	138	18.206
4	2018	80	10.554
5	2017	27	3.562
6	2016	24	3.166
7	2015	20	2.639
8	2014	10	1.319
9	2013	3	0.396
10	2012	4	0.528
11	2011	7	0.932
12	2010	5	0.660

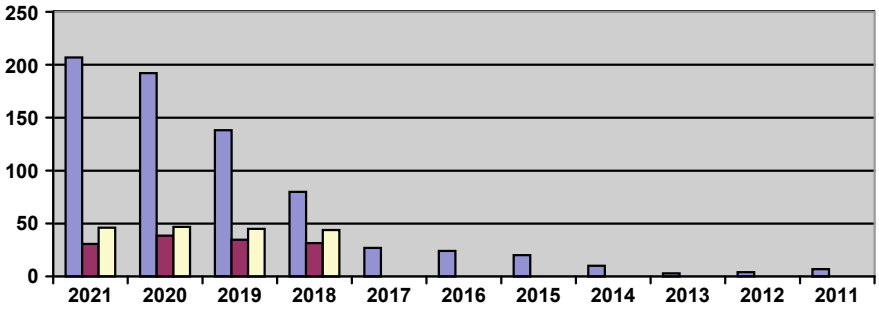

Fig. 3 Publications year

it was around 50. Then from 2018 to now, that means in 2021, that number crossed to 200. So in this field, the working is increasing a lot and it has a lot of scopes to do research which is so helpful for the user in this modern area.

4 Literature Review

In the empirical analysis part, we contemplate some previous research work regarding Medical Insurance Cost Prediction Using Machine (MICP). We will try to precise the basic ideas that are proposed in these works. Let us look at the following Table 2 to overview the last previous few years research work on MICP.

Table 2 Overview of last few years research work on MICP

Sr. no	Title	Authors	Source, Year	Description
1	Prediction Healthcare costs using Evidence Regression	Belisario panay, NelsonBa loian, JoseA.Pin o	Proceedings, 21 Nov 2019	New regression method with the capacity to quickly demonstrate the rationale for generating certain forecasts regarding potential healthcare expenditures, whichever remains a necessary aptitude popular the healthiness province. As we can associate the issue consequences to the calculations produced through dual of the greatest reproductions since the eleventh studied in addition-described through to see how well it was predicted [5]
2	Health Insurance Amount Prediction	Nidhi Bhardwaj, Rishabh Anand	International Journal of Engineering Research & Technology May-2020	For individual health insurance data, Three regression models are tested. The three regression models were developed using health insurance data and the anticipated premiums from these model, which is based on a decision tree. Several variables were employed and their impact on the estimated amount was investigated. In every algorithm used, it was discovered that a person's age and smoking status have the greatest impact on the forecast. The attributes that had no bearing on the prediction were removed from the features [6]
3	A Machine Learning Algorithm for Early Detection of End-Stage Renal Disease	Zvi segal, dan kalifa, kira radinsky, bar ehrenberg, guy elad, gal maor, liat korn & gideon koren	BMC Nephrology, 27 Nov 2020	End-stage renal disease, which demands kidney dialysis and is accompanied by significant comorbidities, necessitates an accurate prediction of people who are likely to develop ESRD and are at a high risk of dying. A variety of ways have been proposed to anticipate ESRD. Diabetes mellitus is the leading cause of the end-stage renal disease (ESRD) [7]
4	Need-based and optimized health insurance package using clustering algorithm	IrumMatloob, shoab ahmad khan, farhan hussain, wasi haider butt, rukaiya and fatimakhalique	applied Science, 13 September 2021	In The healthcare industry, there is a significant need to focus on health insurance challenges and to implement efficient, cost-effective strategies for ensuring that insurance benefits are distributed fairly. One of the most serious issues is the misalignment of healthcare benefits with techniques that can provide employees with demand healthcare benefits [8]

(continued)

Table 2 (continued)

Sr. no	Title	Authors	Source, Year	Description
5	Deep Learning-Based Stacked Generalization Method to Design Smart Healthcare Solution	Ravindran Nambiar Jyothi and Gopalakrisham Prakash	Lecture Notes in Electrical Engineering, 2019	A Pressing need for measures that will contribute to the development of the healthiness-protection corporation. The purpose of the research is to examine patients who are at the hazard of both short and long-haul relapse along with their cost. The obtained results reveal that the stacked ensemble model, which fuses serval models, outperforms the model that arrangements with a solitary information type with high exactness 91.17% [9]
6	Predicting the Risk of Chronic Kidney Disease Using Machine Learning Algorithm	Weilum Wang, Goutam Chakraborty and Basabi Chakraborty	MDPI, 28 December 2020	This work is to create a relapse model to anticipate creatinine levels, then, at that point, integrate the projected creatinine levels with the common 23 health indicators to assess the risk of CKD. We employed an under-sampling procedure and introduced an expense touchy mean squared error (MSE) misfortune capacity to manage the issue since the creatinine esteem, which is the an objective variable is unreasonably imbalanced [10]
7	A Roadmap for Designing a Personalized Search Tool for Individual Healthcare Providers	Gang Luo	Journal Medical Systems, 2014 of Jan	Consumers and Healthcare professionals will benefit from a customised scan device for IHPs. Buyers scan can utilise the search engine to locate IHPs that meet their needs. Similarly, if an IHP discovers that he is unable to effectively deal through a detail enduring or else can be approached towards allude, use may custom the hunt instrument towards allures the enduring towards additional Separate Well-being maintenance Breadwinners which is bound to remain successful. Then we look for therapy trends that lead to positive outcomes as well as therapy strategies that contribute to negative outcomes [11]

(continued)

Table 2 (continued)

Sr. no	Title	Authors	Source, Year	Description
8	Development of non-iterative Supervised Learning Predictor Based on the Ito Decomposition and SGTM Neural-like Structure for Manging Medical Insurance Costs	Roman Tkachenko, Ivan Izonin, PavloVitynskyi, NataliiaLotoshy anska and Olena Pavlyuk	Data, 31 October 2018	In this research, we use a newly created non-iterative computational insight device to tackle the relapse task. It consolidates the Ito disintegration with the progressive mathematical changes model's neural-like design. The simulation was carried out to find a solution. Predicting individual medical costs is a difficult undertaking. The effectiveness of the proposed technique is supported by research. Balance its findings to those of other predictors The derived predictor's precision demonstrates the MAPE, SSE, SMAPE, RMSE, and MAE, in preparing, have the most noteworthy qualities dependent proceeding on five-pointers [12]
9	From hype to Reality: Data Science Enabling Personalized Medicine	Holger Frohlich, Rudi balling, niko beerenwinkel, oliver kohlbacher Alvaro Ribeiro Botelho Junqueira, Farhaan Mirza, Mirza Mansoor Baig	BMC Medicine	Machine integrate multitudinous measure, multitudinous, and lengthwise persevering information to a variety of moderately precise expectations that might even beat human execution at times. Enormous business entertainers who are currently inflowing the arena of medication feature the possibility for computational arrangements that are well recognized [4]
10	A machine learning model for predicting ICU readmissions and key risk factors: analysis from longitudinal records		Health and Technology, 26 Nov 2019	In this research, machine learning techniques were used to assess a large number of patient roles after a solitary medical clinic over a decade to discover changes in readmission risk variables. The results show that the most important delivered assignment danger influences remained relevant afterwards separating the information established into dual sequential areas [1]

(continued)

Table 2 (continued)

Sr. no	Title	Authors	Source, Year	Description
11	Epidemiology And Socioeconomic C Trends in Adult Spinal Deformity Care	Michael M Safaee, MD, Christopher P Ames	Neurosurgery, 2020	Over the last decade, the therapeutic landscape for ADD has shifted dramatically. We identify this as a complex condition with major negative consequences for one's quality of life The crucial significance of surgery in enhancing the personal satisfaction of people with ASD has been demonstrated proofread in symptomatic instruments, order plans, and careful strategies Current strategies, for example, packaged instalment plans, don't adequately represent the intricacy of ASD medical procedure and the high variety among patients and facilities [13]
12	Multimodal Machine learning for automated ICD coding	Keying Xu Mike Lam, Jingzhi Pang	Proceedings of Machine Learning Research, 2019	Different models were created to manage data from various modalities, such as unstructured text, semi-organized text, and organized plan information Analyses show that our ensembled model beats any remaining arrangement draws near. Consolidating human mastery into AI models to further develop execution is effective, and we need to get more familiar with it in the future[14]
13	Prediction of Major Complications And Readmission After Lumbar Spinal Fusion: A Machine Learning-Driven Approach	Akash A. Shah, Sai K. Devana, Nelson F SooHoo	World Neurosurgery, 2021	A machine learning approach that Outperforms logistic regression in Predicting severe problems and Readmission after lumbar fusion Notably, the most relevant predictors for Boost was different from those for regression. The capacity of cutting-edge AI ways to deal with catch connections Between factors that relapse Can't discover could explain XG Boost's improved performance. This technique may help of cutting edge AI ways to deal with catch connections between factors that relapse can't by identifying and addressing potentially modifiable risk Factors [15]

(continued)

Table 2 (continued)

Sr. no	Title	Authors	Source, Year	Description
14	Piecewise-linear Approach for Medical Insurance Costs Prediction using SGTM Neural-Like Structure	Roman Tkachenko, Ivan Izonin, NataliiaLotoshyn ska	CEUR Workshop Proceedings, 2018	A new strategy for predicting insurance medical expenditures is offered. Because of the characteristics of the data sample, the commission can speak using the portion-wise rectilinear method. To properly instrument the strategy in standings of enhancing the precision in addition to the speediness of the situation procedure, the problem may be advised that each data cluster be processed using a non-linear SGTM neural-like structure. The created strategy improved accuracy by 11% when compared to the basic method due to the fast of its work, which depends on a non-iterative preparing calculation with good generalization capabilities [3]
15	Analysing health insurance claims on different timescales to predict days in the hospital	Yang Michael Ying Liu, Xie, Hoy	Journal of Biomedical Informatics, 2016	A worldly information mining approach has been introduced for determining future medical clinic days. On-time intervals (bins), equal duration series features were built to capture delicate temporal information that improves forecast outcomes. In an addition-deuce calendar month, four models were built with different length bins, such as an epoch, partial time, quartier, to see how modifying the transitory aim could affect important prescient capacity [16]

5 Future Scope

The impact of several independent variables on the premium amount was also investigated. For higher accuracy, the qualities were also verified in combination.

Predicting premium amounts is based on a person's personal health rather than the insurance terms and conditions of other companies. The algorithms can be used to forecast premiums using data obtained in the next years. This can assist not just individuals but also insurance firms in collaborating to provide better and more health-focused insurance coverage.

6 Conclusion

For individual health insurance data, three regression models are tested. The three regression models were developed using health insurance data, and the anticipated premiums from these models were compared to actual rates to see how accurate they were. The best performing model was found to be the Gradient Boosting Regression model, which is based on a decision tree. Several variables were employed and their impact on the estimated amount was investigated. In every algorithm used, it was discovered that a person's age and smoking status have the greatest impact on the forecast. The features were stripped of attributes that had no bearing on the prediction.

References

1. Junqueira ARB, Mirza F, Baig MM (2019) A machine learning model for predicting ICU readmissions and key risk factors: analysis from a longitudinal health record. Health Technol. (Berl) 9(3). https://doi.org/10.1007/s12553-019-00329-0
2. Tkachenko R, Izonin I, Kryvinska N, Chopyak V, Lotoshynska N, Danylyuk D (2018) Piecewise-linear approach for medical insurance costs prediction using SGTM neural-like structure. CEUR Workshop Proc 2255:170–179
3. Fröhlich H et al (2018) From hype to reality: data science enabling personalized medicine. BMC Med 16(1). https://doi.org/10.1186/s12916-018-1122-7
4. Panay B, Baloian N, Pino J, Peñafiel S, Sanson H, Bersano N (2019) Predicting health care costs using evidence regression. Proceedings 31(1):74. https://doi.org/10.3390/proceedings2019031074
5. Bhardwaj N, Delhi RA, Akhilesh ID, Gupta D (2021) Health insurance amount prediction [Online]. https://economictimes.indiatimes.com/wealth/insure/what-you-need-to
6. Segal Z et al (2020) Machine learning algorithm for early detection of end-stage renal disease. BMC Nephrol 21(1). https://doi.org/10.1186/s12882-020-02093-0
7. Matloob I, Khan SA, Hussain F, Butt WH, Rukaiya R, Khalique F (2021) Need-based and optimized health insurance package using clustering algorithm. Appl Sci 11(18):8478. https://doi.org/10.3390/app11188478
8. Nambiar Jyothi R, Prakash G (2019) A deep learning-based stacked generalization method to design smart healthcare solution. In: Lecture Notes in Electrical Engineering, vol 545, pp 211–222. https://doi.org/10.1007/978-981-13-5802-9_20
9. Wang W, Chakraborty G, Chakraborty B (2021) Predicting the risk of chronic kidney disease (CKD) using machine learning algorithm. Appl Sci 11(1):1–17. https://doi.org/10.3390/app11010202
10. Luo G (2014) A roadmap for designing a personalized search tool for individual healthcare providers. J Med Syst 38(2). https://doi.org/10.1007/s10916-014-0006-4
11. Tkachenko R, Izonin I, Vitynskyi P, Lotoshynska N, Pavlyuk O (2018) Development of the non-iterative supervised learning predictor based on the ito decomposition and site neural-like structure for managing medical insurance costs. Data 3(4). https://doi.org/10.3390/data3040046
12. Safaee MM, Ames CP, Smith JS (2020) Epidemiology and socioeconomic trends in adult spinal deformity care. Neurosurgery 87(1):25–32. https://doi.org/10.1093/neurons/nyz454
13. Xu K et al (2019) Multimodal machine learning for automated ICD coding [Online]. https://www.cdc.gov/nchs/icd/icd10cm.htm

14. Shah AA et al (2021) Prediction of major complications and readmission after lumbar spinal fusion: a machine learning-driven approach. World Neurosurg 152:e227–e234. https://doi.org/10.1016/J.WNEU.2021.05.080
15. Xie Y et al (2016) Analyzing health insurance claims on different timescales to predict days in hospital. J Biomed Inform 60:187–196. https://doi.org/10.1016/J.JBI.2016.01.002
16. Dash S, Kumar Shakyawar S, Sharma M, Kaushik S (2019) Big data in healthcare: management, analysis and future prospects. https://doi.org/10.1186/s40537-019-0217-0

Scope and Challenges of Artificial Intelligence in Health Care of India

Amanpreet Kaur and Kavita Verma

Abstract In 1947, when India gets its freedom, India was one of the least developed countries in technology and innovations. Indian scientific community and our leaders as determined to achieve mastered in technology and innovation with least funding in sectors like space technology, nuclear energy and agriculture. Many Indian organizations like ISRO and DRDO give their contribution to achieve these goals. Latest research suggests that with start of twentieth century which is also called as age of artificial intelligence, India and world facing new challenges in health care like COVID-19. In this research article, the analytical study demonstrates the research challenges an Indian scientific community and government of India examine in health care system and get to know that is the Indian scientific community ready to use the artificial intelligence techniques to tackle challenges in pandemic (COVID-19) like situations in future.

Keywords Healthcare · Artificial intelligence · Internet of Things

1 Introduction

In today's revolution of technology Artificial Intelligence (AI) drastically alter the world, like intelligent machines with high level processing in learning, decision making and solving of problems. Combined opportunity of AI advance and supplement the intelligence of humans, which improve the living and working style of people. Artificial intelligence [1] and its technologies are begun to develop healthcare into E-healthcare and motivate the business and society. These technologies like artificial intelligence, ML (Machine Learning), IOT (Internet of Things) have

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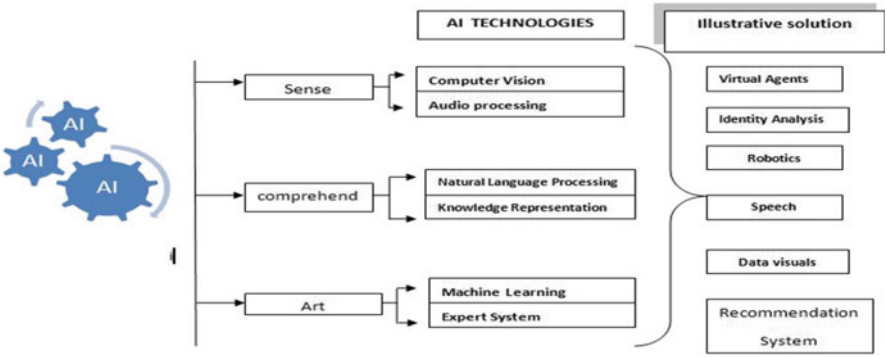


Fig. 1 Application areas of artificial intelligence

potential to transform and enhance many points of patient care or health care, as well as administrative processes within provider and payer.

AI is a collection of number of latest technologies [2] with emulates the capabilities of human sense, brain and act to develop high level intelligent machines. By combined the natural language processing application with the interface application engines the respective AI system that enables to analysis and study the system. Human being reliability and capabilities are developed by his ability to learn and experience things using their brains and make available that learning to handle the problems. AI also increase its implementations by adapting such activities to develop new innovations in very vast fields, from the commercial perspective AI have potential to provide increment in wide range of many sectors and fields. Many application areas are there that collaborates with the AI (Fig. 1).

2 Artificial Intelligence in India

According to analysis by research agency of India Itihaasa in terms Artificial intelligence, India ranks third in world in publications and research but is that significant distance in implementation as compare to world leader countries China and USA. According to NITI Aayog in India they use [3] AI mainly in five sectors or domains to solving society need that are:

- Healthcare: increased the accessibility and affordability the quality of healthcare.
- Agriculture: Increment the farmers' income, and increased in productivity and make reduction of the waste material.
- Education and smart schools: improve the quality and accessibility of education, make good time consumption.
- Smart Infrastructure & smart cities:

Advancement and research in technologies and innovation using internet, provide big opportunities to large populated country India for solve its long existing challenges to effectively provide appropriate healthcare.AI combines with other technologies like IoT and IoMT (Internet of Medical Things) [4] to developed as a new nervous system for the healthcare, also present solutions for addressing the healthcare problems and help the government to tackle the challenges.

India with AI provides the tremendous scope for screening and treatment of cancer like health problem. Now, India can see more than one million cases of cancer annually and also done early management and detection of this cancer like disease. As report by the NITI Aayog to making healthcare solutions and services more appropriate and proactive, they work on another related project that is Bio bank for cancer, that techniques step forward from sick care to true or effective health care with more stress on preventive techniques. New technologies initially give challenges to India, but with low to high level advancement with advance field like AI, ML and IOT, India experience large scale of transformation innovation, which primarily deal with government and able to support private sector too.

3 Healthcare in India with AI

The situation of healthcare in India is most challenging and dynamic via 2020, Compound Annual Growth Rate (CAGR) is upwards to 16%, 40% growth will expect in A1 healthcare market of India in year 2021. Many healthcare leaders step forward to invest in AI technologies approximately 94%, but with challenges.

3.1 Challenges in India

Main challenge in India is lack of professional doctors and nurse, bad doctor-patient ratio and also infrastructure as today we deal with covid-19 like pandemic which outcomes as lack of professional and trained or experience doctors mainly the infrastructures or hospitals, lack in ventilators and main lack in PPE kits for first row warriors in pandemic like situation.

To overcome these challenges Government of India made invent the series of inventions in large scale. NITI Aayog combining contribution with the Microsoft and the Forus Health for the checkout whatever the technology to early detection of diabetic retinopathy as main huge project. The 3Nethra [5] produced or developed by Indian Forus Health contribution Microsoft, is a portable device that helps to screening for common eye infection or problem. With the Integrating it with the AI capabilities device that is 3Nethra using Microsoft's retinal image processing. APIs also used some operators of 3Nethra project device to enable or develop AI-powered insights in the rural area checkup champs combine it with more technologies like cloud computing [6] and image processing.

4 Related Work of Healthcare in Different Countries

As Artificial world technology is a computational based technology that copy or mimic the processing with support of human intelligence. Basically, by Cambridge dictionary synergic the AI is an approach to adapts principles and the respective devices application from different fields, like mathematics, logics, computation and biology. As per research basically there are following themes on which research comprises that is, costs, providers, supply, satisfaction, funding, leadership and market.

Accessibility of the healthcare facilities across different countries is totally depend upon the influencing of their economy and their social factors [7]. According WHO that is world health organization, main impacts of well-established healthcare of a country comprises by its mechanism, training, workforce, financially well, maintained facilities and accessibility. OECD (Organization for Economic Co-operation and Development) members of countries, measure on factors of GDP (Gross domestic Product) as per the capita basis. Figure 2 shows the analysis of GDP as per the countries, United State have high GDP expenditure in healthcare. By year 2021 India may increase by 1.2–2.5%. India in year 2019 GDP expenditure in healthcare is 3.6% that is very low it may increase by one to two percent by year 2021 (Fig. 3).

Analysis study was conducted on the basis of GDP expenditure with respect to the mentioned countries. Analysis concludes that maximum expenditure growth is with the United State and minimum is with the Indonesia from respective countries. After experience with this pandemic in year 2021, many famous companies invest up to 94% in health care with AI.

Experimental study based on Geographical analysis with different countries and their population. As per the above graphical view, population is maximum in China and after that in India. If compare the above figure with the rank of different countries in healthcare. France is at rank one, and if we check particularly in India, India maximum in population but not lie in first 200 ranks of healthcare analysis.

Public Health Research (PHR) study has come with analysis of research done in different countries, USA have maximum research and India counted on number seventh for research article in healthcare by year 2020–21.

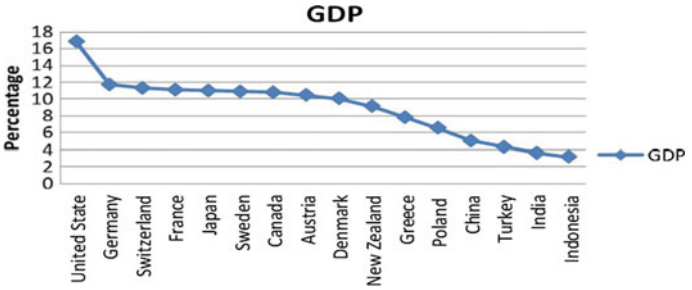


Fig. 2 Analysis of healthcare expenditure (GDP) in countries

Fig. 3 Geographical analysis of different countries with their population

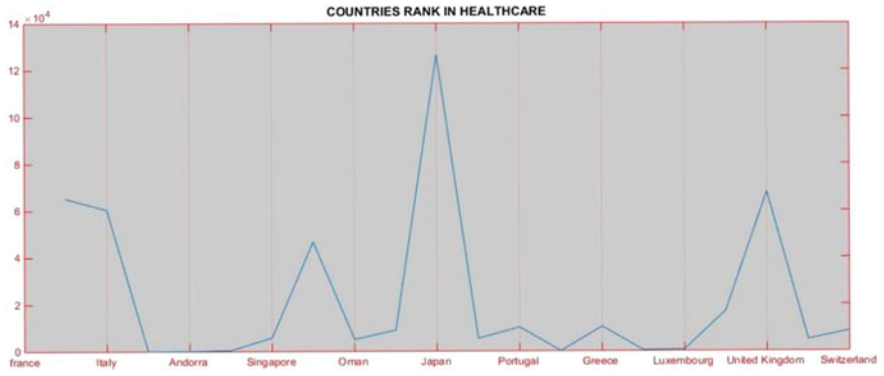


Fig. 4 Global comparative analysis

Above Fig. 4. as per analysis of the WHO (World Health Organization) ranking of different countries and its healthcare system in year 2021.India lies at 112th rank and according to that research well economy set countries like Canada and USA not present in top 25 ranks of records or studies and France is at top one but as this output on the basis of population but overall, the healthcare system of Japan good and maximum with the population count.

STATA version 15 compiles study model or analytical model to perform a study in the growth AI in healthcare and medicine in world publications. In above table by STATA that is the analytical study of research by different countries in healthcare with the technique of Artificial Intelligence in year 2019, we observed that that statics comes as USA ranks highest in research prospective in healthcare and medicines. If we come to India, it's at number 7th, means Indian scholars also done its best to prepare its nation for handle or tackle any challenges in healthcare.

5 Challenges for Adapting AI in India

Main five sectors analysis of AI fields in India that is healthcare, industry, education, agriculture and cities. Outcome as there are many challenges that India should face to make [8] AI like technology for growth and adapt. So, there are large scale requirement for adaption of AI technology. Following are the challenges that come in front of our nation in healthcare.

5.1 Challenges in Healthcare Sector to Adapt AI in India

Lack of stakeholders or industries to collaborate the policies, a policy and research new technologies like new clustering techniques [9] like HER (Electronic Health Record), which collect or share the digitizing record among different hospitals that work still in progress due to absence of industries and stakeholders. Unavailability of data to robust opening of clinical data sets in healthcare field. Main challenge is security basis, privacy of data. Common challenges in all five sectors of smart cities, transportation, and education are: Enabling of data ecosystem, less growth in field of research AI mainly lack of core research, Unavailability of manpower and services, Low awareness to adopt AI in the business processes, and high cost as well as time and Security and the privacy issues.

These challenges have no sense if government of India never took the relevant steps, like government of India should develop a proper framework or building block to make AI as its leadership goal.

6 Interventions and Recommendations

Recommendation for India in field of AI is to adapt new building block available by government also have done research. As per the research system in India there are some innovations done in recent years. As per the research scenario Indian make a huge jump in paper publications and also encourage the number of papers publications in last 10 years.

Analysis of research papers counts or research in Healthcare with AI for respected mentioned countries in Table 2, analysis conclude that by year 2020 USA have highest in research related to healthcare with Artificial Intelligence application or platform. There are many fields like manipulation, human resource availability, testing, and building done excellent with AI. Both Government and private sectors done research with wireless sensor network [10] and AI to handle traffic issue in India (Table 1).

Recently, With Partnership with NASSCOM Government of Karnataka setup a Centre of Excellence for the Data Science and AI Artificial Intelligence. Also, Wadhwani foundation set up India First Research institute for the research mainly

Table 1 Comparative analysis of countries healthcare with population

Name	Rank in healthcare	Population
France	1	65,426.179
Italy	2	60,367.477
San Marino	3	34.017
Andorra	4	77.355
Malta	5	442.784
Singapore	6	5896.686
Spain	7	46,745.216
Oman	8	5223.375
Austria	9	9043.07
Japan	10	126,050.804
Norway	11	5465.63
Portugal	12	10,167.925
Monaco	13	39.511
Greece	14	10,370.744
Iceland	15	343.353
Luxembourg	16	634.814
Netherlands	17	17,173.099

Table 2 Research trends of publications in Health and Medicine in 2020–21

No	Country
1	United State (USA)
2	China
3	Italy
4	Germany
5	Canada
6	France
7	India
8	Spain
9	Australia
10	Japan

in AI.IM-ICPS [11] International mission to develop a framework for promote the research as follow:

- ICON (International Centers of New Knowledge): Generate and focus on developing new research by the knowledge of old research
- CASTLE (Centre for Advanced Studies, Translational research and leadership)
- CROSS (Centre for Research on Sub Systems)

CORE s that are Centers of Research Excellence in Artificial Intelligence. ICTAIs another International Centre for Transformational Artificial Intelligence this provides the application-based ecosystem. Further, ICTAIs [12] also responsible to develop and deliver commercial industries.

7 Conclusion and Future Scope

In technological era, developing new innovation in AI helps to tackle challenges [13] mainly in healthcare. With the public interest or government and mainly with collaboration of industries AI develop innovation as data policy to overcome the issues in basis sectors of India. Observation as in India the ranking is not under the first 20 numbers. Population of India is very high but the healthcare system ranking not lies in first 20. Research USA is at first and India lies in 7th position as per statistics to bridge the gap between the AI researchers and Developed countries in order to ride the innovation in AI, proper framework is established by the government. In research India did good growth but it's more effective if scholar's main stress to implementations of the research. As different countries like USA, UK, Japan and China have their establishments to leadership the growth of AI same Indian Government should also establish an ambitious training and programmers in this transformation world.

References

1. Marda V (2018) Artificial intelligence policy in India: a framework for engaging the limits of data-driven decision-making. Philos Trans R Soc A Math Phys Eng Sci 376(2133). https://doi.org/10.1098/RSTA.2018.0087
2. Yu K-H, Beam AL, Kohane IS (2018) Artificial intelligence in healthcare. Nat Biomed Eng 210 2(10):719–731. https://doi.org/10.1038/s41551-018-0305-z
3. Wisetsri W (2021) Rise of artificial intelligence in healthcare startups in India. Adv Manag 14(1). Accessed: Sep. 13, 2021 [Online]. https://www.researchgate.net/publication/349604103
4. Joyia GJ, Liaqat RM, Farooq A, Rehman S (2017) Internet of Medical Things (IOMT): applications, benefits and future challenges in healthcare domain. https://doi.org/10.12720/jcm.12.4.240-247
5. Evaluation of an Artificial Intelligence System (i-ROP DL) for Retinopathy of Prematurity Screening in Nepal using the Forus 3nethra neo and in Mongolia using the Retcam Portable® | IOVS. ARVO J. https://iovs.arvojournals.org/article.aspx?articleid=2774086 (accessed Sep. 13, 2021)
6. Narkhede BE, Raut RD, Narwane VS, Gardas BB (2020) Cloud computing in healthcare—a vision, challenges and future directions. Int J Bus Inf Syst 34(1):1. https://doi.org/10.1504/IJBIS.2020.106799
7. Lameire N, Joffe P, Wiedemann M (1999) Healthcare systems—an international review: an overview. Nephrol Dial Transplant 14(suppl_6):3–9. https://doi.org/10.1093/NDT/14.SUPPL_6.3

8. Chatterjee S (2020) AI strategy of India: policy framework, adoption challenges and actions for government. Transform Gov People Process Policy 14(5):757–775. https://doi.org/10.1108/TG-05-2019-0031
9. Aggarwal S, Singh P (2018) Cuckoo, Bat and Krill Herd based k-means++ clustering algorithms. Clust Comput 226 22(6):14169–14180. https://doi.org/10.1007/S10586-018-2262-4
10. Kaur A, Sandeep, Kang S (2021) SEEHR: secure and energy efficient hierarchical routing in wireless sensor networks. Int J Comput Netw Wirel Mob Commun 5:19–26. Accessed: Sep. 13, 2021. [Online]. www.tjprc.org
11. Prokhorov S, Safronov V (2019) AI for AI: what NLP techniques help researchers find the right articles on NLP. In: Proc. - 2019 Int. Conf. Artif. Intell. Appl. Innov. IC-AIAI 2019, pp 76–81, Sept 2019. https://doi.org/10.1109/IC-AIAI48757.2019.00023
12. NITI Aayog, TIFR and Intel Establish International Center for Transformative Artificial Intelligence—Policy@Intel. https://blogs.intel.com/policy/2018/09/11/ictai/ (accessed Sep. 13, 2021)
13. Challenges And Future of AI In Healthcare. https://analyticsindiamag.com/challenges-and-future-of-ai-in-healthcare/ (accessed Sep. 13, 2021)

Fs-Set Functions-Images

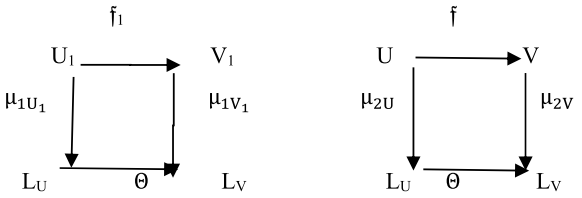
Vaddiparthi Yogeswara, K. V. Umakameswari, and Ch. Ramasanyasi Rao

Abstract In this study, we defined Fs-Set function between two Fs-Sets, identify Image of Fs-Subset under an Fs-Set function and we study some images properties.

Keywords Fs-set · Fs-subset · Type-I void set · Type-II void Set · Fs-union · Fs-intersection · CBA and CBAH · Fs-set function · Fs-complement of an Fs-subset · Image

1 Introduction

Yogeswara et al. introduced the Fs-Function and developed a theory [1]. Based on the following diagram, a triplet $(\mathbf{f}_1, \mathbf{f}, \theta) : \mathcal{U} = \left(\mathbf{U}_1, \mathbf{U}, \overline{\mathbf{U}}(\mu_{1\mathbf{U}_1}, \mu_{2\mathbf{U}}), \mathbf{L}_\mathbf{U}\right) \rightarrow \mathcal{V} = \left(\mathbf{V}_1, \mathbf{V}, \overline{\mathbf{V}}(\mu_{1\mathbf{V}_1}, \mu_{2\mathbf{V}}), \mathbf{L}_\mathbf{V}\right)$ is an Fs-function iff (**i**)$\mathbf{f}_1|_\mathbf{U} = \mathbf{f}$ is surjection (ii) Θ: $\mathbf{L}_\mathbf{U} \rightarrow \mathbf{L}_\mathbf{V}$ a CBA homomorphism. We see examples of following type are not accommodated in their theory.



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$$\mathfrak{f}_1|_U = \mathfrak{f} : U \to V \sqsubseteq V_1, \mathfrak{f}_1 x = \mathfrak{f} x$$

Let $U_1 = \{d_1, d_2, d_3\}$, $U = \{d_1, d_2, d_3\}$

$$V_1 = \{e_1, e_2, e_3\},\ V = \{e_2, e_3\}$$

$$\mathfrak{f}_1 d_1 = e_1,\ \mathfrak{f}_1 d_2 = e_2, \mathfrak{f}_1 d_3 = e_3,\ \mathfrak{f} d_1 = \mathfrak{f}_1 d_1 = e_1,\ \mathfrak{f} d_2 = \mathfrak{f}_1 d_2 = e_2, \mathfrak{f} d_3 = \mathfrak{f}_1 d_3 = e_3,$$

But $\mathfrak{f} d_1 = e_1 \notin V$.

This is a lacuna.

If we redefine the Fs-function $(\mathfrak{f}_1, \mathfrak{f}, \Theta): \mathcal{U} \to \mathcal{V}$ as (a) $\mathfrak{f}_1 \Big|_{U}^{V} = \mathfrak{f} : U \to V$ is surjuctive, (b) Θ: $L_U \to L_V$ is a CBAH, where $\mathfrak{f}_1 \Big|_{U}^{V} = \mathfrak{f}_1 \cap (U \times V)$ and $\mathfrak{f}_1|U = \mathfrak{f}_1 \cap (U \times V_1)$, then the lacuna in the existing theory can be eliminated. Also, we felt that the Fs-Set function is more suitable term in the place of Fs-Function because the values of Fs-functions are Fs-sets. Hence the main interest of this research paper is more about Fs-set functions and their image properties.

The concept of images of Fs-sets generates interesting results in this research paper. Also, we state in this research paper various kinds of Fs-set functions and study their corresponding images.

In this research paper, wherever $\mathcal{U}, \mathcal{V}$ and $\mathcal{E}_i$ are there, we sense $\mathcal{U} = \big(U_1, U, \overline{U}(\mu_{1U_1}, \mu_{2U}), L_U\big)$, $\mathcal{V} = \big(V_1, V, \overline{V}(\mu_{1V_1}, \mu_{2V}), L_V\big)$ and $\mathcal{E}_i = \big(E_{1i}, E_i, \overline{E}_i(\mu_{1E_{1i}}, \mu_{2E_i}), L_{E_i}\big)$. Also, we can see that η is an order homomorphism whenever η is a CBAH. [A] is complete ideal generated by A. ([A]) is equal to the complete sub algebra generated [A] where A is any subset of a CBA. The necessary information to read this research paper we give in section-A [1]. Here [*] stands for reference number.

2 Fs-Set

Let $W \sqsubseteq W_1 \sqsubseteq X$, X is a non-empty universal set. Then a four tuple of the form $\mathcal{W} = \big(W_1, W, \overline{W}(\mu_{1W_1}, \mu_{2W}), L_W\big)$ is an Fs-set iff,

1. L_W is a C B A
2. $\mu_{1W_1}: W_1 \to L_W$, $\mu_{2W}: W \to L_W$ mappings such that $\mu_{1W_1}|W \geq \mu_{2W}$
3. $\overline{W} : W \to L_W$ is defined by $\overline{W}_x = \mu_{1W_1} x \curlywedge (\mu_{2W} x)^c$ for each one $x \in W$

2.1 Fs-Subset

Suppose $\mathcal{W} = \left(W_1, W, \overline{W}(\mu_{1W_1,}\mu_{2W}), L_W\right)$ and $\mathcal{U} = \left(U_1, U, \overline{U}(\mu_{1U_1}, \mu_{2U}), L_U\right)$ are 2 Fs-Sets. We say $\mathcal{U}$ is Fs-Subset of , in symbol, write $\mathcal{U} \sqsubseteq \mathcal{W}$, iff

1. $U_1 \subseteq W_1, W \subseteq U$
2. L_U a Complete Subalgebra of L_W (or) $L_U \leq L_W$
3. $\mu_{1U_1} \leq \mu_{1W_1}|U_1$, and $\mu_{2U}|W \geq \mu_{2W}$

2.2 Remark

For some L_Ω, $L_\Omega \leq L_W$, the specific object $\Omega_\varphi = \left(\Omega_1, \Omega, \overline{\Omega}(\mu_{1\Omega_1}, \mu_{2\Omega}), L_\Omega\right)$ with conditions.

(a) $\Omega \nsubseteq \Omega_1$ or Ω is a empty set
(b) $\mu_{1\Omega_1}x \ngeq \mu_{2\Omega}x$, for some $x \in \Omega \sqcap \Omega_1$ or $\mu_{2\Omega}$ is a void function is called a Type-I void set and is explained by φ_1 and all over this thesis, this specific Ω_φ written by φ_1 and we agree that $\varphi_1 \sqsubseteq \mathcal{U}$, for any Fs - Subset of U.

2.3 Type-II Void Set

If $\mathcal{Y} = \left(Y_1, Y, \overline{Y}(\mu_{1Y_1}, \mu_{2Y}), L_Y\right)$ is Fs-Subset of $\mathcal{U}$, with following properties.

(i) $\mathcal{U} \sqsubseteq \mathcal{W}$
(ii) $Y_1 = Y = W$
(iii) $L_Y \leq L_W$
(iv) $\overline{Y} = 0$ or $\mu_{1Y_1} = \mu_{2Y}$

then, we say that $\mathcal{Y}$ is a Type-II empty set and is denoted by φ_2.

2.4 The Operations Fs-Union (∪)

Let $\mathcal{U} = \left(U_1, U, \overline{U}(\mu_{1U_1,}\mu_{2U}), L_U\right), \mathcal{V} = \left(V_1, V, \overline{V}(\mu_{1V_1}, \mu_{2V}), L_V\right) \sqsubseteq \mathcal{W}$. Then,
$\mathcal{U} \sqcup \mathcal{V} = \mathcal{P} = \left(P_1, P, \overline{P}(\mu_{1P_1}, \mu_{2P}), L_P\right)$ where

(1) $P_1 = U_1 \cup V_1, P = U \cap V$
(2) $L_P = L_U \curlyvee L_V$ = The complete subalgebra generated by $L_U \cup L_V$
(3) $\mu_{1P_1} : P_1 \to L_P$ is explained by $\mu_{1P_1}x = \left(\mu_{1U_1} \curlyvee \mu_{1V_1}\right)x$
$\mu_{2P} : P \to L_P$ is explained by $\mu_{2P}x = \mu_{2U}x \curlywedge \mu_{2V}x$ and
$\overline{P}$: $P \to L_P$ is explained by $\overline{P}x = \mu_{1P_1}x \curlywedge (\mu_{2P}x)^c$

2.5 The Operations Fs-Intersection (∩)

Let $\mathcal{U} = \left(U_1, U, \overline{U}(\mu_{1U_1}, \mu_{2U}), L_U\right)$ and $\mathcal{V} = \left(V_1, V, \overline{V}(\mu_{1V_1}, \mu_{2V}), L_V\right) \sqsubseteq \mathcal{W}$ with the following properties:

(i) $U_1 \cap V_1 \sqsupseteq U \cup V$

(ii) $\mu_{1U_1} x \curlywedge \mu_{1V_1} x \geq (\mu_{2U} \curlyvee \mu_{2V})x$ for every one x belongs to W then $\mathcal{U} \cap \mathcal{V} = \mathbb{Q} = \left(Q_1, Q, \overline{Q}(\mu_{1Q_1}, \mu_{2Q}), L_Q\right)$, where

1. $Q_1 = U_1 \cap,\ Q = U \cup V$
2. $L_Q = L_U \curlywedge L_V = L_U \cap L_V$
3. $\mu_{1Q_1}: Q_1 \to L_Q$ is explained by $\mu_{1Q_1} x = \mu_{1U_1} x \curlywedge \mu_{1V_1} x$
   $\mu_{2Q}: Q \to L_Q$ is explained by $\mu_{2Q} x = (\mu_{2U} \curlyvee \mu_{2V})x$
   $\overline{Q}: Q \to L_Q$ is explained by $\overline{Q}x = \mu_{1Q_1} x \curlywedge \left(\mu_{2Q} x\right)^C$.

2.6 Complete Boolean Algebra (CBA)

A Boolean Algebra L is called a CBA iff sup(A) and inf(A) exist in L for any $A \subseteq L$.

(a) $a \wedge \left(\bigvee_{i \in I} b_i\right) = \bigvee_{i \in I}(a \wedge b_i)$

(b) $a \vee \left(\bigwedge_{i \in I} b_i\right) = \bigwedge_{i \in I}(a \vee b_i)$

2.7 Complete Boolean Algebra Homomorphism (CBAH)

Let A and B be a pair of CBA and $C \subseteq A$. A Boolean algebra homomorphism $f: A \to B$ is said to CBAH iff

$$\text{(a) } f(\text{Inf}(c)) = \text{inf}(f(c)) \quad \text{(b) } f(\text{sup}(c)) = \text{sup}(f(c))$$

2.8 Fs-Complement of an Fs-Subset

Consider Fs-set $\mathcal{W} = \left(W_1, W, \overline{W}(\mu_{1W_1}, \mu_{2W}), L_W\right)$, $W \neq \Phi,$, where

(i) $W \subseteq W_1$

(ii) $L_W = [0, M_W]$, M_W is the biggest element of L_W

(iii) $\mu_{1W_1} = M_W, \mu_{2W} = 0$

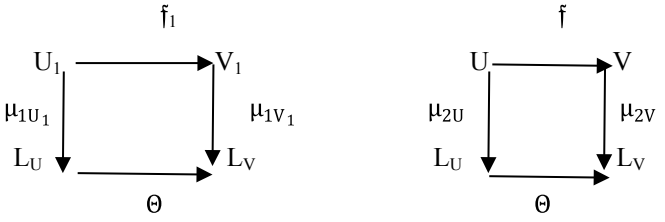
$$\overline{W}x = \mu_{1W_1} x \wedge (\mu_{2W} x)^c = M_W \text{ for each } x \in W$$

Given $\mathcal{V} = (V_1, V, \overline{V}(\mu_{1V_1}, \mu_{2V}), L_V)$. We define Fs-Complement of $\mathcal{V}$ in $\mathcal{W}$, written by $\mathcal{V}^{C_{\mathcal{W}}}$ for $V = W$ and $L_V = L_W$ as $\mathcal{V}^{C_{\mathcal{W}}} = \mathcal{T} = (T_1, T, \overline{T}(\mu_{1T_1}, \mu_{2T}), L_T)$, where

(a′) $T_1 = C_w V_1 = V_1^c \cup W, T = V = W$ where $V_1^c = W_1 - V_1$
(b′) $L_T = L_W$
(c′) $\mu_{1T_1}: T_1 \to L_W$ is defined by $\mu_{1T_1} x = M_W$
$\mu_{2T}: W \to L_W$ is defined by $\mu_{2T} x = \overline{V}x = \mu_{1V_1} x \wedge (\mu_{2V} x)^c$.
$\overline{T}: W \to L_W$ is defined by $\overline{T}x = \mu_{1T_1} x \wedge (\mu_{2T} x)^c = M_W \wedge (\overline{V}x)^c = (\overline{V}x)^c$.

3 Fs-Set Function

For $\mathcal{U} = (U_1, U, \overline{U}(\mu_{1U_1}, \mu_{2U}), L_U)$ and $\mathcal{V} = (V_1, V, \overline{V}(\mu_{1V_1}, \mu_{2V}), L_V) \sqsubseteq \mathcal{W}$, a triplet $\bar{f} = (f_1, f, \Theta): \mathcal{U} \to \mathcal{V}$ is an Fs-set function (with the help of the following diagram) iff



($\bar{f}: \mathcal{U} \to \mathcal{V}$ with figure 3)

(a) $f = f_1 \Big|_U^V : U \to V$ is surjective
(b) $\Theta: L_U \to L_V$ is CH

3.1 Remark

Whenever domain and co domain are CBAs, we use in same sense complete Boolean algebra homomorphism and complete homomorphism between them.

3.2 Proposition

If $\bar{f} : \mathcal{U} \to \mathcal{V}$, then

$$\text{(i) } \mu_{1V_1}|_V \circ f_1 \Big|_{U}^{V} \geq \mu_{2V} \circ f \quad \text{(ii) } \Theta \circ \left(\mu_{1U_1}|_U\right) \geq \Theta \circ \mu_{2U}$$

Proof easily follows.

3.3 Definition of an Increasing Fs-Set Function

$\bar{f} : \mathcal{U} \to \mathcal{V}$ is an increasing Fs-set function explained by $\bar{f}_i : \mathcal{U} \to \mathcal{V}$ iff

$$\text{(a) } \mu_{1V_1}|_V \circ f_1 \Big|_{U}^{V} \geq \Theta \circ \mu_{1U_1} \quad \text{(b) } \mu_{2V} \circ f \leq \Theta \circ \mu_{2U}$$

3.4 Proposition

If $\bar{f}_i : \mathcal{U} \to \mathcal{V}$, then the following statement is correct $\Theta \circ (\mu_{2U}x)^c = [(\Theta \circ \mu_{2U})x]^c$

Proof $\Theta \circ (\mu_{2U}x)^c = \Theta\left[(\mu_{2U}x)^c\right] = [\Theta(\mu_{2U}x)]^c = [(\Theta \circ \mu_{2U})x]^c$

3.5 Proposition

If $\bar{f}_i : \mathcal{U} \to \mathcal{V}$, then $\Theta \circ \overline{U} \leq \overline{V} \circ f$.

Proof easily follows.

3.6 Definition of a Decreasing Fs-Set Function

$\bar{f}: \mathcal{U} \to \mathcal{V}$ is a decreasing Fs-Set Function written by $\bar{f}_d: \mathcal{U} \to \mathcal{V}$ iff

$$\text{(a) } \mu_{1V_1}|_V \circ f_1 \Big|_{U}^{V} \leq \Theta \circ \mu_{1U_1} \quad \text{(b) } \mu_{2V} \circ f \geq \Theta \circ \mu_{2U}$$

3.7 Decreasing Fs-Set Function—A Property

Proposition If $\bar{f}_d: \mathcal{U} \to \mathcal{V}$ then $\Theta \circ \overline{U} \geq \overline{V} \circ f$.
Proof easily follows.

3.8 Preserving Fs-Set Function

$\bar{f}: \mathcal{U} \to \mathcal{V}$ is a preserving Fs-set function written by $\bar{f}_p: \mathcal{U} \to \mathcal{V}$ iff

(a) $\mu_{1V_1}|_V \circ f_1 \Big|_U^V = \Theta \circ \mu_{1U_1}$

(b) $\mu_{2V} \circ f = \Theta \circ \mu_{2U}$

3.9 A Preserving Fs-Set Function—A Property

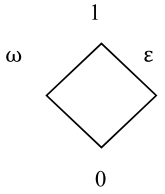
Proposition If $\bar{f}_p: \mathcal{U} \to \mathcal{V}$, then $\Theta \circ \overline{U} = \overline{V} \circ f$.
Proof easily follows.

3.10 An Increasing Fs-Set Function, A Decreasing Fs-Set Function and a Preserving Fs-Set Function-Examples

Increasing Fs-Set function

The following example Stands for an increasing Fs-Set Function.
Let $\mathcal{U} = \left(U_1, U, \overline{U}\left(\mu_{1U_1}, \mu_{2U}\right), L_U\right)$,

$$\begin{aligned}
\mathcal{V} &= \left(V_1, V, \overline{V}\left(\mu_{1V_1}, \mu_{2V}\right), L_V\right) \\
\bar{f} &= (f_1, f, \Theta): \mathcal{U} \to \mathcal{V}, \text{ where} \\
U_1 &= \{d_1, d_2\}, U = \{d_1\}, L_U = L_V \\
V_1 &= \{e_1, e_2\}, U = \{e_1\}, \\
\mu_{1U_1} &= \omega, \mu_{2U} = \omega; \mu_{1V_1} = 1, \mu_{2V} = 0
\end{aligned}$$



$\Theta(0) = 0, \Theta(1) = 1, \Theta(\omega) = \varepsilon, \Theta(\varepsilon) = \omega.$

The following example Stands for an increasing Fs-Set Function.

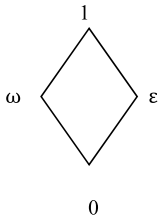
Decreasing Fs-set function

The following example Stands for a decreasing Fs-Set Function

Let $\mathcal{U} = \left(U_1, U, \overline{U}\left(\mu_{1U_1,}\mu_{2U}\right), L_U\right)$,

$$\mathcal{V} = \left(V_1, V, \overline{V}\left(\mu_{1V_1}, \mu_{2V}\right), L_V\right)$$
$$\bar{f} = (f_1, f, \Theta) : \mathcal{U} \to \mathcal{V}, \text{ where}$$
$$U_1 = \{d_1, d_2\}, U = \{d_1\}, L_U = L_V$$
$$V_1 = \{e_1, e_2\}, U = \{e_1\},$$
$$\mu_{1U_1} = 1, \mu_{2U} = 0; \mu_{1V_1} = \varepsilon, \mu_{2V} = \varepsilon$$

$\Theta(0) = 0, \Theta(1) = 1, \Theta(\omega) = \varepsilon, \Theta(\varepsilon) = \omega.$



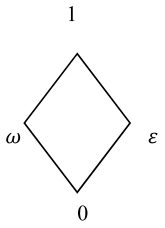
Preserving Fs-set function

The following example Stands for a Preserving Fs-Set Function

Suppose $\mathcal{U} = \left(U_1, U, \overline{U}\left(\mu_{1U_1,}\mu_{2U}\right), L_U\right)$,

$$\mathcal{V} = \left(V_1, V, \overline{V}\left(\mu_{1V_1}, \mu_{2V}\right), L_V\right)$$
$$\bar{f} = (f_1, f, \Theta) : \mathcal{U} \to \mathcal{V}, \text{ where}$$
$$U_1 = \{d_1, d_2\}, U = \{d_1\}, L_U = L_V$$
$$V_1 = \{e_1, e_2\}, U = \{e_1\},$$
$$\mu_{1U_1} = \Omega, \mu_{2U} = 0; \mu_{1V_1} = \varepsilon, \mu_{2V} = 0.$$

$\Theta(0) = 0, \Theta(1) = 1, \Theta(\omega) = \varepsilon, \Theta(\varepsilon) = \omega.$



3.11 Composition

Suppose $\bar{f}:\mathcal{U} \to \mathcal{V}$ and $\bar{g}:\mathcal{V} \to \mathcal{P}$ are two Fs-set functions. Then their composition, given by $\bar{g} \circ \bar{f}:\mathcal{U} \to \mathcal{P}$ is defined as $\left(\bar{g} \circ \bar{f}\right) = (g_1 \circ f_1, g \circ f, \eta \circ \Theta)$.

3.12 Fs-Set functions—Properties of Composition

Suppose $\bar{g} \circ \bar{f}$ exists. Then,

(a) $\bar{g} \circ \bar{f}$ increasing if $\bar{f}$ and $\bar{g}$ are increasing
(b) $\bar{g} \circ \bar{f}$ decreasing if $\bar{f}$ and $\bar{g}$ are decreasing
(c) $\bar{g} \circ \bar{f}$ preserving if $\bar{f}$ and $\bar{g}$ are preserving

Proof easily follows.

3.13 An Observation

$\bar{f}_p$ is always both $\bar{f}_i$ and $\bar{f}_d$ (can be proved easily).

4 Images of fs-subsets

Suppose $\mathcal{U} = \left(U_1, U, \overline{U}\left(\mu_{1U_1}, \mu_{2U}\right), L_U\right), \mathcal{V} = \left(V_1, V, \overline{V}\left(\mu_{1V_1}, \mu_{2V}\right), L_V\right)$,
$\mathcal{P} = \left(P_1, P, \overline{P}\left(\mu_{1P_1}, \mu_{2P}\right), L_P\right), \mathcal{P} \sqsubseteq \mathcal{U}$ and $\bar{f}:\mathcal{U} \to \mathcal{V}$ be an Fs-Set function where

$$P = U \text{ and}$$

$f = f_1\Big|_{U}^{V} : U \to V$ be onto.

We define $\bar{f}(\mathcal{P})$ − Image of $\mathcal{P}$ under $\bar{f}$ as
$\bar{f}(\mathcal{P}) = \mathbb{Q} = \left(Q_1, Q, \overline{Q}(\mu_{1Q_1}, \mu_{2Q})L_Q\right)$, where

1. $Q_1 = f_1(P_1)$
2. $Q = f(P) = f(U) = V$
3. $\mu_{1Q_1}: Q_1 \to L_V$ is defined by

$$\mu_{1Q_1}y = \begin{cases} \mu_{2V}y \curlyvee \left[\mu_{1V_1}y \curlywedge \begin{pmatrix} \curlyvee & \Theta\mu_{1P_1}x \\ y = f_1x & \\ x \in P_1 & \end{pmatrix}\right], \text{if } y \in V \\ \mu_{1V_1}y \curlywedge \begin{pmatrix} \curlyvee & \Theta\mu_{1P_1}x \\ y = f_1x & \\ x \in P_1 & \end{pmatrix}, \text{if} y \notin V \end{cases}$$

4. $\mu_{2Q} : Q \to L_V$ is defined by

$$\mu_{2Q}y = \mu_{2V}y \curlyvee \left[\mu_{1V_1}y \curlywedge \begin{pmatrix} \curlyvee & \Theta\mu_{2P}x \\ y = fx & \\ x \in P & \end{pmatrix}\right]$$

5. $L_Q = \left(\left[\mu_{1Q_1}(Q_1)\right]\right)$ = The complete subalgebra is give rise to $\left[\mu_{1Q_1}(Q_1)\right]$, Where $\left[\mu_{1Q_1}(Q_1)\right]$ = The complete ideal is give rise to $\mu_{1Q_1}(Q_1)$ in L_V.

4.1 Remark

We can easily observe from 2.15 $\mu_{1Q_1}y$, $\mu_{2Q}y$ and $\overline{Q}y \in L_Q$ for any $y \in V$ or $y \in Q_1 - V$ where $L_Q = \left(\left[\mu_{1Q_1}(Q_1)\right]\right)$,

4.2 Image-Properties

Proposition

1. $Q_1 \sqsubseteq V_1$
2. $Q = V$
3. $L_Q \leq L_V$.
4. $\mu_{1Q_1}y \in L_Q, \forall y \in Q_1$

5. $\mu_{1Q_1} y \leq \mu_{1V_1} y$, for each $y \in Q_1$
6. $\mu_{1Q_1} y \geq \mu_{2Q} y$, for each $y \in Q = V$ so that $\mu_{2Q} y \in L_Q$
7. $\overline{Q} y \in L_Q$
8. $\mu_{2Q} y \geq \mu_{2V} y$, for each $y \in V$

Proof easily follows.

4.3 Proposition

$$\bar{f}(\mathcal{P}) \sqsubseteq \mathcal{V} = \left(V_1, V, \overline{V}\left(\mu_{1V_1}, \mu_{2V}\right), L_V\right)$$

Proof easily follows.

4.4 Fs-Set Function—Inclusion Property

Proposition $\bar{f}(\mathcal{P}_1) \sqsubseteq \bar{f}(\mathcal{P}_2)$ whenever $\bar{f}: \mathcal{U} \to \mathcal{V}$, $\mathcal{P}_1 \sqsubseteq \mathcal{P}_2 \sqsubseteq \mathcal{U}$ and $P_1 = P_2 = U$.
Proof easily follows in spite of it takes more number of existing arguments.

4.5 Image of a Type I Void Set

Definition We denote by $\varphi_{\mathcal{W}}$—the image of φ_1 under $\bar{f}$ and $\varphi_{\mathcal{W}} = \Omega_\varphi = \left(\Omega_1, \Omega, \overline{\Omega}\left(\mu_{1\Omega_1}, \mu_{2\Omega}\right), L_\Omega\right)$, where

1. $W \sqsubseteq \Omega_1 \sqcap \Omega$ and $\Omega_1 \not\supseteq \Omega$ or Ω is an void set
2. $\mu_{1P_1} x \not\geq \mu_{2P} x$, for $x \in \Omega_1 \sqcap \Omega$ or μ_{2P} is an void function and $\bar{f}(\varphi_{\mathcal{W}}) = \varphi_{\mathcal{W}}$.

4.6 Proposition

For any family $(\mathcal{P}_i)_{i \in I}$, $\mathcal{P}_i \sqsubseteq \mathcal{U}$, the follow are correct.

(a) $\bar{f}\left(\bigcup_{i \in I} \mathcal{P}_i\right) \sqsupseteq \bigcup_{i \in I} \bar{f}(\mathcal{P}_i)$ (b) $\bar{f}\left(\bigcap_{i \in I} \mathcal{P}_i\right) \sqsubseteq \bigcap_{i \in I} \bar{f}(\mathcal{P}_i)$ Where $\bar{f} : \mathbb{U} \to \mathbb{V}$

Proofs **(a)** $\mathcal{P}_i \sqsubseteq \bigcup_{i \in I} \mathcal{P}$ implies $\bar{f}(\mathcal{P}_i) \sqsubseteq \bar{f}\left(\bigcup_{i \in I} \mathcal{P}_i\right)$ (from 2.17)

which again implies $\bigcup_{i \in I} \bar{f}(\mathcal{P}_i) \sqsubseteq \bar{f}\left(\bigcup_{i \in I} \mathcal{P}_i\right)$ [1]

(b) Case (1) For $\underset{i\in I}{\cap}\mathscr{P}_i = \varphi_{\mathscr{W}}$,

we get $\bar{f}\left(\underset{i\in I}{\cap}\mathscr{P}_i\right) = \bar{f}(\varphi_{\mathscr{W}}) = \varphi_{\mathscr{W}} \sqsubseteq \underset{i\in I}{\cap}\bar{f}(\mathscr{P}_i)$ (from 2.18)

Case (2) For $\underset{i\in I}{\cap}\mathscr{P}_i \neq \varphi_{\mathscr{W}}$,

$\underset{i\in I}{\cap}\mathscr{P}_i \sqsubseteq \mathscr{P}_i \Rightarrow \bar{f}\left(\underset{i\in I}{\cap}\mathscr{P}_i\right) \sqsubseteq \bar{f}(\mathscr{P}_i)$(from 2.15)

which again $\Rightarrow \bar{f}\left(\underset{i\in I}{\cap}\mathscr{P}_i\right) \sqsubseteq \underset{i\in I}{\cap}\bar{f}(\mathscr{P}_i)$ [1].

References

1. Yogeswara V, Biswajit, Reddy SVG (2013) A study of Fs-functions and properties of images of Fs-subsets under various Fs-functions. MS-IRJ 3(1)
2. Yogeswara V, Srinivas G, Biswajit (2013) A theory of Fs-sets, Fs complements and Fs-DeMorgan laws. IJARCS 4(10)
3. Yogeswara V, Rath B, A study of axiom of choice for Fs-sets fuzzy information and engineering. Elsevier Accepted
4. Goguen JA (1967) L-fuzzy sets. JMAA 18:P145-174
5. Givant S, Halmos P, Introduction to Boolean algebras. Springer
6. Szasz G, An introduction to lattice theory. Academic Press, New York
7. Birkhoff G, Lattice theory, American mathematical society, vol xxv. Colloquium Publications
8. Jech T, Set theory, the third millennium edition revised and expanded, Springer book of proceedings: ICCAMEET2017 international conference on contemporary approaches in mathematics and emerging engineering trends, vol 78. ISBN: 978-93-81899-77-9
9. Klir GJ, Yuan B, Fuzzy sets, fuzzy logic, and fuzzy systems: selected papers by Lotfi A. Zadeh. Advances in fuzzy systems applications and theory, vol 6. World Scientific

Offline Handwritten Signature Verification Using Decision Tree

Ashok Kumar and Karamjit Bhatia

Abstract The verification of a signature is an exigent research area as the signatures of two individuals may have similarity whereas the signatures of a person may vary at various circumstances. The accuracy of signature verification framework relies mainly upon the classifier used for the classification process and the feature extraction scheme. Keeping this perspective in sight, the goal of this study is to see how well a decision tree classifier combined with a Local Binary Pattern feature set can be utilized to construct an offline writer-independent signature verification system. To evaluate the system's performance, two signature databases of 100 and 260 writers are used. Genuine signatures as well as random forgery signatures are utilized for the development of the desired system, while genuine signatures, as well as random forgery, unskilled forgery, and simulated forgery are used to test the performance of the developed system. In simulation study, false acceptance rate of 1.00%, 7.00% and 11.00% for random, unskilled, and simulated forgery signatures, respectively is obtained whereas the false rejection rate of 0.00% is achieved using Local Binary Pattern features.

Keywords Decision tree · Writer-independent approach · False acceptance rate · Offline-signature verification · False rejection rate · Local binary pattern features

1 Introduction

The signature of a person is regarded as an acknowledged biometric trait. An individual signature can be used to verify and authenticate his or her personal identity as well as the document's legitimacy [1]. The Handwritten-Signature-Verification (HSV) system can be used to validate the authenticity and genuineness of a signature. The forgeries set is generally separated into three forgery subsets for creating

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Fig. 1 Genuine and its corresponding forgery signatures

the offline HSV system: random forgery, unskilled forgery, and simulated forgery. Figure 1 depicts a writer's genuine signature and its accompanying random forgery, unskilled forgery, and Simulated forgery.

The performance of an offline HSV system is evaluated using the "False-Acceptance-Rate (FAR), Average-Error-Rate (AER), and False-Rejection-Rate (FRR)" performance measures [2]. FRR stands for the percentage of real signatures that are identified as forgery signatures, whereas FAR stands for the percentage rate of forgery signatures that are recognized as genuine signatures. The AER is calculated by taking the mean of the FAR and FRR. Random Forgery (FARR) signatures, Unskilled Forgery (FARU) signatures, and Simulated Forgery (FARS) signatures are used to calculate FAR in this work [3].

To build the offline/online HSV systems, researchers used Writer-Dependent (WD) as well as Writer-Independent (WI) techniques [2]. In WD approach, a personal model (also called specific model) is constructed for every writer. In contrast, using the WI technique, an alternative model (also called global model) is constructed to cope with signatures from all writers, and the resulting model is capable of classifying new writer signatures without retraining [4]. Figure 2 illustrates a Writer-independent offline signature verification mechanism [5].

In the writer-independent technique, the Dissimilarity Feature Vectors (DFVs) of the questioned-signature (q) is compared with DFVs of the reference signature samples *refk* to determine whether it is genuine or forged. Dissimilarity concept was proposed by Pękalska [6], which said that dissimilarities should be maximal for the things of different classes and minimal for things of the same class. The difference between refk and q is passed to a classifier to make a partial judgement and finally, fusion procedures are employed to arrive at a final judgement from a collection of partial decisions.

In this proposed work, WI offline HSV system is developed by using Local-Binary-Pattern (LBP) features. The LBP features are one kind of pseudo dynamics features which extract the local characteristics of signature image. The local features are more suitable to differentiate the genuine and simulated forgery signatures as

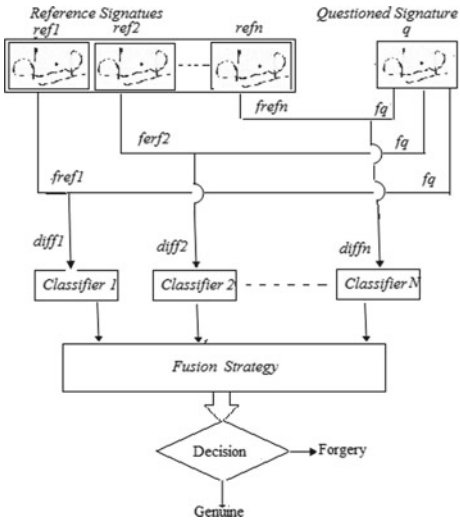

Fig. 2 Writer-independent technique for offline HSV system

local features can discriminate the signature images of negligible variations [7]. As a result, in this research, LBP features are proposed for developing the WI approach based offline HSV system.

The present work is devoted to device an approach with following objectives:

- to absorb unfamiliar writers' handwritten signatures without retraining,
- to minimize the FRR and AER through decision tree classifier system, and
- to study the efficacy of LBP features for developing an offline HSV.

The novelty of this work is two-fold. First, the fitness of LBP features in designing an offline HSV system using WI approach is probed as these features are capable of distinguishing the images with minor variation, and second, the usefulness of decision tree classifier in development of a WI approach based offline HSV system using is investigated.

2 Literature Review

Several researchers have contributed towards the development of WD approach based offline HSV system and significant work is reported in literature for such systems using LBP feature set. Initially, Wang and He [8] proposed the LBP features for the texture classification. The LBP feature set along with the Local-Directional-Pattern feature set was used by Ahlawat et al. [7], Hiremath [9], Madhavi et al. [10] and Mathew and Chandra [11] to construct the WD offline systems. To develop the LBP features based offline system by using the WD approach, different classifiers are used

by researchers for classification process such as the k-NN classifier was utilized by Pal et al. [12], Vickram and Swapna [13], Patki and Dhole [14]. The Support Vector Machine (SVM) classifier along with LBP feature set was used by Ramesh and Nageswara [15], Singh and Kaur [16] and Wajid and Mansoor [17] to develop the WD offline system. All above-mentioned researchers used single classifier system to develop the WD offline system.

Literature study reveals that the WI approach for constructing an offline HSV system is not addressed by the researchers. Initially, Santos et al. [18] proposed the WI approach for the offline HSV system. An ensemble of the SVM classifiers and GF set was used to construct the HSV system by Bertolini et al. [2]. They reported FRR of 11.32%, FARR of 4.32%, FARU of 3.00%, and FARS of 6.48%. Batista et al. [19] used pixel density features along with SVM classifier and claimed FRR of 8.33%, FARR of 0.50%, FARU of 0.50%, and FARS of 15.50%. Dominique et al. [20] used stroke in addition to Spatial Distribution (SD) features and obtained FRR of 9.77%, FARR of 0.02%, FARU of 0.32%, and FARS of 10.65% through SVM classifier. The features related to the texture and signature shape were utilized by Kumar et al. [21].

Literature survey reveals that different feature sets, as mentioned above, are considered by the researchers while designing offline HSV system using WI approach. However, it is found that LBP features are not given due attention by researchers in the development of such systems using WI approach. The present study focuses on exploring the effectiveness of Decision Tree (DT) classifier system with LBP feature set for the development of WI approach based offline HSV system.

3 Research Methodology

The major steps to develop the WI approach based HSV system are creation of signature database used for training and testing, preprocessing and feature extraction, the creation of DFV set, and the classifier system's training and testing.

3.1 Signature Database

Two signature databases (SD-100 and SD-260) are used in verification of signatures. Database utilized in research contain the genuine, unskilled forgery, and simulated forgery signatures. Signatures of the 60 Individuals and 40 Individuals of the SD-100 are utilized for training and testing process, respectively, whereas SD-260 separated into 160 and 100 Individual's signatures for the training and testing. To accomplish the training/testing process, six genuine, four unskilled forgery, and four simulated forgery samples of the signature per writer are utilized.

3.2 Preprocessing and Feature Extraction

A median-filter is utilized to eliminate noise from the signature-image during the pre-processing step. The grey level signature image is then converted to a binary image. After that, the signature image is cropped and scaled to 256 × 512 pixels. The intensity value of the central pixel is compared with the intensity value of 8 pixels in a 3 × 3 window lying on a circular path of radius 1 in the neighborhood in an anticlockwise orientation to extract the LBP features. The feature vector of 256 length is produced in this manner.

3.3 Creation of DFV Set

The positive (genuine) plus negative (forgery) Dissimilarity Feature (DF) vector subsets are utilized to train the classifiers. The Positive Feature Vector (PFV) subset is obtained by calculating the dissimilarity between six signatures (genuine) per writer; consequently, 15 different combinations are found. In this manner, 900 PFVs are produced from the 60 writers for the SD-100 signature database. Likewise, 2400 PFVs from the 160 writers are produced for the SD-260 signature database.

Only random forging signatures are used to create the Negative-Feature-Vector (NFV) subset in this study. The dissimilarity among the four genuine-signatures of the five writers and the four genuine-signatures of fifty writers is computed to build the NFV subset for the SD-100 signature database. As a result, 1000 negative feature vectors are generated. The dissimilarity among the four genuine-signatures of the five writers and the four genuine-signatures of 140 writers is computed to create the NFV subset for the SD-260 signature database. 2800 negative feature vectors are obtained in this manner. Thus, Dissimilarity Feature (DF) vector set of total 1900 (900 PFVs plus 1000 NFVs) DF vectors for the SD-100 signature database and DF vector set of 5200 (2400 PFVs plus 2800 NFVs) DF vectors for the SD-260 signature database are utilized to train the classifiers.

3.4 Classifier System's Training and Testing

The classification system is developed by using the DT classifier to classify the questioned signature. The DF vector sets of 1900 DF vectors and 5200 DF vectors are utilized to train the classifier system. Then, all trained classifier system is utilized to classify the genuine, simulated forgery, unskilled forgery, and random forgery samples of signature of the test set. To classify the test set signatures, "3, 5, 7, 9, 11, 13, and 15" references are used. The performance is assessed by means of the FRR, FARR, FARU, and FARS.

4 Experimental Results

MATLAB 2013a is used to conduct the experiments. Experiments are conducted with "3, 5, 7, 9, 11, 13, and 15" reference signatures. The partial decisions of the classifiers are merged using the mean fusion approach. In the current technique, the writers involved in the training step are not involved in the system's testing phase.

Tables 1 and 2 show the performance of DT classifiers on the SD-100 and SD-260 signature databases, respectively. The performance is presented in terms of FRR, FARR, FARU, and FARS. Table 3 shows the results of a comparison of proposed and existing WI offline systems. The performance of proposed WI offline systems is compared only those existing WI offline systems whose performance was reported in FRR, FARR, FARU, and FARS performance matrices. Figures 3 and 4 illustrate the elapsed time of all reference signatures for the SD-100 signature database and the SD-260 database, respectively. Experiments were conducted on a configuration of 4 GB RAM with core 2 dual processor system and time elapsed in experiment is recorded for training/testing of the classifier systems. The elapsed time supposed to differ due to the configuration of the system.

It is observed that the required elapsed time is increasing if number of reference signatures are increasing for both signature databases. It is also observed that the

Table 1 Performance of the DT classifier in FRR, FARR, FARU, and FARS for SD-100 signature database

RS	FRR (%)	FARR (%)	FARU (%)	FARS (%)
3	10.00	17.50	7.50	22.50
5	5.00	12.50	15.00	22.50
7	5.00	2.50	7.50	20.00
9	5.00	2.50	10.00	30.00
11	2.50	0.00	10.00	30.00
13	2.50	0.00	10.00	32.50
15	0.00	0.00	7.50	35.00

Table 2 Performance of the DT classifier in FRR, FARR, FARU, and FARS for SD-260 signature database

RS	FRR (%)	FARR (%)	FARU (%)	FARS (%)
3	2.00	5.00	9.00	14.00
5	1.00	3.00	7.00	15.00
7	0.00	1.00	8.00	13.00
9	0.00	1.00	9.00	10.00
11	0.00	0.00	9.00	12.00
13	0.00	0.00	8.00	12.00
15	0.00	1.00	7.00	11.00

Table 3 Comparative results of existing and proposed WI offline systems

S.No.	Authors	Classifier	Feature set	FRR (%)	FARR (%)	FARU (%)	FARS (%)	AER (%)
1	Bertolini et al. [2]	Ensemble of SVM	GF	11.32	4.32	3.00	6.48	6.28
2	Batista et al. [19]	Ensemble of SVM, Gentle AdaBoost	Pixel Density	8.33	0.50	0.50	15.50	6.21
3	Dominique et al. [20]	Ensemble of DT	Stoke, SD	9.77	0.02	0.32	10.65	5.19
4	Kumar et al. [21]	MLP-ANN, Ensemble of SVM-RBF	Texture, Shape	8.33	-	-	8.33	8.33
5	Proposed approach	Decision Tree	LBP	0.00	1.00	7.00	11.00	5.00

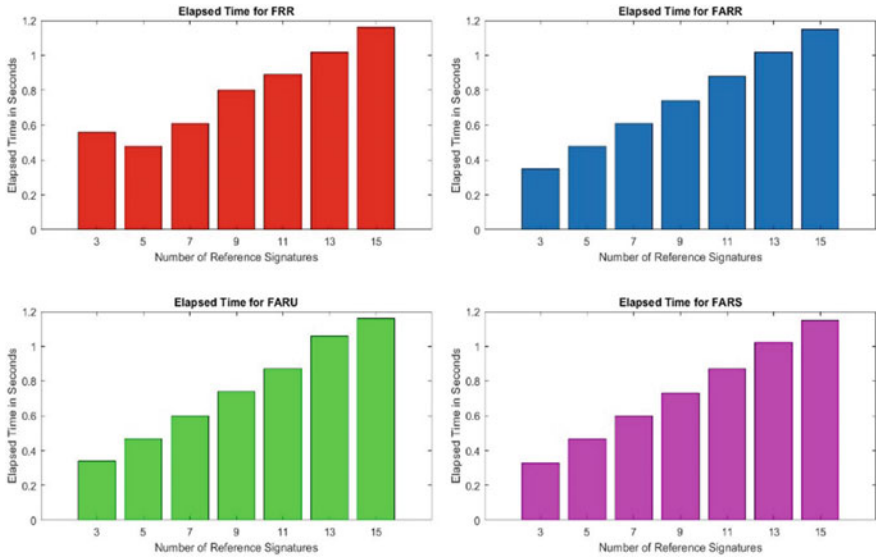

Fig. 3 Elapsed time of all reference signatures for SD-100 signature database

required elapsed for SD-260 signature database is more in comparison to the SD-100 signature database.

In the performance evaluation process of the SD-260 and SD-100 signature databases, it is detected that the performance of the SD-260 database in terms of FRR, FARR, and FARS is better than the SD-100 database, but in terms of FARU, the SD-100 database performance is slightly better than SD-260 database. The FRR of 0.00%, FARR of 1.00%, FARU of 7.00%, and FARS of 11.00% is given by the

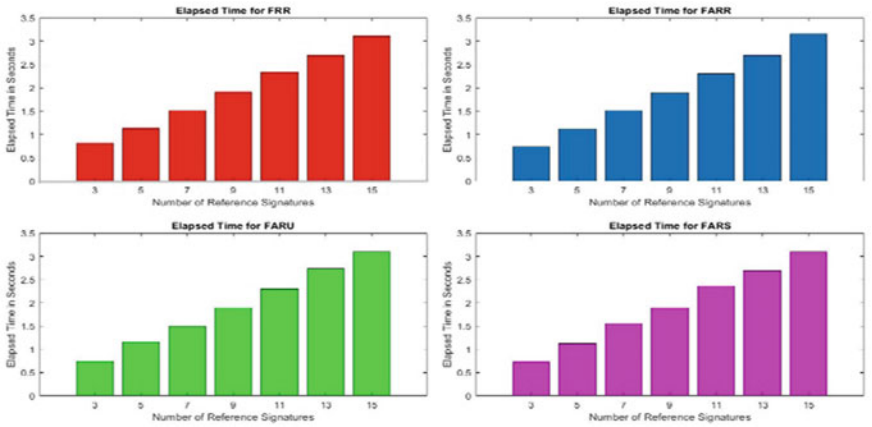

Fig. 4 Elapsed time of all reference signatures for SD-260 signature database

DT classifier as the best result by using the 15 reference signatures for the signature database SD-260.

According to the findings of the study, increasing the number of reference signatures and writer signatures, the performance of WI offline HSV system may be improved in terms of FRR, FARR, FARU, and FARS but elapsed time is also increasing.

5 Conclusion

The performance of a DT classifier trained using the LBP feature set is evaluated in this paper utilizing two signature databases. The writers that participated in the testing procedure are not part of the training. The DT classifier employed in the study was able to classify the signatures in the testing set without the need for retraining, meaning that the proposed classifier system for WI offline signature verification can absorb the signature of a new writer without the need for retraining. Experiments showed that classification accuracy of the classifiers for the SD-260 signature database is superior to the SD-100 signature database. From the foregoing, it can be stated that increasing the writer's number in the training and testing processes will improve the system's classification accuracy in terms of FRR and FAR.

The suggested classifier system outperforms the existing WI offline HSV systems in terms of FRR as well as AER, as shown in the comparison table of the proposed and existing WI offline HSV systems. In summary, by combining the DT classifier with the LBP feature, an effective WI offline HSV system can be created.

References

1. Kumar A, Bhatia K (2016) A survey on offline handwritten signature verification system using writer dependent and independent approaches. In: 2nd international conference on advances in computing, communication, & automation (ICACCA). IEEE, Bareilly, pp 1–6
2. Bertolini D, Oliveira LS, Justino E, Sabourin R (2010) Reducing forgeries in writer-independent off-line signature verification through ensemble of classifiers. Pattern Recogn 387–396
3. Justino EJ, Bortolozzi F, Sabourin R (2001) Off-line signature verification using HMM for random, simple and skilled forgeries. In: International conference on document analysis and recognition. IEEE, pp 1031–1034
4. Sharma N, Gupta S, Mehta P (2021) A comprehensive study on offline signature verification. J Phys Conf Series 1–17
5. Kumar A, Bhatia K (2018) Multiple classifier system for writer independent offline handwritten signature verification using hybrid features. Int J Comput Inf Syst Ind Manag Appl 252–260
6. Pękalska E, Duin RP (2002) Dissimilarity representations allow for building good classifiers. Pattern Recogn Lett 943–956
7. Ahlawat S, Goel A, Prasad S, Singh P (2014) Offline signature verification using local binary pattern and octave pattern. In: 5th international conference on graphic and image processing. IEEE, China
8. Wang L, He D-C (1990) Texture classification using texture spectrum. Pattern Recogn 905–910
9. Hiremath G (2016) Verification of offline signature using local binary and directional pattern. Int J Innov Sci Eng Technol 76–80
10. Madhavi M, Yaram MR, Krishnaiah RV (2012) Effective implementation techniques in offline signature verification. IOSR J Comput Eng 25–30
11. Mathew DC, Chandra N (2015) Implementation of offline signature verification based on LBP and LDP techniques on beagle board XM. Int J Eng Res Gen Sci 357–363
12. Pal S, Alaei A, Pal U, Blumenstein M (2015) Performance of an off-line signature verification method based on texture features on a large Indic-script signature dataset. In: 12th IAPR international workshop on document analysis systems. Greece, pp 1–6
13. Vickram P, Swapna AK (2016) Off-line signature verification using support local binary pattern. Int J Artif Intell Appl 85–94
14. Patki P, Dhole N (2016) Offline signature verification using local binary pattern. Int J Adv Res Sci Manag Technol 1–4
15. Ramesh P, Nageswara P (2013) Handwritten signature verification based on the use of gray level values. Int J Image Process Vis Sci 50–56
16. Singh S, Kaur A (2014) Off-Line signature verification using sub uniform local binary patterns and support vector machine. In: International conference on chemical engineering and advanced computational technologies. IEEE, South Africa, pp 93–100
17. Wajid R, Mansoor AB (2013) Classifier performance evaluation for offline signature verification using local binary patterns. Europan workshop on visual information processing. IEEE, Paris, pp 250–254
18. Santos C, Justino E, Bortolozzi F, Sabourin R (2004) An offline signature verification method based on the questioned document expert's approach and a neural network classifier. In: 9th international workshop on frontiers in handwriting recognition. IEEE, Japan, pp 498–502
19. Batista L, Granger E, Sabourin R (2010) Applying dissimilarity representation to off-line signature verification. In: 20th international conference on pattern recognition. IEEE, USA, pp 1293–1297
20. Dominique R, Granger E, Sabourin S (2013) Multi feature extraction and selection in writer independent offline signature verification. Int J Doc Anal Recogn 83–103
21. Kumar R, Sharma J, Chanda B (2012) Writer independent offline signature verification using surroundedness feature. Pattern Recognit Lett 301–308

IoT in Healthcare in Times of Pandemic (COVID-19)

Humra Yusuf and Suhail Javed Quraishi

Abstract The novel corona virus (COVID-19) has created a challenge for health experts and doctors to take control of the current situation. There has been continuous research made worldwide to combat this global public health crisis. The infectious cases have already crossed over 223 million cases as per WHO, so far. Internet of things (IoT) is one of the main tools that have to break the ground with its numerous benefits. The IoT has changed the outlook of the modern healthcare system. Various devices embedded with the internet are used to minimize the spread of COVID-19. These devices help in early diagnosing, performing necessary procedures, and monitoring patients' health. This paper outlines the role of IoT based technologies as to how it is used for combating the novel severe respiratory syndrome corona virus-2 and also proposes a better solution for the patients to identify the efficient healthcare unit when suffering from a health issue. This helps the common man to identify which healthcare unit is specialized in treating them.

Keywords COVID-19 · Health crisis · WHO · IoT · Respiratory syndrome

1 Introduction

A good health is the main part of our life upon which every other part relies. Without a good health, a person cannot achieve anything. So when it comes to the care of our health no one wants to compromise over it. The internet of things has been a phase changing story in the healthcare unit. The boons of IoT have now made it the need of the hour to implement it in almost every field of human life. With the advancement in various technologies there has been a rapid growth in the chronic diseases in humans over time. The nature has always challenged the science and advancement. After 1918 pandemic influenza outbreak, in 2020 COVID-19 has disturbed the normal lives of

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humans. It has impacted the daily life too much, that it seems to be impossible to return back to normal shortly. So with the adoption of IoT in healthcare there is a wide range of opportunities for the health experts to prepare for the new normal. The coronavirus spread very rapidly as it is highly contagious. The patients suffering from this disease are advised to keep a distance from others in order to lower the risk of spreading the virus which has led to a new concept of social distancing i.e., keeping a distance of 2 mts. between people. This social distancing is the root cause, why every industry suffered a loss such as the aviation and tourism industry, automobile industry and many more. Every industry suffered a huge loss during this hard time of pandemic. The entire world is continuously trying to defeat this devastating virus. But at the same time, there was huge burden and double load over the healthcare industry. The hospitals were expected to work extraordinarily to treat maximum number of patients. Coronavirus impacted almost every field of the human lives. It has a huge impact over human lives and it has enforced a significant change in the priorities, activities and policies of almost every one, be it a human, organization or even government. This situation however has opened many doors for sensor based industries for discovering new perks. Sensors have made easier for the people to step out of the worst part of the pandemic. This outbreak has changed the opinion and perception of IoT now and forever [14]. IoT not only made the remote diagnosing of the symptoms easier but also helped in treating the infected person remotely [9]. The medicines and several medical equipments were easily delivered easily even to the remote areas. The patients were easily treated through IoT embedded devices and interconnected networks. There are many applications of IoT at the time of the outbreak. Some of them are:

Telehealth Consultant: In order to minimize the mass rush at the healthcare centre, the physicians and the doctors remain connected with their patients through video chats and other means. This was all possible through IoT. This also lessened the physical contact of the doctors with the infected person [7].

Digital Diagnostics: Various digital devices launched in the market has helped in digital diagnostics. Smart thermometers as compared to traditional thermometers in one such example.

Remote Observation: The deadly virus can be worst in case of elderly patients who are already suffering from some kind of diseases. So monitoring the health of such patients remotely can be done easily through IoT [7, 14].

Robotic Aid: Use of IoT robots is now a common trend. These robots are used to do various tasks such as deploying them at the hospitals for carrying the tasks such as disinfecting the hospitals and many more.

Drones: Drones are the simple aircraft that are operated by remote monitoring. These devices require very less or no human intervention. Disinfectant drones, surveillance drones, announcement and medical drones are the kind of drones that can be deployed at healthcare domain.

Wearables: Wearables devices can be defined as anything that has been embedded with the sensors and that can be wore. These devices receive and process the input while they are stick or is worn by the patient. Eg.: bands, glasses and watches [8].

IoT Buttons: Small programmable button that is connected to cloud through wireless communication is termed as an IoT button. Different repetitive tasks can be performed using this IoT button based on the kind of code written for it. They can be used by a patient for alerting the hospital staff at times of emergency.

IoT not only provided aid in healthcare sector at time of the pandemic but also made its place in other field. Some of the fields are listed below:

Work from home and IoT: The sudden outbreak pushed the adoption of IoT for the employees to work from home. All the work units were forced to shut down in order to avoid the spread of the virus. Remote working has now widely adopted by the different companies as is likely to continue for the few upcoming years (Fig. 1).

Blockchain and IoT: Blockchain secured the data which is carried all the way down to the doctors and other authorities through various applications. Blockchain help people to share the real time data. Different parties act as nodes connected across a network in a secured network. It is assumed that adoption of block chain for sharing the data may have reduced so much of pain and death caused due to COVID-19 [11, 12].

E-Commerce and IoT: At the time of the lockdown the sellers and the wholesalers suffered huge loss. But IoT turned into a means of delivering essential services to the consumers more transparently.

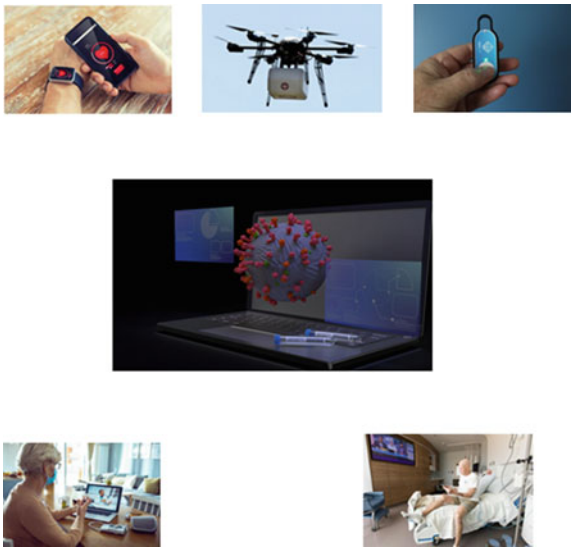

Fig. 1 IoT in healthcare in the pandemic time

Fig. 2 IoT in the other fields during pandemic time

According to the studies it has been predicted that by 2023, the sensor market not just for only healthcare sector but for all verticals, is expected to grow by 42% (Fig. 2).

1.1 Understanding the Spread of Deadly Virus

In this section, we will better understand as how COVID-19 spreads. How this deadly virus move from on individual to another? How an infected person affects the others? What is the setting in which the virus spreads? Coronavirus is a respiratory pathogen, a respiratory virus. So, most of the people who are suffering from this virus, tend to have these similar respiratory disorders. The virus can be spread by droplets that come out of a person's mouth or nose when the person talk, sneeze, sing or cough when he/she is in close proximity to someone else. These particles coming out can vary in the size. They could be larger or they could be smaller. The larger droplets tend to drop more quickly and the smaller one can remain suspended in the air for a little bit longer. This virus transmits more quickly when an infected person is in close contact with somebody else and these infectious droplets get into the eyes or mouth of non-infected person. Another way, in which this virus can transmit is through contaminated surfaces. The infectious droplets remain on the surface for a long period of time, and if someone touches those surfaces and the touches their eyes, mouth or nose, they can infect themselves if they have not washed their hands. But the good news is, if a person washes their hands, if you keep physically distanced from people, they can prevent that from happening.

When this virus spreads? It is important to understand that people can transmits this virus even when they do not have any symptoms. So it is possible that a person is infected with the virus and not yet has developed any symptoms. Also the infected

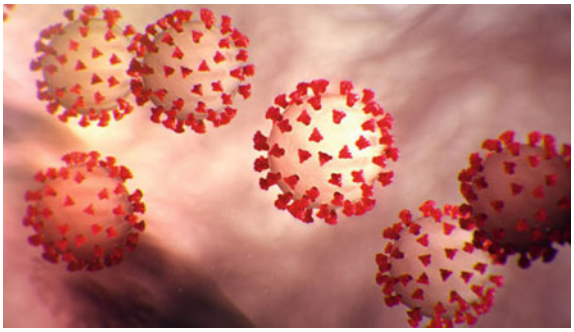

Fig. 3 Corona virus

person can pass the virus when they do have symptoms. It appears that most people are infectious at times when they develop the symptoms. It includes a few days before they actually got sick or actually starts to feel unwell.

The setting in which the virus spreads is the combination of the intensity of the exposure somebody has, the duration of exposure they may have to an infected individual and then the location where this all is taking place. This increases the risk of spreading the virus at the crowded places where are people are very close to one another, they spend long period of time in that crowded place that may not have good ventilation. This scenario is a good example of where transmission can take place readily (Fig. 3).

2 Related Literature

In the upcoming years, IoT is going to transform our lives completely by fighting the deadly coronavirus. This paper discusses the analysis and give proposal in order to control the outbreak, their challenges and limitations.

Yousif et al. [1], discussed as how IoT can be adapted by the population at large with improved security and privacy. Their main motive of their paper is to provide a deeper analytical view of the categorization of the IoT in various sectors. A thorough study was done by using various sources of literature. Different challenges and limitations faced by the IoT in different sectors is also brought up in the paper.

Siddiqui et al. [2], focuses largely on how social distancing can be maintained amongst the public by giving a proper strategy and a multi-layered IoT architecture. Various challenges associated with each layer of architecture and their respective solution has been presented.

Umair et al. [3], in their paper they presented a thorough literature view of how IoT has been adopted by various firms and organization. They integrated with various leading consulting organizations and prepared a report. They, however also gave some of the initiatives as how the use of IoT can be accelerated in numerous fields

by addressing the limitations that may arise. The paper highlights many important points in wake of COVID-19.

Akbarzadeh et al. [4], the main motive of their paper is to propose a new initiative in the smart buildings in wake of coronavirus as how the hospitality level and number of guests can be maximized. This initiative is also helpful in future pandemics in places like hotels, healthcare units, conferences halls, etc. They give the proposal as how the number of attendees can be managed in the respective by online appointments, navigating them online and also managing the physical queue by handling everything over the internet. This indeed is the best solution at the time of the pandemic as to avoid the public gatherings and their physical contact. Further, in the future some more innovation can be done to the proposal. This paper highlights every issue related to the smart buildings based on the data collected by various IoT sensors in the network. This data collected is stored in the servers and facilitating the users at the time of requirement.

Mukhtar et al. [5], in the paper proposed a medical device embedded with sensors for remote monitoring. It also kept a check over the people who have symptoms of this virus and of those who are already suffering from it. The device is embedded with the sensors integrated with the Arduino hardware interface and a smartphone application. The proposed medical device uses various human body symptoms such as heartbeat, cough, temperature and oxygen concentration (SpO2) to determine the health status of the patient. This device proved to be very useful in quickly identifying the virus infected patients. It also facilitates the healthcare experts to inspect their patients for the virus without coming in contact with them in order to reduce the risk of the infection. In the entire paper specifications and explanation about the sensors, the medical device, IoT framework, the smartphone application is given.

Nasajpour et al. [6], their paper highlights various phases of the deadly coronavirus. Through their theory they gave solution as how the technology can be used to combat the virus in three main phases i.e., early diagnosis, the restraining period (quarantine) and also post recovery. Through various devices the symptoms can be detected at a very early stage and thus the spreading of the virus can be minimized. After the detection of the virus, the suspect is quarantined and thus the IoT based devices are used to monitor their health remotely. In the last they have brought up the solution that how IoT is used to control the situations even after the recovery (Table 1).

The paper mainly focuses on the different countries fighting with the deadly virus. We collected the data from various sources and consized. Many countries were developed enough to take control of the situation through different IoT techniques but some countries faced terrible situations because of the limited sources and proper knowledge of IoT [15].

The numerous theories given in respect of role of IoT in the time pandemic has ease the load over the healthcare experts.

Table 1 Summary of few of the work done

Year	Paper	Aim	Highlights
2021	Yousif et al.	IoT adopted by different sectors with improved security and privacy	Deeper analytical view, potential research directions for next generation
2021	Shama et al.	Proposal of multi-layered IoT structure for better maintain better social distancing	Short and long term strategy to manage the methodology, challenges associated with different layers have been discussed
2021	Mohammad Umair et al.	Literature review of adoption of IoT by various firms and organization	How IoT use can be accelerated, highlighted the challenges that need to be addressed in wake of IoT adoption
2021	Omid Akbarzadeh et al.	To propose new initiative in the smart building in times of pandemic	Maximize hospitality level by managing the masses online
2021	Hamid Mukhtar et al.	To build a medical device for remote monitoring	Use of arduino based hardware interface, quick identification of infected people
2020	Mohammad Nosajpur et al.	Combating the virus through IoT technology in three different phases	Quick and early detection of virus infected patients, remote monitoring

3 Challenges for IoT in Healthcare

As the technology seems to grow with time, there is a lot of study which shows that many organization and humans are exposed to the unethical development practiced by those who are misusing the technology. These individuals use the technology in the wrong way and thus abuse others. A thorough knowledge of the cyber security should be given to both the organization and the individuals [10, 11, 13].

The study shows that these cyber-attacks are ruining our personal lives by various means. In regards of these malpractices, it is very necessary to have a comprehensive knowledge of these cyber threats and attacks.

Moving further, the next challenge to IoT technology is that the most IoT devices do not have a good battery life. Due to the limited battery life, these devices cannot be used for long duration and extended distances in case of drones and robots. Robots who are sent in the remote areas to collect the sample or to provide essential services needs to have good battery life so as to carry out the whole task efficiently.

In addition to this, the next challenge to IoT technology is its adoption by the common public. All the advancements and progress done by IoT in healthcare field is of no use until or unless it is completely entrusted and adopted by common men, health professionals and patients.

4 Suggestions and Future Directions

The aim of this paper is to focus on the engagement of IoT in the field of healthcare during the times of COVID-19. In this paper, various researches done by the researches and their consideration of research in context of their professionals practice have been explained.

Imagine a truly modern healthcare system, which is accessible to all from the comfort of your home. A system that utilizes net of things allowing us to monitor our health, share data with our care providers and alert others when we are in need embedding intelligent functionality into our homes. It would allow patients to be monitored around the clock, built-in sensors track movement from inside the home alerting family or emergency services when needed [7, 16]. Also wearable technology embedded into clothing could track a wide range of patient parameters and provide a conditional assessment. This technology has the potential to displace invasive testing methods, thus eventually saving time and money. These advancements in technology are enabling the production of targeted medicines that can fit the needs of the patients thus increasing success rates. This also reduces side effects and home treatment such as light therapy can offer non-invasive solutions for many possibilities to become a reality. This all has improved the overall processes of entire healthcare system (Fig. 4).

The above graph shows the graph between the total cases and total recovery cases across the world. The data is the analysis of the continents: Europe, North America, Asia, South America, Africa, and Oceania. The data is as per 3rd of October 2021.

The conclusion is made that the gap between the total cases and the recovery was the minimum in the countries of Africa i.e., 1 million. The total cases in Africa are 8 million with the recovery of 7 million. On the other hand this gap of total cases and total recovery was the maximum in the countries of North America. North America has the total cases reaching to 53 million with the recovery of just 41 million populations.

The IoT technology has helped to avoid the spread of coronavirus across the globe. The great lesson learned from the theory is that the different countries should act

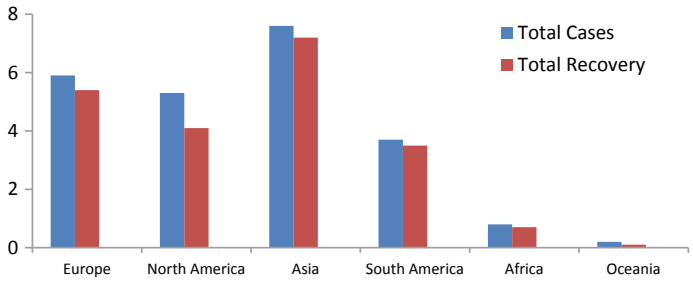

Fig. 4 The total cases and total recovery cases across the world

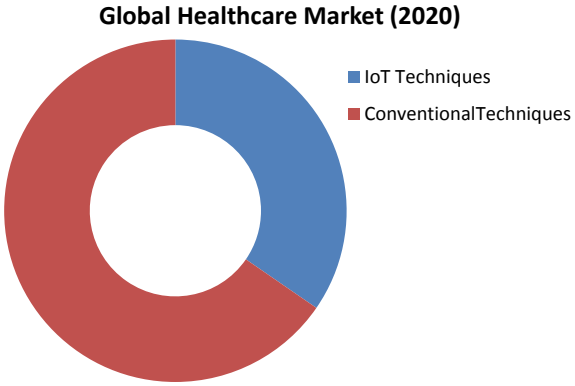

Fig. 5 Global health monitoring

positively, decisively, and responsibly to execute the crucial preventive measures in the structure of healthcare.

At the work places, proper screening system should be installed to detect the infected person. These screening kits are no-touch detection kits which are easily portable.

Furthermore, in order to avoid the rush and control the mass gathering at various public places, checking of the vehicles can be done by the officials. Measuring capacity levels and social distancing should be kept in the consideration.

Air quality of the cities should be regularly checked as the clean and pollution free atmosphere will eventually help to eliminate the virus with time.

Based upon end-users, the healthcare segment holds a share of about 34.6% in 2020. Still 65.4% of the patient care and health monitoring involves conventional methods (shown in Fig. 5).

This share is expected to grow and dominate in the upcoming years. It is expected to grow up to $332.67 billion by 2027.

IoT technology has helped to loosen the load over the healthcare system thus combating the deadly virus. This evolving technology will help the people to get back to their normal lives soon. The correlation of the digital and physical world is more necessary than ever. It will lead to the analysis of the real world with the objective data, and apply those factors to trigger the alarm and also establish lucid actions.

5 Conclusion

The IoT in healthcare sector has accelerated the growth of this area. Some of the rising skills of the upcoming years are going to be creativity, collaboration, and interpersonal dynamics between people. Teamwork and specialized healthcare roles

are the things that are actually at the forefront of how people relate to each other. We need to deploy technology across all of that. But, this all is going to be a combination of being digital and also being very human. The governments of the different countries needs to change their agendas and policies to ensure the better health conditions and improved health quality. The common masses should be given proper knowledge of IoT techniques and their adoption. The better services and knowledge should be availed to the population in one-stop shop so that they should not render in search of it during these hard times of COVID-19.

Over the last few years, different organizations have collaborated with the health-care sector from clinical research to independent living and remote patient monitoring. This has all transformed through internet of things creating new care modals and has improved decision-making. It has helped in providing continue health care and dramatically reduced costs. Eventually people live longer and healthy. With advancements in technology, new approaches to patient care and new methods of monitoring are coming into picture. This is how we can remain safe today and tomorrow.

References

1. Yousif M, Hewage C, Nawaf L (2021) IoT technologies during and beyond COVID-19: a comprehensive review. Future Internet 13:105. https://doi.org/10.3390/fi13050105
2. Siddiqui S, Shakir MZ, Khan AA, Dey I (2021) Internet of things (IoT) enabled architecture for social distancing during pandemic. Front Comms Net 2:614166. https://doi.org/10.3389/frcmn.2021.614166
3. Umair M, Cheema MA, Cheema O, Li H, Lu H (2021) Impact of COVID-19 on IoT adoption in healthcare, smart homes, smart buildings, smart cities, transportation and industrial IoT. Sensors
4. Akbarzadeh O, Baradaran M, Khosravi MR (2021) IoT-based smart management of healthcare services in hospital buildings during COVID-19 and future pandemics. Hindawi Wirel Commun Mobile Comput
5. Mukhtar H, Rubaiee S, Krichen M, Alroobaea R (2021) An IoT framework for screening of COVID-19 using real-time data from wearable sensors. Int J Environ Res Public Health 18:4022. https://doi.org/10.3390/ijerph18084022
6. Nasajpour M, Pouriyeh S, Parizi RM, Dorodchi M, Valero M, Arabnia HR (2021) Internet of things for current COVID-19 and future pandemics: an exploratory study
7. Paré G, Moqadem K, Pineau G, St-Hilaire C (2010) Clinical effects of home telemonitoring in the context of diabetes, asthma, heart failure and hypertension: a systematic review. J Med Internet Res 12(2):e21
8. New Technologies and Challenges for Personal Identity—The Digital Health Society (2021). Available online: https://thedigitalhealthsociety.com/new-technologies-and-challenges-for-personal-identity
9. Farooq UM, Waseem M, Mazhar S, Khairi A, Kamal T (2015) A review on internet of things (IoT). Int J Comput Appl 113:1–7 [CrossRef]
10. Leloglu E (2017) A review of security concerns in internet of things. J Comput Commun 5:121–136 [CrossRef]
11. Dorri A, Kanhere SS, Jurdak R, Gauravaram P (2017) Blockchain for IoT security and privacy: the case study of a smart home. In: Proceedings of the IEEE international conference on pervasive computing and communications workshops, PerCom Workshops, Kona, HI, USA

12. Huh S, Cho S, Kim S (2017) Managing IoT devices using blockchain platform. In: Proceedings of the international conference on advanced communication technology, ICACT, Phoenix Park, Pyeong Chang, Korea
13. Nawaf L (2021) Optimizing IoT security by implementing artificial intelligence—Infosecurity magazine. Available online: https://www.infosecurity-magazine.com/next-gen-infosec/optimizing-iot-ai
14. Hori T, Nishida Y (2005) Ultrasonic sensors for the elderly and caregivers in a nursing home. In: Proceedings of the seventh international conference on enterprise information systems, pp 110–115
15. Christaki E (2015) New technologies in predicting, preventing and controlling emerging infectious diseases. Virulence 6(6):558–565
16. Lavanya S, Lavanya G, Divya Bharathi J (2017) Remote prescription and I-home healthcare based on IoT. IEEE international conference on innovations in green energy and healthcare technologies (ICIGEHT'17)

An Novel Approaches for High Security in Finger Vein Based Authentication System in Military Forces

Yogiraj Bhale and Anish Gupta

Abstract The most dangerous problem in current digital world in high security area is spoofing attacks. The development of consumer electronics requires advanced security with extreme accuracy and secure verification. Biometrics has a wide range of solutions to electronics security issues in human behavior and physical characteristics. However, current senario biometric based systems are very complicated and hard in respect of time or interplanetary or together and are therefore not appropriate for high safety. Thus the embedded finger-vein recognization system is proposed for authentication of electronic devices. Finger vein recognition system is one of the innovative great studies in the biometrics based identification system. A growing problem for consumer to maintain high security to electronics privacy. We use the finger vein system to authenticate high security intelligence equipment for military forces.

Keywords Finger vein recognition · Tradional biometric system

1 Introduction

As the number of activities in the Internet has increased, it is impossible to secure personal authentication that affects individual individuals. As a result, certification plays an essential role in a person's life. Biometric systems are designed to protect and secure the identity of that individual. Identifiers in a biometric system cannot be misplaced. Biometric systems use pattern recognition that analyzes physical and biological features. The uniqueness and persistence of finger images are well known to the biometric system. Personal identification technology is used in a variety of applications, including location access control, device login & online shopping.

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Biometrics is a statistical measure of a person's physical or behavioral characteristics. Simple methods such as keys, passwords, and PIN numbers have been implicated in theft, loss, and dependency on human memory, hence biometric detection approaches have recently gotten a lot of attention.

The modern field of biometric, security and usability of systems is important [1]. The system, in particular, needs perfect precision and rapid response times. Fingerprints [2–4], facial characteristics [5], iris [6], voice [7], hand geometry [8], and posterior artery [9] are all biometric approaches. However, these methods do not promise to be concealed because the function used in this method is known to the human body. These processes can be repeated over and over again. A biometric recognition system based on a human body model and a finger blood model [10] was presented to overcome this challenge. Fingerprint verification is a reliable method widely accepted throughout the community. When a person places his finger on a special semiconductor pad (e.g. fingerprint sensor), his fingers are removed and his image is analyzed. The result of the analysis is then checked by taking that person's fingerprints in advance to prove authenticity. In this Infrared Light is passed to the back of the hand. After this a finger is inserted between the infrared light source and the camera. The arterial pattern in the arm is termed a shadow pattern because haemoglobin in the blood absorbs infrared light. The photographs taken differ not only in the pattern of the veins, but also in the sound. Stains form on the bones and tissues of different fingers. Therefore, areas with veins and not properly defined are in the same image.

To create the most accurate identification system, fingerprints should be drawn directly from the captured images and this process should be done quickly to satisfy the user's convenience. Typical methods for detecting line-shape features in photographs are the matching filtering method [11], mathematical syntax [12], highlighted line connections [13] and the gray finger diagrams after locating the ridge line minte [4]. As we know that every image needs to be filtered, if we use the similar methods of filteration then we can get a quick response. However, it can also emphasize abnormal inclusions, leading to self-limitation as it hides parts of the vascular pattern. Furthermore, because no continuity is observed, sound spots are highlighted. When the finger pattern is removed by connecting strapped seam lines, the line is removed if it is regarded continuous. However, the special performance and efficiency of line connections can incur significant computational costs. The image takes ten minutes or more to process. Therefore, if real time processing is required, this method is not suitable.

1.1 Traditional Biometric Security System

A. *Fingerprint Biometric Security System*

The fingerprint recognition algorithm is one of the most innovative biometric methods in terms of availability and probability. The fingerprint is verified by comparing its precision with that of a microscopic template. However, it

requires the touch of the body and hands from among the most impure parts of the body. So it can cause problem with the device. However, this requires physical contact and the hands are among the most impure parts of the body. So this may cause a problem with the device.

B. *Face Recognition Biometric Security System*

Facial images can be corrupted by incorrect lighting, viewing angle, and other parameters.

C. *Iris Matching Biometric Security System*

Iris detection is very accurate, but it can be disruptive as the cost of capturing the device is high and the user has to line up his iris with the photographic camera.

The main issue in these biometric system is that it's also can work with after death of person. In ideal case it should be make authorized to non-authorized after the death, while it's work with dead person also.

2 Proposed Methodology

To overcome the drawbacks of todays hand-made biometric systems, fingerprint authentication studies have been conducted [13]. By [reference] he proved that each finger had a different vein pattern used for authentication. Finger-based biometric systems have many advantages over other hand-based biometric methods. First of all, it is difficult to show the vein pattern because it is internal relaxation. Also, the eminence of the vein pattern is not effortlessly affected by the skin condition.

In addition, compared to palm-based and vascular systems [14], the device must be small in size. Finally, we found that no contact between the finger and nerve is required to obtain a finger vein. This requires some clean and robust procedures.

Currently available feature detection methods [2, 3, 13] for fingerprint recognition have similarities in using features of broken vascular networks for identification. However, due to mild irritation and skin dispersal problems, images of arteries are not always clear, and abnormal shadows may appear [4]. Therefore separation faults may arise during the removal procedure due to the small features of the finger vein pictures. If the network is not correctly disconnected, identity accuracy is compromised.

To resolve this issue, a fingerprint diagnosis method using LBP (Local Binary Model) [8] and LDP (Based Regional Model) [6] has been proposed. In the proposed method, we enlarge the collected fingerprints with a highly modified Gaussian filter and extract binary codes from the enhanced images using LBP and LDP. The similarity between an issued binary code and a given binary code is calculated by the Hemingway range. Although LDP is used as the discharge factor, the accuracy of detection and processing time is 2.5 times that of LBP. Also, the memory size of LDP binary cache memory is 4 times that of LBP.

In addition to LDP, many variants of LBP have been proposed to date. There is another proposal called LTP (local ternary pattern) [7]. In the original version of LTP, LTP used a three-digit code instead of a two-digit code. Another alternative

is proposed using a 5-digit LBP [15] code called the quintile region pattern (LQP). Recently [1] proposed a new LBP alternative called the Local Line Binary Model (LLBP) and used it to identify it. They showed that the projected approach can lead to higher acquisition rates than LBP in both measures.

Because of the limitations of LDP and the advantages of LLBP, LBBP is now used as a vein detection exclusion factor. The fundamental difference between LLBP and LBP/LDP is that LLBP uses a straight line with long pixels n, whereas LBP/LDP uses a square position. We believe that the linear formation of LLBP is best suited for capturing patterns within finger vein images. The finger vein pattern is clearer in images treated with LBBP than images treated with LBP. LBP and LLPP use a binary code computed for each pixel. Decimals are converted to numbers to identify scale values and then numbered from 0 to 255. 1 (middle) of LBP and LLBP, respectively.

2.1 Local Binary Pattern

The LBP operator has been used to remove the feature from the face and recognition of the iris because it is strong in bright light. It is expressed as Eqs. (1) and (2):

$$LBP(x_a, y_a) = \sum_{n=0}^{7} s(p_n - p_c) \cdot 2^n \tag{1}$$

$$s(x) = \begin{Bmatrix} 1, & x \geq 0 \\ 0, & x < 0 \end{Bmatrix} \tag{2}$$

where p_c and p_n show the gray pixel value in the center and those around the inside area, respectively. For example, p_c is 97. p_0, p_1, p_2,…, p_7 82, 75, 84, 95, 113,…, 92 respectively. In the case of n = 0, s ($p_n - p_c$) · 2n is s (82–97) · 20. Based on Eq. (2), s (82–970) is 0. As a result, us (82–97) · 20 becomes 0. In the similar way, where un = 1, s (75–97) is also 0 and −s (75–97) · 21 is 00 since 21 is 10. In case that n = 2, s (84–97) is also 0 and s (84–97) 22 is 000 since 22 is 100. Since there, we get the binary code 01110000 (Fig. 1).

8 bits LBP Codes are generated with the difference of the nearby pixel and the middle pixel of the local area. Its size is 3 × 3 pixels. The local LBP codec cover mask is rotated upwards and straight at a 50 × 20 pixel sample image. As a result,

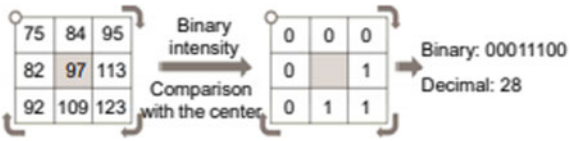

Fig. 1 The general binary pattern (LBP) operator

the total number of LBP code bits extracted from the sample image below the sample 50×20 equals 6912.

2.2 Finger Vein System

The fingervein verification process involves of 4 stages: (1) information collection, (2) processing, (3) feature extraction and (4) editing.

During the data collection phase, vein images are taken using an infrared electronics scanner. The captured image was influenced by venous blood pressure, temperature and environment. Specifically, a progression phase is required.

The pre-processing phase consists of Region-of-Interest (ROI) domain, background removal and upgrade sections. It can perform certain morphological functions of ROI extraction and background removal. In Ref. [16], ROI is expressed using interphalangeal joints. During the improvement phase, a number of methods were used. In Ref. [10], a separate algorithm of the niblock threshold segmentation segment algorithm was used. Feature removal methods are used to classify users based on finger veins (e.g. bones, swine flu). HOG and low-level hand features such as HOF and Skeleton and Hough transitions are not enough and are different enough. It may not be so, so I suggest. An FVA program based on an unsupervised learning approach. This method has learned the best features of identifying fingerprint images using autoencoders. The use of an autoencoder not only improves performance but also requires an extraction process, but does not require prior system treatment. Sample images of finger veins are taken with an infrared camera and then authenticated via the Local Ternary Co-Occurrence Pattern (LTCoP) process, a technique used for MRI and CT scan analysis.

An infrared camera creates a picture in grayscale that highlights the finger veins in the picture due to the hemoglobin in the blood. The LTCoP algorithm assigns gray values to the gray variations in the picture and then identifies matching patterns in the gray values to generate a numeric vector representing the finger vein pattern.

Vectors are stored in a database and classified via k-nearest neighbor (KNN) classification, a simple machine learning classification that groups finger vein vectors according to their degree of similarity.

2.3 Image Acquisition

For best-quality infrared (NIR) images, a specialized tool is designed to detect fingervein images without being exposed to existing heat. In general, vein-finger patterns can be imaged based on the principles of reflection or light transmission14. We have made a finger vein thinking tool which works on different imaging light transmission.

2.4 Image Segmentation and Alignment

Because finger locations vary between photos of each vein, it's required to normalise the sample images before removing and matching the feature. The bone in the joint finger is cartilage. NIR light can be easily penetrate. The composite image of a finger illuminated by the same NIR brightness is brighter than other objects. As a result, the projection curve peaks in the horizontal display of the finger vein diagram correlate to the proximity of the joints. Because the second finger joint is thicker than the first, the second joint's maximum value is lower. As a result, the first joint's position is used to find the finger.

2.5 Image Enhancement

As illustrated in Fig. 4, the image divided by finger vein is stretched to enhance the difference. The image was resized to 1/4 of its actual state before being resized back to its original size. The image recognition is then reduced to 1/3 of its original size. In this measurement, bikubic implants are employed. Finally, the image's grey scale contrast is increased using the histogram equation.

2.6 Feature Extraction

Mandelbrot's fractal model [3] is a good technique to describe environmental sensitivity and acts as an effective tool for image compression and fragmentation research. The computational approach is employed to differentiate the structure since distinct fractal sets have different modes having the same fractal angle [4]. The primary principle of miniaturisation, according to several definitions, is to identify a "gap or key" from a specified area that is utilised to enhance a landscape image. To increase finger recognition, we focused on a combination of cracked and loose movements in our investigation.

3 Finger vien hardware integration

Figure 3 depicts the procedure of identifying a person using patterns on the veins of the finger.

3.1 Discovery of Finger Infrared Image

The veins on the fingers are photographed using a special camera. The back portion of the hand is illuminated by a strong light, which travels through the fingers. This light is captured with a palm-fringed camera. The brightness of the image determines the intensity of the LED light. The modelling machine is depicted in Fig. 2a. There are 7 cm (width) × 60 cm (height) × 4 cm (top) with 1/3-inch CCD camera. This device is made of reasonable parts. Because hemoglobin in the blood engrosses infrared light, the shear pattern in the palm is considered a shadow. Also, the transmission of infrared radiation depends on the size of your finger. Depending on the location, there are uneven areas in the phone image. Examples of pictures taken in Fig. 4 b and c. Each and every image is gray, 240 × 180 pixels in size, 8 pieces per pixel. Finger length is horizontal and the finger is to the right of the image.

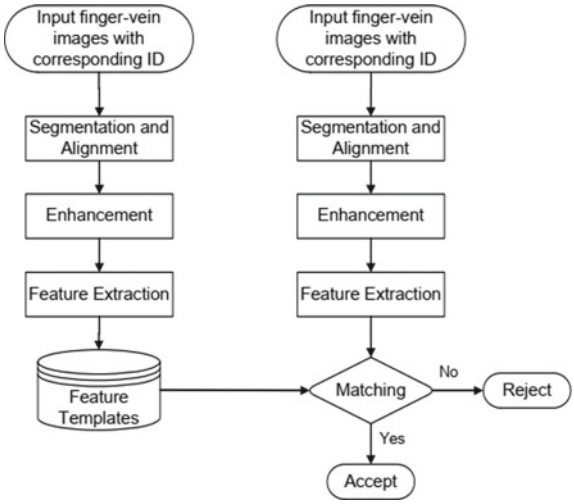

Fig. 2 The flow-chart of the proposed recognition algorithm

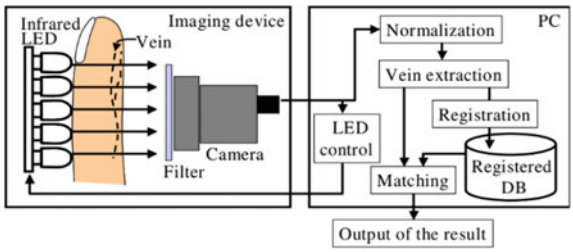

Fig. 3 Principle of personal identification using finger-vein patterns

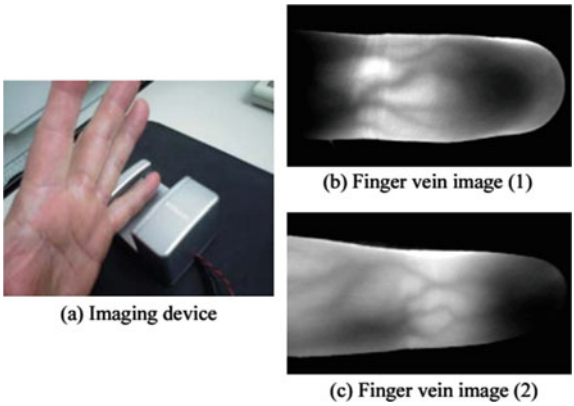

Fig. 4 Finger vein detetion system

4 Expermental results

As per our study, no information about finger veins has been made available. As a result, we produced a test finger vein database containing the finger veins of 100 people of various racial and ethnic backgrounds. Academic years range from 21 to 58 years. We collected photographs of the veins from the front, middle, and ring fingers of both the hands. We took 10 Pictures of each fingure in different seasons. Therefore we have collected 6000 sample fingre vein images as a database. Figure 5 depicts an example of many finger veins (after adjustment).

4.1 Performance Evaluation

There are two forms of faults in matching results in biometric validation. The initial is an illegal denial that causes a real couple to lose patience, and second is a false acknowledgment that the real couple is real. These are two types of errors in sales. In biometrics, system performance was assessed by the Uniform Error Rate (ERE).

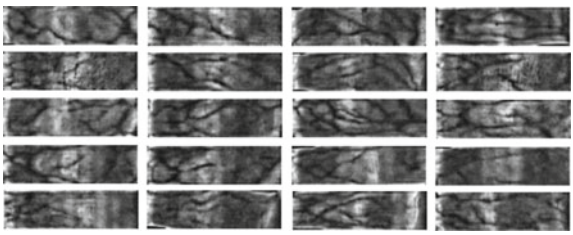

Fig. 5 Finger-vein sample images after preprocessing

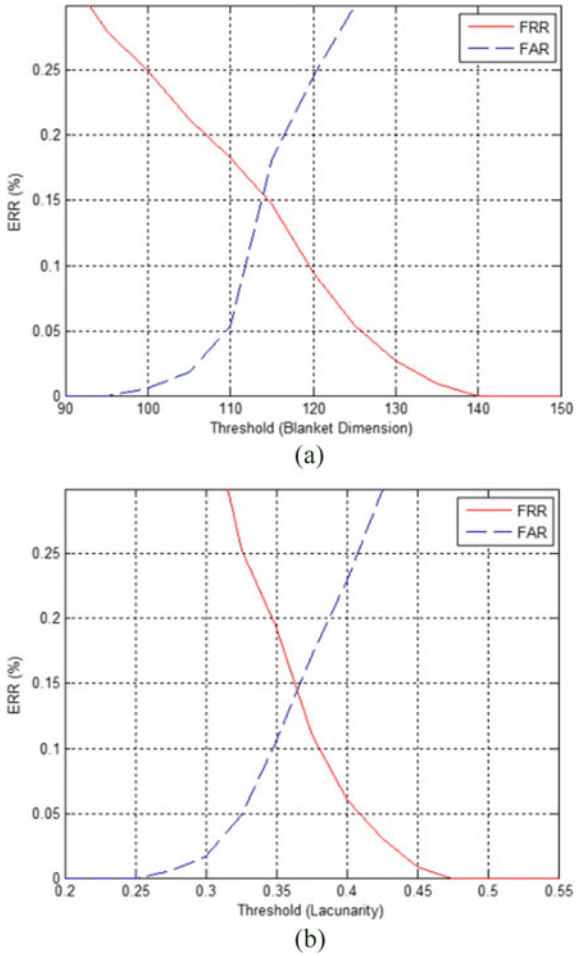

Fig. 6 The FAR and FRR curves of the methods based on **a** blanket dimension and **b** lacunarity, respectively

When the False Rejection Rate (FRR) is equivalent to the False Acceptance Rate (FAR) and EER Error Rate, the FRR and FAR are considered equal, making them ideal for computing the overall recital of biometric systems (Fig. 6).

5 Conclusion

The need to have a safe, secure and secure personal identity document is a clear requirement today. We can conclude from this study, that the proposed algorithm is being used in various high-tech programs such as security area, physical access

control system, and digital authentication. In addition, the protruding vein pattern can be considered a useful biometric image as it contains details about important factors such as vein width, number and type of branches, etc. For example, vein removal is used in vascular pathology for accurate diagnosis and follow-up of angiogenesis in the body.

The finger vein has many advantages over other biometric devices:

(a) The vein pattern of the finger is different and different for everyone.
(b) As veins are not visible so it becomes tough to cheat or steal.
(c) As we know that veins donot leave any traces or prints during verification, so it can not be repeated.
(d) Fingerprint patterns can only be taken by a living person.
(e) As we are aware that the finger print lasts longer than the vein pattern, it is not necessary to re-register the vein pattern once it has been signed.

References

1. Pulluru KK, Agrawal GA (2009) Vein pattern recognition based biometric system and methods thereof
2. Wang K, Ma H, Feng W, Li X, Wang FG (2010) Fingerprint and finger vein bimodal recognition decision level fusion method
3. Lee EC, Park HC (2009) Finger vein recognition using minutia-based alignment and local binary pattern-based feature extraction. Int J Imag Syst Technol 179–186
4. Rosdi BA, Suandi CW (2011) Finger vein recognition using local line binary pattern, pp 11357–11371
5. Song ZL (2012) An embedded real-time finger-vein recognition system for mobile devices. In: IEEE transactions on consumer electronics, pp 522–527
6. Hashimoto J (2006) Finger vein authentication technology and its future
7. Miura N, Miyatake AN (2004) Feature extraction of finger-vein patterns based on repeated line tracking and its application to personal identification
8. Hui M, Yongliang S, Linlin HG (2013) Finger vein recognition method fusing local features and global features
9. Liu Z (2009) Finger vein recognition system
10. Nguyen DT, Park YH, Park KY (2013) New finger—vein recognition method based on image quality assessment, pp 347–356. Ksii Trans Internet Inf Syst
11. Feng W, Guan F, Liu J, Ma H, Wang K, Wu Q (2010) Method for extracting finger vein feature for matching identification
12. Kumar A, Zhou Y (2011) Method and apparatus for personal identification using finger imaging
13. Shujuan Z (2014) Identity recognition method and system based on finger vein characteristics
14. Huang B, Dai Y, Li R, Li DT (2010) Finger-vein authentication based on wide line detector and pattern normalization. In: 20th international conference on pattern recognition
15. Gozzini G (2012) Electronic device performing finger biometric pre-matching and related methods
16. Lee EC, Kim HJ (2011) New finger biometric method using near infrared imaging, pp 2319–2333

Bow Type Active Frequency Selective Surface for Satellite Communication

Yukti Anand and Ashok Mittal

Abstract Novel bow type active FSS (frequency selective structure) is explored and proposed in this paper. The bow type structure with RT-Duroid substrate loaded with pin diode in each cell is presented in this paper. The proposed active FSS is used for Ku band satellite communication application. The transmission and reflection coefficients of proposed structure were investigated. Active FSS shows good isolation and insertion loss by increasing the number of cells of proposed structure.

Keywords Active Frequency selective surface (AFSS) · PIN diode · Satellite communication · HFSS software

1 Introduction

Frequency selective surfaces (FSS) also known as Meta-surfaces are periodic structures exhibits the spatial filtering mechanism. FSS have found application in antennas, beam steering, mainly in communication and military applications [1, 2]. Frequency selective surface (FSS) resonates at fixed frequency for Transmitting and Receiving of electromagnetic wave [3]. However, for various other applications, it is necessary to alter the frequency behaviour with time and for that purpose active frequency selective surface area is of great interest.

In recent years, vast advancement in microwave technology has been done resulting in the rapid growth of Tele-communication and wireless technology at a very high data rate [4]. This advancement brings revolution in various areas like radar sectors, wireless systems and satellite communication devices etc. [4]. To encounter all the emerging needs of telecommunication sector, study mainly focus on how to upgrade the bandwidth, how to improve system performance and how to increase its efficiency. For fulfilment of all these requirements, proper designing of Active

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Frequency selective surface is very important. Classification of FSS can be done by various types "on the basis of array elements", "on the basis of their function" and "on the basis of application" [5, 6]. Besides FSS, recent researches heading towards Active Frequency selective surface (AFSS) using different controlling elements i.e. PIN diodes, Varactor diodes for various applications [7].

Proposed structure of Active FSS is presented with its design and analysis in this paper. Bow type FSS loaded with PIN diode on Rogers (RT-Duroid-5880) substrate is presented. Simulated results like transmission curve and reception curve with PIN diode 'ON' and 'OFF' state is shown in the results section. Comparative to single-cell performance in relation to insertion loss and isolation, as the number of cells in FSS layer is increasing the performance of FSS is getting better.

2 Design and Analysis

The proposed Active FSS structure consists of bow type unit FSS cells loaded with Pin diode on Rogers (RT-5880) Duroid substrate having (ε_r) dielectric constant of 2.2 with the thickness of 1.5 mm. PIN diode (BAP65-02,115) is used for tune-ability of active FSS. Diode is placed in the middle of the each dipole (placed along y-axis) of single cell of FSS layer. Figure 1, shows 'Single Cell' structure of proposed active FSS. All the specifications of unit FSS cell and diode are listed in Table 1.

The proposed AFSS structure is analysed by MS Boundary conditions and excited using Floquet port excitation on HFSSv-15 software. Parametric Analysis was performed for taking the appropriate width and height of active FSS unit cell. Proposed Structure is realised for both PIN diode conditions by turning diode 'ON' and 'OFF' state.

In this paper, 'Lx' and 'Ly' define the corresponding lateral and longitudinal lengths of substrate and 'H' is the height of substrate layer. 'D_x' is the horizontal

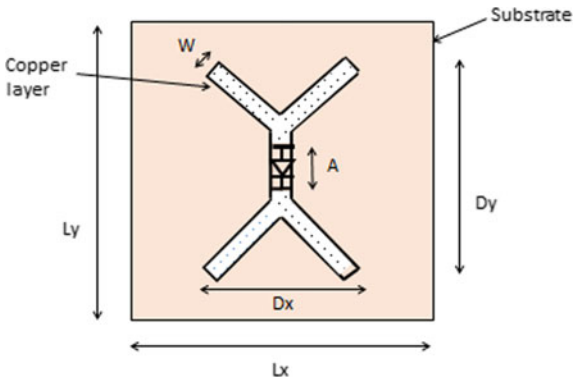

Fig. 1 AFSS unit cell structure

Table 1 FSS single cell and diode specifications

Classification	Parameter	Value
FSS single cell dimensions (mm)	Dx	3.1 mm
	Dy	6.25 mm
	Lx	7 mm
	Ly	8 mm
	W	0.3 mm
	H	1.5 mm
Diode dimension	A	1 mm
	L_D	0.4 mm
	C_D	1uF
	R_D	1Ω
	R_R	20kΩ
	C_R	0.5pF

length from one arm of the conducting element till second arm and 'D_y' is the vertical length between both the pairs of bow. 'W' is the width of the single cell. 'A' is the total diode specification in which 'L_D' is the diode inductor and it has same value in both cases of PIN diode 'ON' and 'OFF'. 'C_D' is the diode capacitance; it has also same value for both the conditions of PIN diode. When diode state is 'ON' then 'R_D' is the resistance of diode. 'C_R' and 'R_R' are the Diode Capacitance and diode resistance, when the diode condition is 'OFF'.

First, Single cell active FSS structure is analysed. All the dimensions of Active FSS single cell is defined in Table 1. "Bow type Active FSS" structure is realised using MS boundary conditions on its side walls opposite to each other presented in Fig. 2. Floquet port excitation is done on the topmost and bottommost face of single unit cell structure. PIN diode is positioned in the middle of dipole which is placed along the y-axis for controlling the functioning frequency by switching 'ON' state and 'OFF' state. Figure 3 represents the resultant (S_{21}) transmission curve. When the 'ON' diode condiotion is active, it shows resonance frequency around 11.8 GHz at 29 dB and when 'OFF' diode condition is active, the cut-off frequency is around 13 GHz at 35 dB is observed. Good insertion loss, below 4 dB is observed. As, the number of cells are increasing in the AFSS layer, the better performance of the structure is realized (Fig. 4).

With larger number of cells in the AFSS layer, the proposed structure is presented in Fig. 4. Now, the AFSS layer consists of twelve unit cells embedded with Pin diode in the centre of dipole i.e. placed along y-axis. Substrate used for AFSS layer is Roger (RT-5880) Duroid. The proposed structure is analysed using MS Boundary conditions along with Floquet port excitation shown in Fig. 5. After simulation of proposed structure on HFSS v-15 version, Transmission Loss curve (S21) is observed, when is diode turned 'ON', the cut-off frequency is 11.8 GHz at 33 dB and for diode 'OFF' state condition, the cut-off frequency is 13 GHz at 38 dB. The results in Fig. 6 clearly shows that as the number of cells are increasing in the FSS structure, the

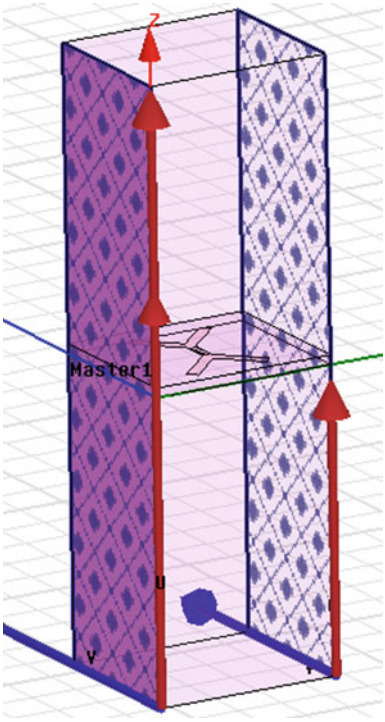

Fig. 2 AFSS with MS boundary conditions

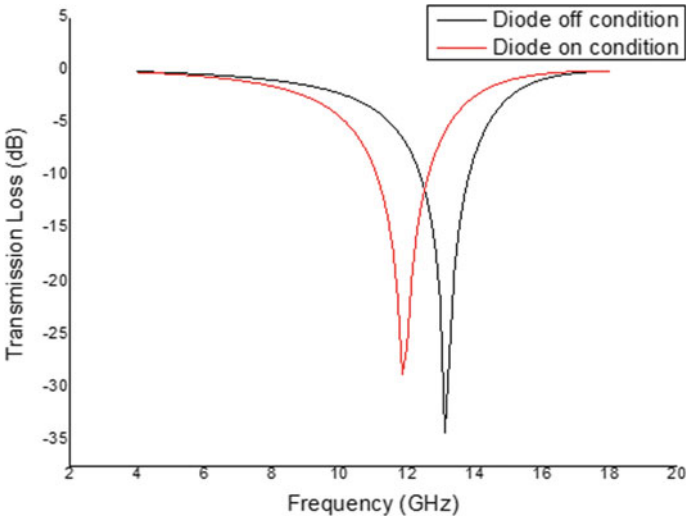

Fig. 3 Transmission loss curve of single unit cell

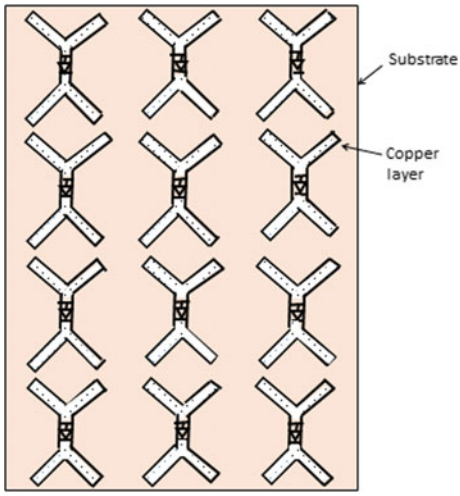

Fig. 4 AFSS layer with twelve unit cells

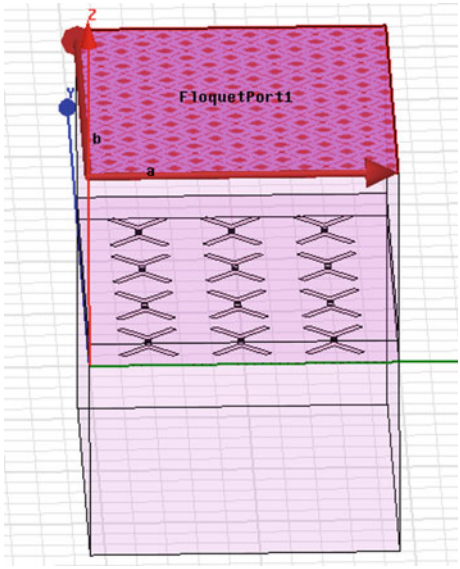

Fig. 5 Twelve AFSS cells with Floquet port excitation

better performance of the structure is coming out in terms of isolation and insertion loss.

In the proposed structure, number of cells is further increased to 'twenty unit cells' AFSS layer presented in Fig. 7. The proposed structure is analysed by using Master–Slave boundary and floquet ports are being used for the excitation shown in Fig. 8.

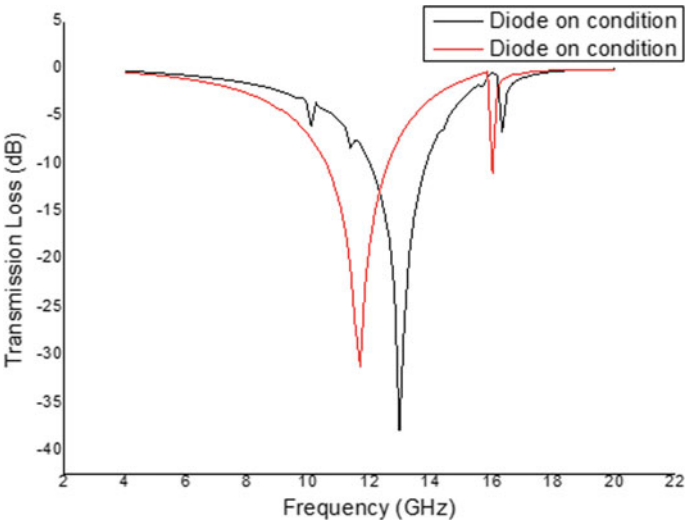

Fig. 6 Transmission Loss curve of twelve AFSS cells

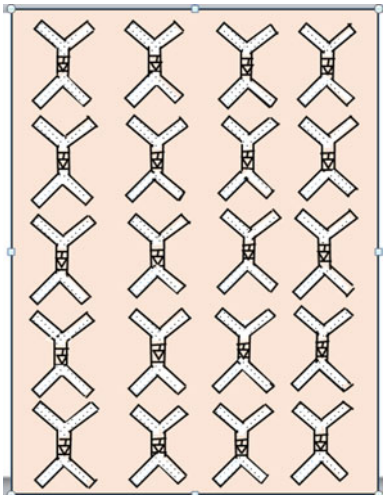

Fig. 7 Twenty AFSS unit cells

After simulation of proposed structure on HFSS v-15 software, it is cleared from the results shown in Fig. 9 that as the number of cells are increasing the better and better performance of the structure is obtained. Resonance frequency of the 'twenty unit cell' AFSS layer at diode 'ON' state position is 11.9 GHz at 35 dB and when the diode position is in 'OFF' state position, it shows resonance frequency at 13.2 GHz at 42 dB down.

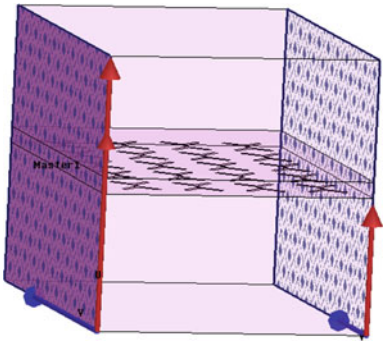

Fig. 8 Twenty unit cell AFSS layer with Master–Slave boundary condition

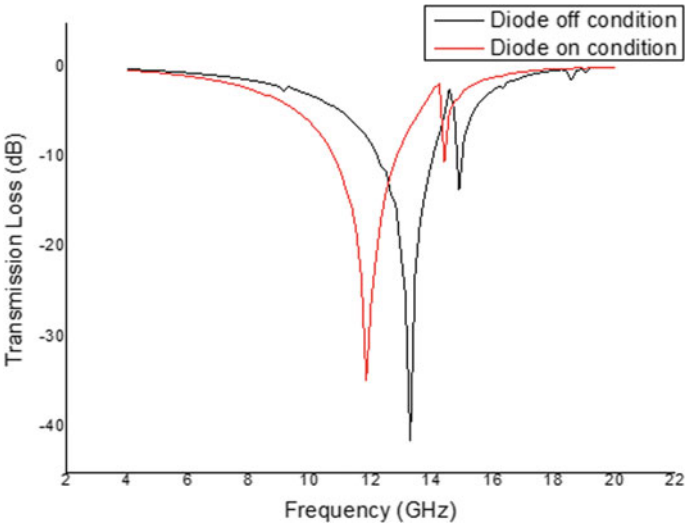

Fig. 9 Transmission curve of twenty AFSS unit cells

3 Conclusion

In this paper, the concept of 'Bow type Active Frequency Selective surface' structure is presented using Pin diode. Bow type concept is well demonstrated on the basis of twelve unit cell AFSS layer and on the basis of twenty unit cell AFSS layer. Designing and Analysis of the structure is performed using HFSS v-15 software.

It has been observed that after simulation the resonance frequency of unit cell structure in Pin diode ON state and in OFF state is same for twelve unit cell bow type structure and it is also same for twenty unit cell bow type structure. The difference comes in terms of insertion loss and isolation, resulting in better performance of structure, as the number of cells are increasing in AFSS layer. The proposed

AFSS structure can be used in Ku- band satellite communication application. Future research work can be done on improving the design of structure and different tuning elements can be used.

References

1. Feng D, Wuhan (2014) Design of a new active frequency selective surface (FSS). In: IEEE, 3rd Asia-pacific conference on antennas and propagation. https://doi.org/10.1109/apcap.2014.6992776
2. Munk BA, Kouyoumjian RG, Peters, LJR (1971) Reflection properties of periodic surfaces of loaded dipoles. IEEE Trans Antennas Propag 19(5):612–617
3. Anand Y, Mittal A, Raheja DK (2021) Active frequency Selective Surface for duplexers in wireless applications. In: INCET (International Conference of Emerging in Technology)
4. Garg N, Jain S, Yadav A, Sharma MD (2020) Dual band frequency selective surface for WiMAX/WLAN band application. IEEE, 21 Sept, 2020. 978-1-7281-5284-4/20
5. Costa F, Monorchio A, Vastante GP (2011) Tunable high-impedance surface with a reduced number of varactors. IEEE Antennas Wirel Propag Lett 10:11–13
6. Costa F et al (2009) On the bandwidth ofhigh-impedance frequency selective surfaces. IEEE Antennas Wirel Propag Lett 8:1341–1344
7. Chawla P, Anand R (2017) Micro-switch design and its optimization using pattern search algorithm for applications in reconfigurable antenna. Modern Antenna System

Productive Study Routine Generator

Sujatha Karimisetty, G. Sudheer Kumar, Komali Adari, Garishma Malla, Surendra Talari, and Sudhanshu Maurya

Abstract Productivity plays a vital role in completing all the tasks on time. Likewise, being productive is really foremost thing for the students to ace the exams and reach their goal. Scheduling for exam preparation will help students to prepare and write the exam with tension free. So, we come up with an idea which will assist the students to making more earnest by introducing Automatic Productive Study Routine Generator with the help of Graph Colouring Technique. Graph colouring is an algorithm that can be applied in making a time table or a schedule. This Automatic Productive Study Routine Generator takes the period that user wants to complete the syllabus like number of weeks or months. The machine learning based generator schedule is automatically prepared as per the input.

Keywords Scheduling · Graph ColouringTechnique · Automatic Productive Study Routine Generator (APSRG)

1 Introduction

A day consists of 24 h; productivity is being most efficient and creates lasting habits instead of following endless list of tasks. In other word, instead of working harder, work smarter. A study plan is an organized one that outlines studying schedules and learning objectives. College students, like those who work or go to school, should create a calendar that includes committed time. Each week for studying. Students might want to plan for their competitive exams which need a plan before weeks or months. Students might feel strenuous to sketch out their plan in organizing the subjects and accommodate their activities in 24 h that is a day. Routine planning is

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tedious job for students with respect to time and one's power [1, 2]. This system allows creating a study routine automatically. Our automatic time generator application will help to create time tables which saves the time and reduces the burden. This automatic generated study routine generator reduces the stumbling blocks or hurdles of manually preparing the planner. The main aim is here to develop a simple, easily understandable, productive and portable application which could automatically generate good quality productive study plan [3, 4].

As honourable Prime minister of India, Narendra Modi talked about the preciousness of time management for preparation of examinations for the students in Pariksha Pe Charcha, 2021 which is a part of movement 'Exam Warriors' led to create a stress free atmosphere for youngsters. A stress free atmosphere could be achieved by proper planning or scheduling for exams [5].

There exist a lot of diverse problems such as:

1. Unproductiveness
2. Less concentration
3. Procrastination
4. Less score in exams

This generator takes the period that user wants to complete the syllabus like number of weeks or months.

- Number of subject and the list of subjects.
- Collage or class timings.
- Study session duration per subject. As input

Then generates a schedule as per the input and also recommend the warm up exercises during breaks.

2 Methodology

Only one subject is allowed for a each time slot to get rid of conflict [6, 7]. This can be done with the graph colouring algorithm which will assign each colour to particular each node and makes sure that no 2 adjacent nodes are coloured the same. Given the list of courses DBMS, W.T, Python, DAA, and Operating Systems and 10 h per day to study. This is because single student cannot study more than a subject in a single time slot. The timeslots are shown in Fig. 1 for this illustration.

Here each node 1, 2, 3, 4, 5 are represents each subject such that no 2 time slots can occupy single subject in order to implement this graph coloring algorithm can be used with minimum chromaticity.

1. Colour assignment to the colliding subjects using graph colouring algorithm
2. Placing the courses to the table according to the colours assigned.

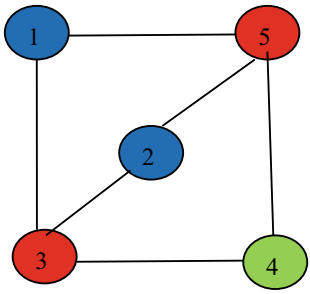

Fig. 1 Scenario of instance graph

The maximum critical section inside the observe is the era of the time table [8, 9]. Operations completed in this phase may be ordered as follows.

3 Results

The layout of the study routine generator is illustrated in Fig. 2:

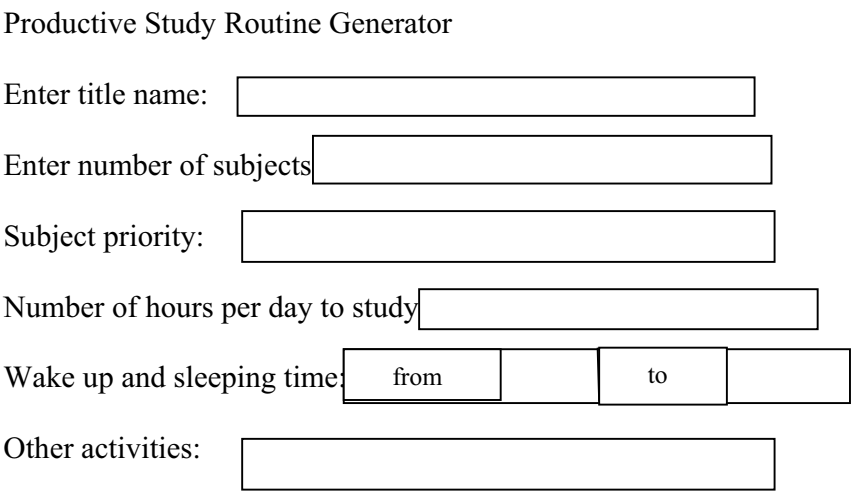

Fig. 2 Scenario of instance graph

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
5:00 -5:30	Wake up and Fresh up	Wake up and Fresh up	Wake up and Fresh up	Wake up and Fresh up	Wake up and Fresh up	Wake up and Fresh up	------
5:35 -6:30	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6	Wake up and Fresh up
6:30-7:00	Revision	Revision	Revision	Revision	Revision	Revision	Read priority subject
7:00-7:30	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Read priority subject
7:30-8:30	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6	Subject 1	Breakfast
8:35-9:00	Revision	Revision	Revision	Revision	Revision	Revision	Revision
9:00-9:30	Exercises on topic	exercises on topic	exercises on topic	exercises on topic	exercises on topic	exercises on topic	exercises on topic
9:30 - 10:00	Free time	Free time	Free time	Free time	Free time	Free time	Free time

Fig. 3 Image generated by study routine generator

4 Output

The resultant image generated from the study routine generator is shown in Fig. 3 below:

Taking subjects list from 1–6, their priorities, and their leisure hours as input this gen-erator generates a routine as in Fig 3. Here as the user enters the wake up, sleeping time and leisure time there will be a schedule generated by making sure that no two adjacent timeslots can have same subject. In case if user wishes to have a time block for other activities like breakfast, etc.

5 Analysis

As depicted in the Fig. 4, taking the input constraints such as number of subjects, number of hours per day to study etc., this generator generates a study routine that will help students to be more productive. More the productivity, more the diligent.

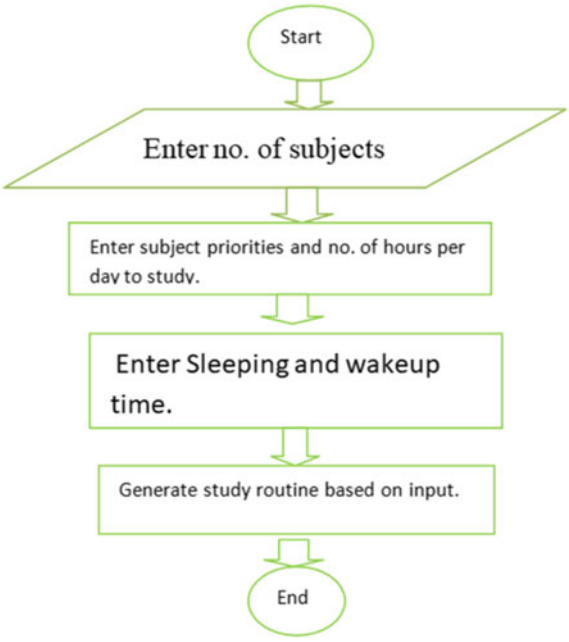

Fig. 4 Steps involved in the study routine generator

6 Conclusion

Students may want to prepare for their competitive exams which they plan before weeks or month. Students may find it difficult to organize their topics and schedule their activities in the 24 h that make up a day. So, our system helps students to make a productive study schedule which help students to ace the exams. And reach their goals. The future scope includes an application that can be implemented with added productive tools like To-Do list, Task Checker, Pomodoro timer etc., where user can have multiple productive applications in a single domain and make them more productive.

References

1. Verma OP, Garg R, Bisht VS (2012) Optimal time-table generation by hybridized bacterial foraging and genetic algorithms. In: 2012 international conference on communication systems and network technologies, pp 919–923.https://doi.org/10.1109/CSNT.2012.196
2. Burke EK, Newall JP (1999) A multistage evolutionary algorithm for the timetable problem. IEEE Trans Evol Comput 3(1):63–74. https://doi.org/10.1109/4235.752921

3. Schonberger J, Mattfeld DC, Kopfer H (2000) Automated timetable generation for rounds of a table-tennis league. In: Proceedings of the 2000 congress on evolutionary computation, vol 1. CEC00 (Cat. No.00TH8512), pp 277–284. https://doi.org/10.1109/CEC.2000.870307
4. Al Perumal S, Tabassum M, Norwawi NM, Al Narayana Samy G, Perumal SA (2018) Development of an efficient timetable system using angular JS and bootstrap 3. In: 2018 8th IEEE international conference on control system, computing and engineering (ICCSCE), pp 70–75. https://doi.org/10.1109/ICCSCE.2018.8685002
5. Khonggamnerd P, Innet S (2009) On improvement of effectiveness in automatic university timetabling arrangement with applied genetic algorithm In: 2009 Fourth International Conference on Computer Sciences and Convergence Information Technology, pp 1266–1270.https://doi.org/10.1109/ICCIT.2009.202
6. Ribić S (2012) A school timetable description language. In: 2012 20th telecommunications forum (TELFOR), pp 1709–1712. https://doi.org/10.1109/TELFOR.2012.6419556
7. Aminu A et al (2019) Design and implementation of an automatic examination timetable generation and invigilation scheduling system using genetic algorithm. In: 2019 2nd international conference on applied engineering (ICAE), pp 1–5. https://doi.org/10.1109/ICAE47758.2019.9221700
8. Calle-López D, Cornejo-Reyes J, Pesántez-Avilés F, Robles-Bykbaev V, Rodas-Tobar M, Vásquez-Vásquez C (2018) A university administration system to automatically assign courses to teachers and support the design of timetables through mathematical modeling and restrictions analysis. In: 2018 IEEE world engineering education conference (EDUNINE), pp 1–5.https://doi.org/10.1109/EDUNINE.2018.8451006
9. Ilham NI, Saat EHM, Rahman NHA, Rahman FYA, Kasuan N (2017) Auto-generate scheduling system based on expert system. In: 2017 7th IEEE international conference on control system, computing and engineering (ICCSCE), pp 6–10. https://doi.org/10.1109/ICCSCE.2017.8284370

Semantic Web Undertaking Effort Estimation Utilizing COCOMO II, SVM and NN

Naveen Malik, Sandip Kumar Goyal, and Vinisha Malik

Abstract Programming exertion and cost assessment are urgent pieces of programming project improvement. It decides the spending planning time, and assets expected to foster a product project. The achievement of a product project advancement relies primarily upon the exactness of programming exertion and cost assessment. The semantic web basically focused upon the quality assessment utilizing the effort estimation. The COCOMO model utilized for assessment is contrasted and the proposed work and further based on disarray framework boundaries accuracy, review, f-measure, precision are determined and similar examination utilizing proposed model against COCOMO II, SVM and NN is performed in MATLAB. The general investigation shows that the proposed model accomplished better outcomes as contrast with COCOMO II model. The near examination of assessment boundaries (tp, fp, tn, fn) are registered by utilizing proposed model against COCOMO II, SVM and NN models. The outcome utilizing exertion assessment is isolated based on two standards, first guideline depends on 5% exertion investigation and second principle depends on 10%. The normal % of exertion investigation utilizing proposed model is registered as 127.729. The execution characterizes that the proposed model is superior to the COCOMO II model using fuzzy logic.

Keywords COCOMO II · SVM · NN · MAE · Software cost assessment etc.

1 Introduction

The Semantic Web offers a well-known stage for sharing and repurposing information through applications, undertakings, and networks. It's a joint task drove by World Wide Web Consortium (W3C), with a wide number of scientists and industry individuals partaking. It is a dream of a World Wide Web augmentation that gives

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programming programs machine-interpretable metadata of distributed data and data. Effort Estimation modes are partitioned into two sections for example model based and Expert Based techniques [1]. In the model based framework the equations are utilized to sum up the antiquated information and make expectation with respect to the new tasks.

1.1 The COCOMO Model

The principle reason for fundamental COCOMO model is utilized to quantify the exact size of undertaking boundaries. It is determined based on articulation that is given beneath:

$$Effort = a1 * (Kloc)a2PM$$

$$Tdey = b1 * (efforts)b2Months$$

Here, Effort characterizes the absolute exertion used to foster any product it is estimated as individual each month (PM). Kloc is the assessment size of any product as kilo lines of code, a1, b1, a2, b2 are characterized as a constant for each gathering of programming item [3]. Tdev is characterize as the absolute time taken to foster any product it is measure as months. ESTIMACS emphasizes approaching the challenge of estimating from a market perspective. SEER-SEM is an item that has been available for quite a long time and depends on the first Jensen model [Jensen 1983]. It has formed into a complex instrument that upholds both hierarchical and base up assessment approaches during that period.

1.2 Estimacs

Initially created as Quest (Quick Estimation System) in the last part of the 1970s, was subsequently consolidated into the Management and Computer Services (MACS) line of items [Rubin 1983]. It centers around the development interaction of the machine life cycle, conceding support to later apparatus extensions. Rubin has set up six primary assessment measurements and a guide that portrays their interrelationships, from the gross market prerequisites with the impact on the designer's drawn out assessed portfolio blend [4]. Coming up next are the basic assessment measurements:

- staff size and sending
- hardware asset prerequisites
- risk
- Portfolio sway.

The fundamental standard of ESTIMACS is that the gauge measurements are dictated by the gross business boundaries, or "venture factors." Project factors, as per Rubin, are "parts of the objective framework's business usefulness that are obvious from the get-go, in a business setting, and are firmly connected to the gauge measurement" [5].

1.3 SEER-SEM

Soothsayer SEM is a thing that has been accessible for a serious long time and relies upon the principal Jensen model [Jensen 1983]. It has shaped into a refined instrument that maintains both progressive and base up appraisal methods of reasoning during that period [6]. Though the association's showing conditions are restrictive, they use a parametric method to manage appraisal. Article orchestrated, reuse, COTS, contorting, course, model, and consistent advancement are among the improvement modes guaranteed. third- and fourth-time tongues (C++, FORTRAN, COBOL, Ada, and so on) similarly as application generators are covered [7]. It considers the contribution of goals like staff limit, required arrangement and cooperation essentials, and levels of reasonable headway danger as shown in Fig. 1. Components of the model fuse the going with:

- Allows free factors, for instance, probability level of figures, work, and plan impediments to be entered [8].
- The cost drivers for the endeavor are shown [9].
- Allows project parts to be naturally moved toward Gantt-diagrams [10].

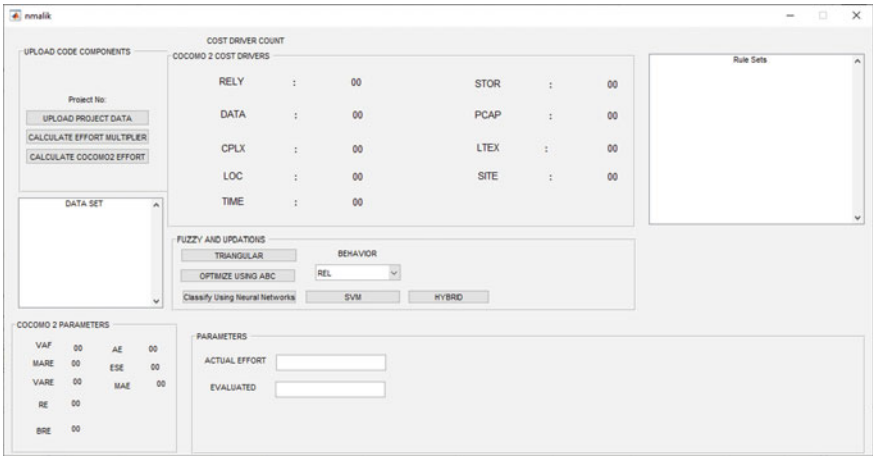

Fig. 1 Graphical user interface of working process

2 Problem Statement

Programming effort evaluation is one of the basic viewpoints to pick the accomplishment or dissatisfaction of an endeavor. A lot of assessment workers have used COCOMO as their fundamental evaluator at this point, there are following restrictions with COCOMO-I.

(i) Less mathematical depiction for symbol authentic data relationship.
(ii) Less number of limits.

As a result of this leeway, COCOMO-II started getting taken on by the analysts and investigation workers. COCOMO-II has more number of appraisal limits which works mathematically [11].

The issue of this investigation work is to further develop the effort appraisal through COCOMO-II by adding [12, 13].

1. To read the past calculation for quality assessment for semantic web applications utilizing AI. The target stretches out to assess the elements of measures influencing the quality.
2. To plan and foster a drawn-out AI calculation by improving multitude knowledge for the readiness of.

3 Proposed Methodology

The proposed procedure would upgrade the assessment strategy by utilizing Neuro-based technique be utilized to foster a reasonable nonexclusive type of model that can be utilized to gauge programming exertion for a wide range of ventures. The creators suggested that NN-based procedures be utilized to make a conventional type of model that can be utilized to assess programming exertion for a wide range of tasks.

4 Cocomo-II

COCOMO-II is a numerical and adored answer for assess the work on a task. The accompanying numerical boundaries have been used:

(i) Required Software Reliability (RELY)
(ii) Product Complexity (CPLX)
The item intricacy is isolated into five segments

(a) Control Operations CPLX
(b) Computation Operation CPLX
(c) Device Dependent CPLX

(d) Data Management CPLX
(e) User Interface CPLX

(iii) Required Reusability (RUSE)
(iv) Execution Time (TIME)
(v) Capacity Constraints (STOR)
(vi) Developer Capability (PCAP)
(vii) Language and Tool Experience (LTEX)
(viii) Multisite Development (SITE).

4.1 Dataset Description

The dataset used in the analysis and model evaluation is NASA dataset. In the present work, the 93 projects dataset is used for the training and 63 projects dataset is used for the testing work. The effort adjustment is manipulated and estimation results are compared with the existing COCOMO II estimations using following descriptors.

4.2 Load and Extraction of Dataset

The principle motivation behind information extraction is to recover information from various sources. In the extraction cycle The dataset that is utilized in proposed work is taken from NASA dataset that contain 93 activities to prepare and 63 ventures included for testing. Along these lines, informational index is stacked and afterward begins extraction of the characteristics from dataset.

4.3 Identification of Actual Effort and Apply COCOMO II

The back many undertakings records that are utilized in proposed work. In this way, distinguishing proof of the genuine exertion of each task that has a place with the dataset is vital [15]. Then, at that point, apply COCOMO II model with the end goal of to assess individual genuine exertion of each task. Metric assessment is done in COCOMO II model (Fig. 2).

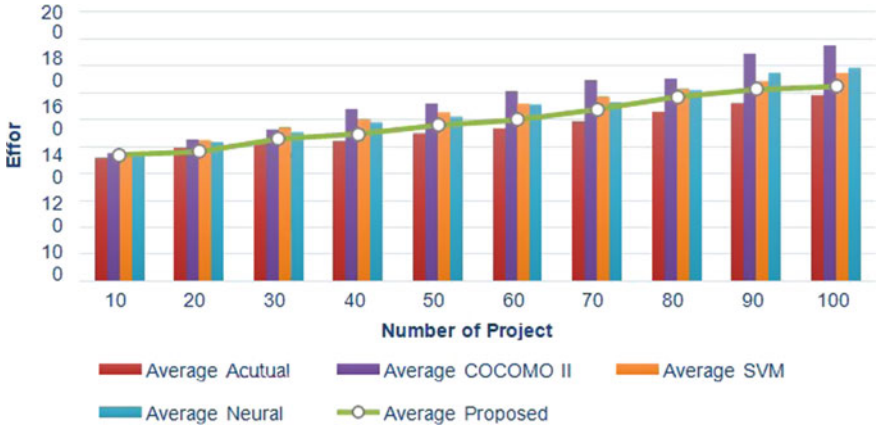

Fig. 2 Comparative analysis of confusion matrix parameters using COCOMO II, SVM, NN and proposed model

5 Results and Simulation

The accompanying recreation results have been assessed. As talked about in the past segments of the paper (Fig. 3).

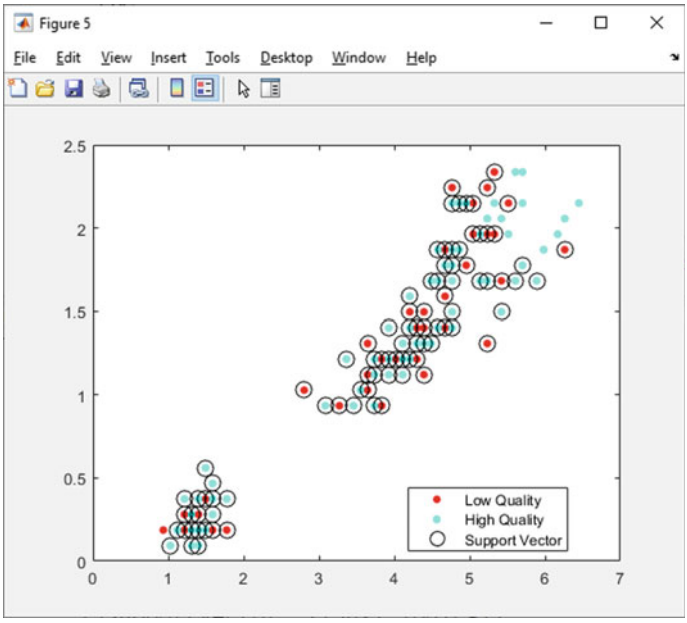

Fig. 3 Normal SVM

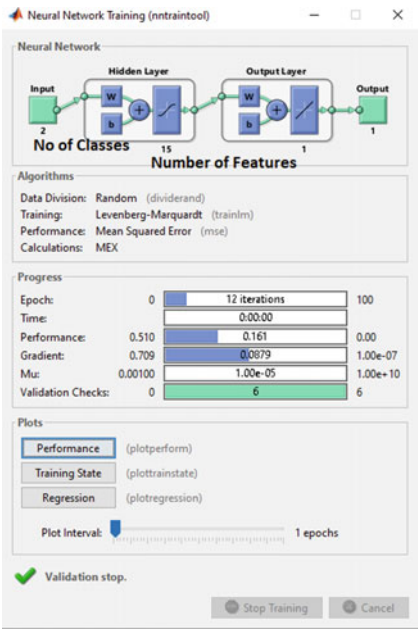

Fig. 4 Neural classification

The likelihood of the quality appraisal is isolated into three classes; Low, Moderate and High (Fig. 4).

Table 1 shows the Moderate Quality appraisal result dependent on exertion assessment. The moderate outcome that depend on 5% standard depict neural organization, SVM and Proposed model give a similar outcome like 14% [14]. Then again, moderate outcome that depend on 10% principle portray neural organization, SVM model give a similar outcome like 13%. The consequence of COCOMO II and Proposed model is computed as 14%. So the overall results are calculated that proposed model give better outcomes as contrast with different models.

Overall Effort Analysis using COCOMO II, SVM, NN and proposed model.

Table 1 Moderate quality appraisal result dependent on exertion assessment

Number of project files	True positive	False positive	True negative	False negative
1. COCOMO II model				
100	0.614	0.364	0.274	0.239
200	0.623	0.376	0.265	0.241
300	0.663	0.336	0.259	0.2
400	0.701	0.298	0.241	0.235
500	0.7	0.299	0.253	0.204
600	0.735	0.364	0.238	0.201
700	0.76	0.239	0.232	0.194
800	0.785	0.214	0.225	0.186
900	0.81	0.189	0.218	0.179
1000	0.835	0.164	0.212	0.171
2. SVM model				
100	0.679	0.32	0.231	0.201
200	0.668	0.331	0.21	0.204
300	0.678	0.321	0.204	0.231
400	0.693	0.306	0.206	0.233
500	0.699	0.3	0.21	0.214
600	0.703	0.296	0.198	0.233
700	0.709	0.29	0.193	0.238
800	0.716	0.283	0.189	0.243
900	0.722	0.277	0.184	0.249
1000	0.729	0.27	0.179	0.254
3. Neural network model				
100	0.74	0.26	0.21	0.104
200	0.732	0.2679	0.22	0.105
300	0.771	0.228	0.191	0.123
400	0.721	0.278	0.187	0.107
500	0.714	0.285	0.178	0.123
600	0.717	0.282	0.168	0.124
700	0.711	0.288	0.158	0.128
800	0.705	0.294	0.149	0.132
900	0.698	0.301	0.139	0.136
1000	0.692	0.307	0.129	0.14
4. Proposed model				
100	0.789	0.1025	0.102	0.121
200	0.745	0.107	0.108	0.104

(continued)

Table 1 (continued)

Number of project files	True positive	False positive	True negative	False negative
300	0.796	0.203	0.105	0.111
400	0.785	0.156	0.102	0.107
500	0.756	0.141	0.102	0.106
600	0.767	0.161	0.102	0.102
700	0.785	0.174	0.101	0.099
800	0.811	0.186	0.101	0.097
900	0.831	0.199	0.1	0.094
1000	0.859	0.212	0.099	0.091

6 Conclusion

The review dependent on the semantic web fundamentally engaged upon the quality appraisal using the work assessment. job, Basically the COCOMO model utilized for assessment is contrasted and the proposed work and further on the basis of confusion matrix parameters precision, recall, f-measure, precision are determined and relative examination utilizing proposed model against COCOMO II, SVM and NN is performed. The general examination shows that the proposed model accomplished better outcomes as contrast with COCOMO II model. The concentrate likewise considers the product advancement measure utilizing various variables, programming exertion assessment, and cost assessment models. The writing read for this primarily focused on quality, GA dependent on Quality evaluation, SVM, Hybrid based quality appraisal. During the correlation of COCOMO II with proposed work different models are used. The relative investigation of assessment boundaries (tp, fp, tn, fn) are registered by utilizing proposed model against COCOMO II, SVM and NN models. The normal of assessment boundaries for example tp, fp, tn, fn by utilizing COCOMO II model is determined as 0.722, 0.285, 0.242, 0.205 individually. The normal outcomes assessment boundaries tp, fp, tn, fn by applying on proposed model is processed as 0.792, 0.164, 0.102, 0.103. The execution characterizes that the proposed model is superior to the COCOMO II model. It has been seen that the analyzed normal of accuracy esteem, review, f- measure and precision by utilizing proposed model is registered as 0.829, 0.885, 0.856, and 68.173. By contrasting the proposed model and existing COCOMO II model normal of accuracy esteem, review, f-measure and exactness by utilizing determined as 0.715, 0.776, 0.745, and 49.837. It depicts that the proposed model give better outcomes as contrast with COCOMO II model. The reenactment result dependent on exertion examination gives the proportion of execution quality. The general consequence of the work examination depicts that the proposed model (SVM + NN) give preferable outcomes rather over the COCOMO II, SVM and NN. The outcome utilizing exertion assessment is partitioned based on two principles, first guideline depends

on 5% exertion examination and second standard depends on 10%. The normal % of exertion investigation utilizing proposed model is processed as 127.729.

The use of number of parametric review infer that the proposed model that is corresponded with the work investigation and MAE is processed by utilizing four models that are COCOMO II, SVM, NN and proposed model. The best result of MAE is computed by the proposed model. The average worth of the MAE utilizing proposed model is registered as 0.012. After MAE the following boundary is assessed that is RMSE. The recreation consequences of RMSE are shows that the better result of RMSE is computed by using proposed model. The average % value of RMSE utilizing proposed model is figured as 0.051.

SD is likewise processed for exertion investigation by utilizing proposed model against COCOMO II, SVM and NN. The best outcome is processed by utilizing proposed model. The normal % worth of SD utilizing proposed model is processed as 3.03107.

The last parameter that is computed in proposed work is that SE parameter. It is computed by using proposed model against COCOMO II, SVM and NN. The reenactment results are executed based on two guideline set. The standard set is partitioned into 10% or 5%. The general outcome assessment characterize that the proposed model give better outcomes as contrast with different models. The general assessment based on proposed work portrays that the proposed model is superior to different models. The work assessment is done through the proposed model is superior to different models. In future work, one more method will be utilized for exertion assessment. In proposed work, just engaged upon the work however in future it is feasible to appraise exertion assessment just as cost assessment.

References

1. Molokken K, Magen J (2003) A review of software surveys on soft- ware effort estimation. In: Empirical software engineering. International symposium on IEEE, p 223
2. Schmidt R, Lyytinen K, Cule P, Keil M (2001) Identifying software project risks: an international Delphi study. J Manag Inf Syst 17(4):5–36
3. Shepperd M, Schofield C (1997) Estimating software project effort using analogies. IEEE Trans Softw Eng 23(11):736–743
4. Basha S, Dhavachelvan P (2010) Analysis of empirical software effort estimation models, pp 1–10
5. Attarzadeh I, Ow SH (2011) Improving estimation accuracy of the COCOMO II using an adaptive fuzzy logic model. Fuzzy Systems (FUZZ). IEEE International Conference on IEEE, pp 2458–2464
6. Boehm BW, Madachy R, Steece B (2000) Software cost estimation with Cocomo II with Cdrom. Prentice Hall PTR
7. Boehm BW, Valerdi R (2008) Achievements and challenges in Cocomo-based software resource estimation. IEEE Softw 25(5):1–10
8. Zadeh LA (1994) Fuzzy logic neural networks and soft computing. Commun ACM 37(3):77–85
9. Idri A, Alain A, Kjiri L (2000) COCOMO cost model using fuzzy logic. In: 7th international conference on fuzzy theory & techniques, pp 1–4
10. Mittal A, Parkash K, Mittal H (2010) Software cost estimation using fuzzy logic. ACMSIG-SOFT Softw Eng Notes 35(1):1–7

11. Xu Z, Khoshgoftaar TM (2004) Identification of fuzzy models of software cost estimation. Fuzzy Sets Syst 145(1):141–163
12. Chen Z (2005) Finding the right data for software cost modeling. IEEE Softw 22(6):38–46
13. Malik N, Goyal SK, Malik V (2017) Quality assessment of semantic web based Applications and Saas. In: Presented in ISPCC—4th IEEE international conference JUIT Solan and published in IEEE Xplore
14. Malik N (2014) Ontology based test case reused a semantic web technique national conference RAPS-2014. PEC University of Technology, Chandigarh
15. Yadav RK, Niranjan S (2017) Optimized model for software effort estimation using cocomo-2 metrics with fuzzy logic. Int. J. Adv. Res. Comput. Sci 8

Design and Method of 16.24 GHz Microstrip Network Antenna Using Underwater Wireless Communication Algorithm

S. Meivel, Nidhi Sindhwani, S. Valarmathi, G. Dhivya, M. Atchaya, Rohit Anand, and Sudhanshu Maurya

Abstract A micro strip antenna or printed antenna has been designed for 16 GHz radiation agreement in the Network antenna for support saltwater of undersea whereas using coverage with large density. One of the major applications of this design is the ability to transfer a proper communication and increasing the efforts of delivering the conditional and unconditional information about working level from undersea water/saltwater. This method of designing an antenna is made using MAGUS and HFSS software. The simulated result shows the good effective radiation where the S11 parameter value is 20 dB for the resonant frequency 16.24 GHz. The three-dimensional view of the proposed antenna is also shown. The design of the proposed antenna design is very much significant for a lot of wireless communication applications under saltwater/sea level also. This method may be applied for any ocean wireless communication if possible in future. The performance BW is typically 3% (minimum 2% to maximum 5%) while the complexity of the design is medium. The impedance is 50Ω with the major application in Wi-Fi base station.

Keywords Microstrip antenna · Underwater · Gain · Wireless communication

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1 Introduction

An antenna is a passive device that translates power present in electrical form into waves in the form of electromagnetic (EM) energy. An antenna consists of a metal conductor that conveys radio frequency waves between two points in space. A rectangular patch [1, 2] antenna is used to calculate the free space wavelength. For antenna design using under water communication, the propagation of EM waves is very much challenging if the electric field intensity of the wave is depleted due to the high value of dielectric constant of the medium. A rectangular microstrip antenna is designed using the appropriate formulae and is fabricated using the quick fabrication procedure and its tested using Network analyzer [3].

The proposed antenna is designed in 16 GHz frequency range. Even though the antenna is desired to operate at this frequency, but when tested practically it is found that, it is resonating at 16.24 GHz. This research work presents an underwater configuration of a microstrip antenna. The various electromagnetic parameters like return loss/Voltage Standing Wave Ratio, antenna gain, and bandwidth are calculated. The antenna is found to be significant in so many high-speed applications because of its excellent characteristics, low cost, small length wire, suitable shape and simple construction.

2 Literature Survey

The authors in Ref. [4] described underwater wireless communication network and sensors. This work described the co-ordination of UAV information. It is feasible to design this antenna at high data rates for the distances up to 100 m. Message Communication traverses very long distance despite of the severe medium. But the water turbidity is high or distance between the terminals is large. So, system can also operate in low data rates. The authors in Ref. [5] described the underwater Antenna communication systems. They discussed the various seawater network algorithms and reported the antenna wave propagation results in some particular areas. The paper [6] described an antenna with good impedance matching at 433 MHz to be used in underwater WSN in free space as well as water with no impedance matching circuit required. The design predicted the distance and attenuation at high frequencies. The authors in Ref. [7] accessed the conductivity and input impedance of a loop antenna for the underwater communications. The type of antenna avoids airborne transmission with poor noise immunity. The simulation model of an originally optimized antenna has been done for the underwater communication systems in ref. [8]. It has been calibrated in 20 dB range of signal. The reference paper [9] described fresh water identification using underwater communication antenna to improve the bit error rate performance. In Ref. [10], the authors proposed a high directivity underwater communication antenna with very high gain for return loss −29.21 dB. The

reference paper [11] gave an overview of several techniques of underwater communication antenna systems with networks to solve deep water bed problems and the possible solutions for underwater communication network issues. The results of the paper [12] analyzed a 433 MHz RF antenna results and leads array patch angle while achieving the distances of 7 m at 1.8 Kbps and 5 m at 26 Kbps. The reference paper [13] described lack of sensitivity to sea water variability using underwater communication antenna equipment. The antenna prototype can be set as 70 MHz bandwidth and around 2.4 MHz for Wi-Fi under water Communication.

3 Antenna Design

The communication with submerged submarines by means of radio waves is limited to the VLF band of frequencies or lowers because of the large attenuation in seawater brought about by the high conductivity. The antenna submerged in sea water transmits the signal up to the air-sea interface and would be severely attenuated. An attenuation of 100 dB would have a devastating effect on the power requirements of the transmitter. It is described by using patch antenna theory, combined with some general array theory as a simple array theory does not take mutual coupling into account. The design of microstrip antenna is based on dielectric substrate and copper ground plane. Our design can be used for the missiles by rectangular and circular microstrip resonant patches with planar arrays. In under water communication, we have used low loss tangent substrate at higher frequencies [14–17]. The antenna is implemented in MODEM devices for measuring the reflection parameters.

3.1 Detailed Description of the Design

The centre frequency of the antenna is 16.24 GHz that we want to set and operate in order to transmit the ultrasonic waves under water. At the range of minimum distance, GPS tracer location is at every 5 km. If any object is detected, the waves are to be propagated and the communication process is done. The number of patches is 8. The patch width and length are approximately 7 mm and 6 mm. The patch spacing from the centre is 11.07 mm. The substrate height, relative permittivity and loss tangent are 248.8 μm, 2.2 and 0. Top view of the rectangular patch antenna shows the conducting patch and the bottom ground creates radiation from the antenna. The design view is metallic strip placed on a ground plane with dielectric materials from the edges of antenna. Figure 1 shows the preview of an (N × 1) microstrip array of rectangular shape with the corporate feed antenna.

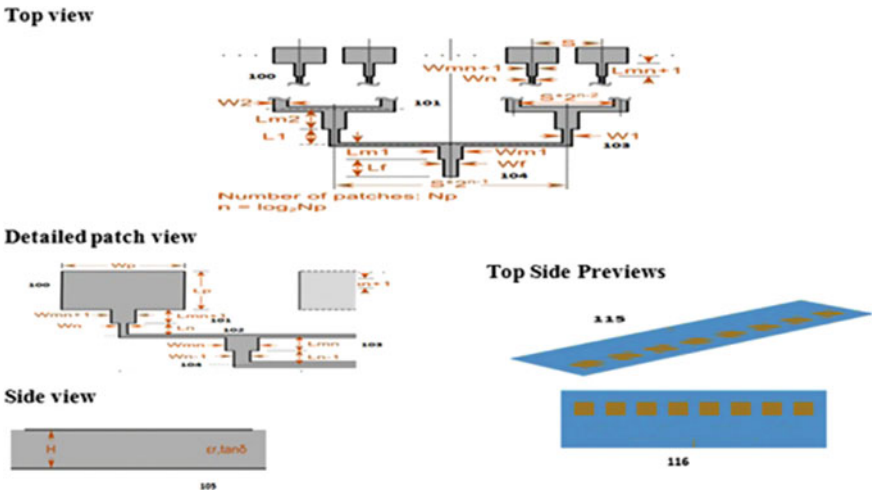

Fig. 1 Design of N-by-1 rectangular patch array with corporate feed

3.2 Antenna Design: N × 1 Rectangular Microstrip Array with Corporate Feeding

In Fig. 1, an (N × 1) rectangular shaped microstrip antenna array has been designed with corporate feed for the mobile network and device network using Magus Software. The placed spare parts are the patch views of antennas and top side previews of antennas and side view of antennas. It is designed with centre frequency 16.24 GHz using 8 patches, six Network lines, seven matching lines.

In this diagram $w_{2'}$ is network line 2 width whereas it is connected to Matching line LM_2. Thus 'L_1' Network line 1 length is joined with LM_1' Matching line 1 length, Here L_f is known as feed line length, W_f is known as feed line width.

4 Methodology of Antenna Design

In this antenna, we can connect an ultrasonic sensor, modulators and GPS modem [18–20] using satellite network for high speed underwater network from sea level to depth of water 0 to 100 m. This antenna supports transmitter and receiver method to transfer the sound waves through ultrasonic wave sensor. There are so many different types of RF Receiver antenna. The two most common are monopole and dipole antennas, which have been originated from transmission line theory [21]. Here we have designed a microstrip antenna operating at 16 GHz frequency and hence we can operate the working within 5 km access Network.

When an electric pulse of high voltage is produced, it's vibrated in a particular spectrum of frequencies and produces sound waves. Audio and Video Receiver

refers to the antenna type supporting audio, video signal and satellite receiver signal using remote controller. The carrier generator restores the power of running signal and can pass through a strong signal with this support of generator for effective communication process [22, 23].

4.1 Antenna Design Algorithm

In Fig. 2, the fabrication of antenna design is explained in terms of an algorithm. The proposed antenna is useful for the aerospace and defense applications. A new approach is needed to meet next-generation antenna requirements. To miniaturize the dimensions of the antenna, a substrate material having large value of relative

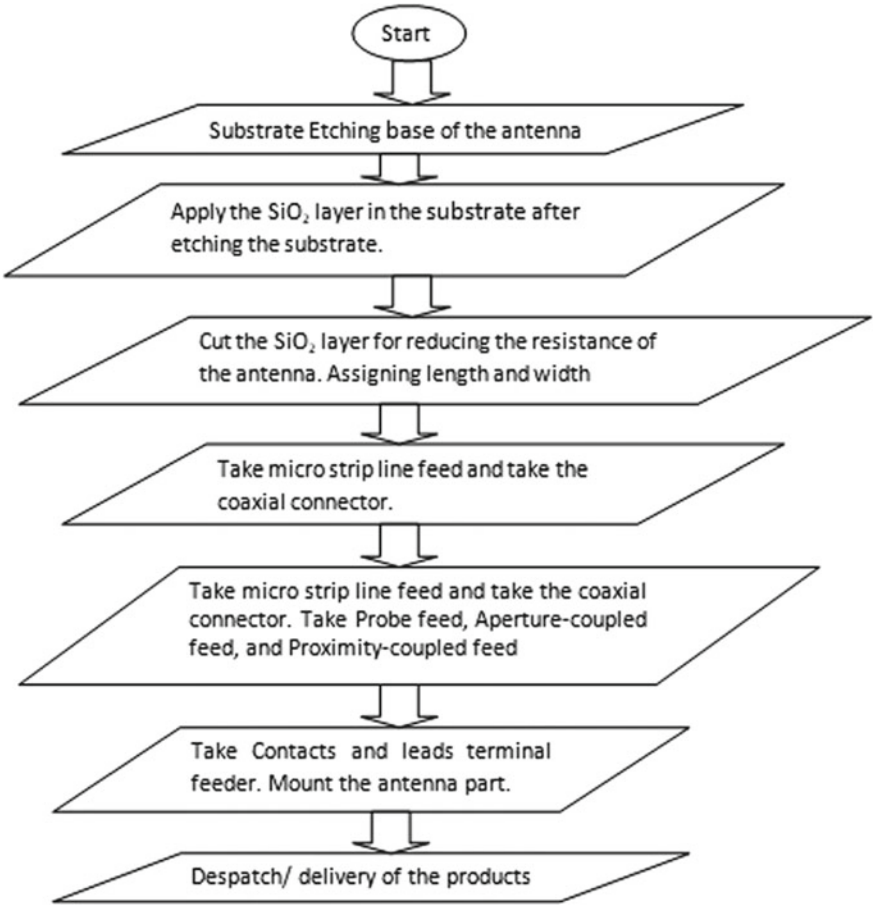

Fig. 2 Algorithm for fabrication of antenna design

permittivity should be used although it might be somewhat expensive and it might result in the deviation of the frequency (because of its tolerance) that causes the bandwidth to be quite narrow. The most commonly used materials used for the substrates of the microstrip geometries antennas include ceramic, semiconductor, ferromagnetic, synthetic, composite, and foams. The most important features of the substrate materials while designing the microstrip antennas are relative permittivity (ε), Q-factor, and coefficient of temperature for the resonant frequency (τ_f). Some more properties thermal attributes, sintering temperature, thermal properties, and chemical competitiveness in concerned with the various aspects of fabrication.

4.2 Fabrication Process

Step 1 Generation/production of the mask on film (transparency substrate).
Step 2 Exposure process.
Step 3 Etching in developer Solution.
Step 4 Etching in the Ferric chloride.
Step 5 Soldering the probe.

Antenna fabrication focuses the top and bottom layers in DXF format in first step. UV exposure photo-resists the circuit pattern image in laminated board. Then the exposed resist developed solution is washed. Subsequently, the spray wash removes the solution to remove the unwanted copper place in PCB in next step. Finally, the etching, soldering and feeding the copper place is performed for contacts.

5 Underwater Communication Algorithm

The algorithm for the underwater communication is explained below:

Step 1 Signal is tracked through GPS under the water.
Step 2 Under water communication uses ultrasonic waves instead of the electromagnetic waves.
Step 3 Radio wave propagates under water at extremely high frequencies (16 GHz & above) that requires a large antenna and high transmission power else acoustic waves are the best solution for communicating under water. The frequency range more than 1 MHz is less commonly used as this range is very low susceptibility under water.
Step 4 RF detector translates discrete data into underwater audio signals that can be collected by a GPS modem IC that can be converted back into digital data.
Step 5 The control under water instrument acquires the data that has been collected remotely.

The same technology may also be utilized for controlling small and unmanned submarines, referred to as autonomous under sea vehicles (‘AUVs’) in real time applications.

When the GPS is tracking an object within 15 km location, its process is onto the Network availability and then communication process is at 16.24 GHz with the help of ultrasonic sensor waves. If the object is detected, it means that the ultrasonic sensor wave transmission and reception process will be executed otherwise communication is not done. These communications are executed in underwear via RF antenna. If the object is not detected, it means that the GPS process is tracking another GPS location within the location (i.e. 15 km). The receiver side reaches the signal with effectiveness. The same loop process is circulated again and again vice versa.

6 Results and Analysis

Antenna input impedance is the most complicated. So the current is proportional to frequency of the designed antenna. The frequency of antenna generates input impedance matching of radiation with reflection coefficient. Transmission network depends on $50\Omega + 0\Omega$ with VSWR value 6.

Voltage Standing Wave Ratio (VSWR) of the antenna indicates the reflections of the waves. Smaller the value of VSWR, more would be the impedance matching of the antenna. The frequency range having VSWR lower than 2 determines the bandwidth for which the antenna radiates effectively. The plot of VSWR is shown in Fig. 3.

The plot of the gain with respect to angle determines the 2D radiation pattern of the antenna. It might be concluded from Fig. 3 that the antenna is having maximum gain in the broadside direction. The gain plotted has been normalized to indicate the radiated power with reference to the maximum power. The antenna voltage gain and current gain mention all direction radiation of antenna. This antenna radiates to all directions. The co-polarization is the desired polarization of the radiated wave (which is 40 dBi). Cross polarization also known as X-polarization is the orthogonal radiation of the desired linear, circular and elliptical polarization (for example if the

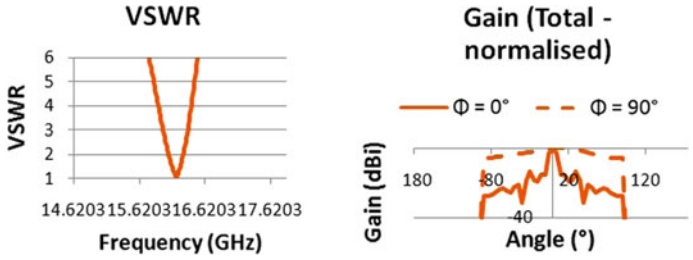

Fig. 3 Graph of VSWR and Gain for the proposed antenna

desired is horizontal then the orthogonal will be vertical and if the desired is Right hand polarized the orthogonal will be left hand polarized). The cross-orthogonal component level is approx. 31 dBi.

7 Conclusion

The performance of an undersea microstrip antenna has been analyzed in this paper. The experimental results have been obtained for the micro strip antenna in terms of the overall normalized gain. Furthermore it also includes the measurements of antenna characteristics. The antenna design has been facilitated with high data rates and moderate underwater distance data communication. The antenna should be implemented in underwater communication with location tracking environment equipment. The support of GPS is locating information conveyed to the receiver with range of 5 km distances. For the critical situation, we can analyze where we want to move on to avoid the risks. The proposed antenna may be useful for the human protection environment scenario. The trust base mechanism of microstrip antenna is easy to implement for the continuity of antenna design works. The process of design is implemented in underwater communication with reduced complexity of the work design manner. We have made the better communication in between the transmitter and receiver side.

References

1. Anand R, Chawla P (2020) A novel dual-wideband inscribed hexagonal fractal slotted microstrip antenna for C-and X-band applications. Int J RF Microw Comput Aided Eng 30(9):e22277
2. Sindhwani N, Singh M (2016) FFOAS: antenna selection for MIMO wireless communication system using firefly optimisation algorithm and scheduling. Int J Wirel Mob Comput 10(1):48–55
3. Anand R, Chawla P (2020) Optimization of inscribed hexagonal fractal slotted microstrip antenna using modified lightning attachment procedure optimization. Int J Microw Wirel Technol 12(6):519–530
4. Inácio SI, Pereira MR, Santos HM, Pessoa LM, Teixeira FB, Lopes MJ, … Salgado HM (2016) Antenna design for underwater radio communications. In: OCEANS 2016, pp 1–6. IEEE, Shanghai
5. de Paillette TD, Gaugue A, Parlier E, Dardenne S (2017) Antenna design for underwater wireless telemetry systems. In: 11th European conference on antennas and propagation (EUCAP), pp 2251–2255. IEEE, Paris
6. Sudhaman K, Godhavari T, Anusha R (2020) IOP conference series: materials science and engineering, vol 993, no. 1, 012066, pp 1–6. IOP Publishing
7. Basheer B, Pulickal N (2018) High frequency antenna design challenges for underwater communication. An intensive probe. Oceanogr Fish Open Access J 5(5):111–112
8. Mendez HFG, Le Pennec F, Gac C, Person C (2011) Deep underwater compatible Wi-Fi antenna development. In: 14th international symposium on wireless personal multimedia communications (WPMC), pp 1–5. IEEE, Brest

9. Ali MF, Jayakody DNK, Chursin YA, Affes S, Dmitry S (2020) Recent advances and future directions on underwater wireless communications. Arch Comput Methods Eng 27(5):1379–1412
10. Alhawari AR, Majeed SF, Saeidi T, Mumtaz S, Alghamdi H, Hindi AT, … Abbasi QH (2021) Compact elliptical UWB antenna for underwater wireless communications. Micromachines 12(4):411
11. Aboderin O, Pessoa LM, Salgado HM (2017) Performance evaluation of antennas for underwater applications. In: 2017 wireless days, pp 194–197. IEEE, Porto
12. Saeed N, Celik A, Al-Naffouri TY, Alouini MS (2019) Underwater optical wireless communications, networking, and localization: a survey. Ad Hoc Netw 94:101935
13. Jouhari M, Ibrahimi K, Tembine H, Ben-Othman J (2019) Underwater wireless sensor networks: a survey on enabling technologies, localization protocols, and internet of underwater things. IEEE Access 7:96879–96899
14. Dahiya A, Anand R, Sindhwani N, Deshwal D (2021) Design and construction of a low loss substrate integrated waveguide (SIW) for S band and C band applications. MAPAN, pp 1–9. https://doi.org/10.1007/S12647-021-00449-X
15. Srivastava A, Gupta A, Anand R (2021) Optimized smart system for transportation using RFID technology. Math Eng Sci Aerospace (MESA) 12(4):953–965
16. Dahiya A, Anand R, Sindhwani N, Kumar D (2021) A novel multi-band high-gain slotted fractal antenna using various substrates for X-band and Ku-band applications. MAPAN, pp 1–9. https://doi.org/10.1007/s12647-021-00508-3
17. Anand R, Chawla P (2016) A review on the optimization techniques for bio-inspired antenna design. In: 3rd international conference on computing for sustainable global development (INDIACom), pp 2228–2233. IEEE, New Delhi
18. Singh L, Saini MK, Tripathi S, Sindhwani N (2008) An intelligent control system for real-time traffic signal using genetic algorithm. In: AICTE sponsored national seminar on emerging trends in software engineering, vol 50
19. Sindhwani N, Singh M (2014) Transmit antenna subset selection in MIMO OFDM system using adaptive mutation Genetic algorithm. arXiv preprint arXiv:1410.6795
20. Saini MK, Nagal R, Tripathi S, Sindhwani N, Rudra A (2008) PC interfaced wireless robotic moving arm. In: AICTE sponsored national seminar on emerging trends in software engineering, vol 50
21. Chibber A, Anand R, Arora S (2021) A staircase microstrip patch antenna for UWB applications. In: 9th international conference on reliability, infocom technologies and optimization (Trends and Future Directions) (ICRITO), pp 1–5. IEEE, Noida, India
22. https://doi.org/10.23919/INDIACom54597.2022.9763277
23. Anand R, Chawla P (2022) Bandwidth optimization of a novel slotted fractal antenna using modified lightning attachment procedure optimization. In: Smart antennas, pp 379–392. Springer, Cham

IoT Security Using Machine Learning Techniques

R. Ganesh Babu, S. Markkandan, V. Vinotha, S. Priyadarshini, and V. Kaviya

Abstract Internet of things (IoT) devices that integrate into networks should provide increasingly sophisticated services that must protect security and privacy besides address threats along with spoofing, denial of service, jamming, and surveillance. Throughout this paper, we look at the proposed scheme for IoT systems along with IoT security products that use machine learning techniques like deep classification, unsupervised classification, and classification algorithms. To protect data privacy, we concentrate on IoT with machine learning-based verification, secure unloading, and malware detection system. We will talk about the obstacles of implementing machine learning-based security strategies in real-world IoT devices.

Keywords IoT security · Machine learning · Denial of service · Surveillance · Malware detection system

1 Introduction

For the first time, the term "Internet of Things" represented supply chain facets to the general public. The concept was so intriguing that it expanded quickly over the last few years. Sensors and actuators are the most basic IoT utilities; these are low-resource devices. Shall indicate, which use limited resources than edge devices, are another type of IoT device [1]. As the advancement of IoT devices progresses, data transmission between devices becomes more common, and data security is now an issue. Correct selection within an IoT network presents several challenges. The security protocol serves as the foundation for all system communication as well as verification. Physical security entails the following steps: registration, authorization, and certificate formation, certificate sharing, verification, and access control [2]. To overcome this concern of securing IoT devices, humans propose utilizing machine learning inside an IoT device to assist in system security. In this document, we present an idea that the client who wants to gain access to an IoT device can qualify to the

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cloud utilizing cryptography [3]. Once the IoT system authorizes the customer, a machine learning algorithm keeps logs of customer authorization mistakes [4]. This concept's goal will provide security for IoT systems.

2 IoT Security

Performing computationally hard and frequent security activities on IoT devices with limited simulation, memory, broadcast bandwidth [5], with battery capacity is usually prohibitive, especially when dealing with massive data streams. However, many other current security solutions place a high communication and computation burden on IoT system and also low-cost sensors to glow security mechanisms [6] be typically additional resistant to threats to computer networks. We will look at IoT verification, authentication, secure unloading, and malware detection [7] shown in Fig. 1.

- Authentication helps IoT devices identify between source nodes that defend against connection attacks like spoofing as well as Sybil attacks [8].

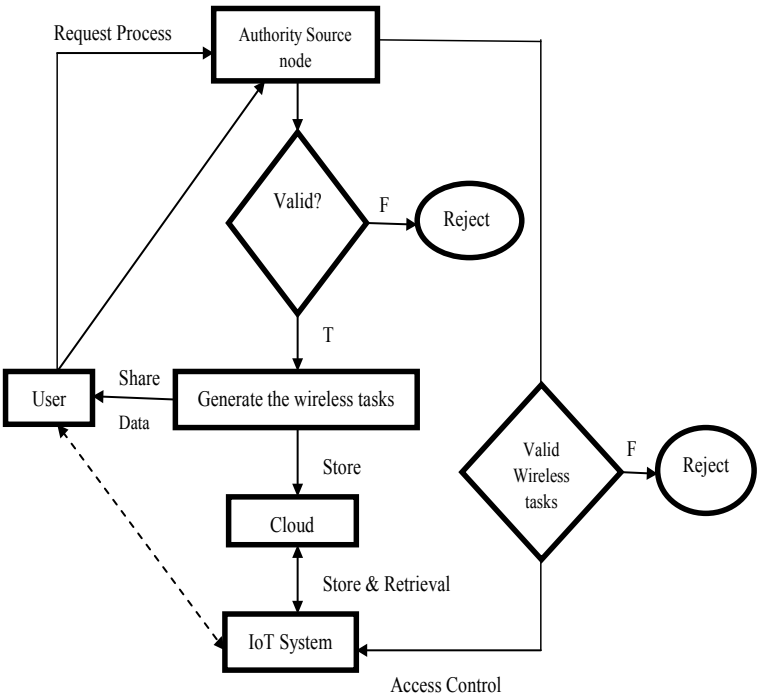

Fig. 1 The architecture of authentication support in IoT system

- Authenticating users prevents unauthorised individuals from accessing IoT services.
- Besides expensive data and wireless tasks, secure unloading techniques allow IoT devices to compute and store resources with servers and edge devices.
- Malware detection safeguards IoT devices against data leakage, power drain, and data quality destruction caused by malware and viruses, cloud with Spyware.

Through advancements to machine learning (ML) and intelligent attacks in IoT, gadgets must select a military policy and identify critical limitations within the security protocols again for exchange in a heterogeneous network. This approach is hampered by the fact that IoT devices with limited capabilities have a hard time accurately assessing the total infrastructure and assault level in real time.

The system authentication quality in, for example, is to responsive application systems in the suggestion test that is dependent on equally to radio channel model with also spoofing model. Often these outdoor sensors lack this information, resulting in an elevated false positive rate; otherwise, forget detection rate in sending fake recognition.

3 Proposed Methodology

Machine learning techniques such as supervised classifications, un-supervised classifications, as well as reinforcement learning (RL) have been commonly used to increase network security for purposes such as authentication, security systems, anti-jamming offloading, and malware detection.

Support vector machine (SVM), K nearest neighbour (K-NN), deep neural network (DNN), naive Bayes, as well as decision tree are supervised classification methods which could be used to categorise network activity or software traces from IoT devices in order to build a classification and problem representation. In addition to spoofing attacks, IoT devices may use SVM to detect network encroachment, K-NN to detect the network incursion as well as malware, and also neural networks to identify the network encroachment and DoS attacks. In IoT devices, Naive Bayes for vulnerability scanning and just an irregular timber algorithm for user authentication could be used. DNN can detect perceptual distortion in IoT devices in order to provide adequate stimulation and physical memory.

Algorithm of Random Forests.

Step 1: Choose measurements at random from such a given dataset.
Step 2: The above algorithm would then construct a tree structure for every sample. When each decision tree has been designed, the approach will be obtained.
Step 3: Voting for each projected outcome will take place in this step.
Step 4: Finally, choose the most popular prediction performance as a predicted outcome.

As a result, if the values of the supervised classification techniques (i.e., the regression equation) corresponding to several independent variables need to be evaluated using any established formulae, all the detected quantitative data in the formula must be used in the computation of each assessment. If unsupervised classification techniques are used in their (simplest) form, this repetitive computation can be obtained in Eqs. (1) and (2).

$$y = a1_0 + a1_1 x + a1_2 x^2 + a1_3 x^3 + \cdots + a1_n x^n \tag{1}$$

$$a1_0, a1_1, a1_2, a1_3, \ldots, a1_n \tag{2}$$

Let,

$$(x_0, y_0), (x_1, y_1), (x_2, y_2), \ldots, (x_{n-2}, y_{n-2}), (x_{n-1}, y_{n-1}), (x_n, y_n) \tag{3}$$

x–y plane n points in Eq. (4)

$$y = f(x) = a1_0 + a1_1 x + a1_2 x^2 + \cdots + a1_n x^n, \quad a1_n \neq 0 \tag{4}$$

where x and y are a constant variable.

Unsupervised learning, unlike supervised learning, does not require a classification model and instead looks for similarities between unlabeled to band them into the various groups. For instance, IoT devices can detect DoS attacks using multivariate correlation and use IGMM throughout PHY-layer verification with data privacy in Eq. (5).

$$(x_n, y_n), (x_{n-1}, y_{n-1}) \tag{5}$$

x–y plane two points in Eq. (6)

$$y = ax + b \tag{6}$$

where a and b denote the parameters to be calculated from its two points in Eqs. (7)–(9).

$$\begin{aligned} y &= a(x - x_n) + b + \{ax - a(x - x_n)\} \\ &= a(x - x_n) + (b - ax_n) \end{aligned} \tag{7}$$

$$\begin{aligned} y &= A(x - x_n) + B \\ A &= a \& B = b + ax_n \end{aligned} \tag{8}$$

$$(x_n, y_n), (x_{n-1,} y_{n-1}), (x_{n-2}, y_{n-2}) \tag{9}$$

where x and y denote from its three points in Eqs. (10)–(13).

$$y = ax^2 + bx + c \tag{10}$$

$$\begin{aligned} y &= a(x - x_n)(x - x_{n-1}) + bx + c + \{ax^2 - a(x - x_n)(x - x_{n-1})\} \\ &= a(x - x_n)(x - x_{n-1}) + \{b + a(x_n + x_{n-1})\}x + (c - ax_n x_{n-1}) \end{aligned} \tag{11}$$

$$\begin{aligned} &y = a'(x - x_n)(x - x_{n-1}) + b'x + c' \\ &a' = a, b' = b + a(x_n + x_{n-1}) \& c' = (c - ax_n x_{n-1}) \end{aligned} \tag{12}$$

$$b'x + c' \tag{13}$$

Linear function in Eq. (14) is,

$$y = A(x - x_n)(x - x_{n-1}) + B(x - x_{n-1}) + c \tag{14}$$

Information retrieval techniques, including Q-learning and allow an IoT gadget to decide security measures, and A, B, and C are constant key parameters toward intruders through trial and error. Q-learning, for example, was utilized as a representation free RL classification technique to enhance the productivity of verification, anti-jamming delegate, as well as threat protection.

4 Result Analysis

IoT systems can unload device traces to the process outlined in the cloud otherwise edge systems to notice malware through such an outsized database, seek opportunities haste, more fabulous memories, as well as many additional influential security forces. The available radio state determines the optimum solution quantity with the draw to transfer to every edge system as well as a number of produced interface traces.

An IoT gadget have use Q-learning to attain the most favourable unloading rate in a malware recognition system established in. To determine the present condition, divides concurrent device draw into portions and monitors consumer density as well as radio station bandwidth, as shown in each IoT gadget. The IoT gadget estimates the sensors' gain, detection delay, and energy usage to determine the utility obtained throughout that time. In comparison to the conventional unloading strategy in the 100 portable devices network, these seeking improvements detection accuracy by 43%, reduces disciplinary and grievance procedures by 17%, and increases portable device show in Fig. 2 utility by 49%.

The Dyna-Q-support malware analysis system is obtainable in takes advantage of the Dyna infrastructure to recognize from hypothetical observation and find the

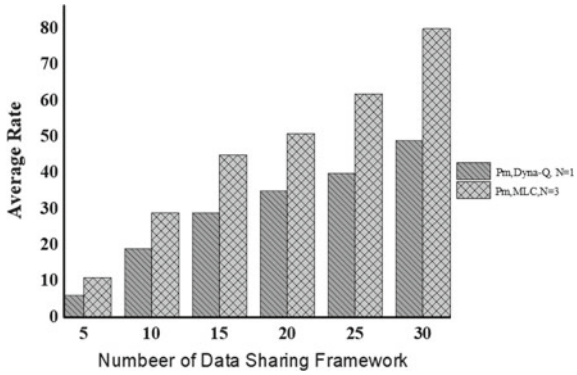

Fig. 2 Performance analysis of data sharing in IoT system

best offloading strategy. To improve learning performance, this scheme uses both real-world defence and unique systems generated by the Dyna infrastructure. For example, compared to Q-learning detection, this approach minimizes recognition latency by 31% and adds to detection correctness by 19%.

To address Dyna-false Q's virtual experiences, particularly at the start of the knowledge process, the PDS analysis of the residential malware scheme employs the famous available radio framework to go faster classification efficiency. This system improves discovery efficiency by utilizing recognized information about the network, attack, quality factor, and Q-learning to analyze the remaining unidentified feature space. In a network of 200 portable devices, this scheme improves recognition accuracy show in Fig. 3 by 27% when evaluating the Dyna-Q bottom system.

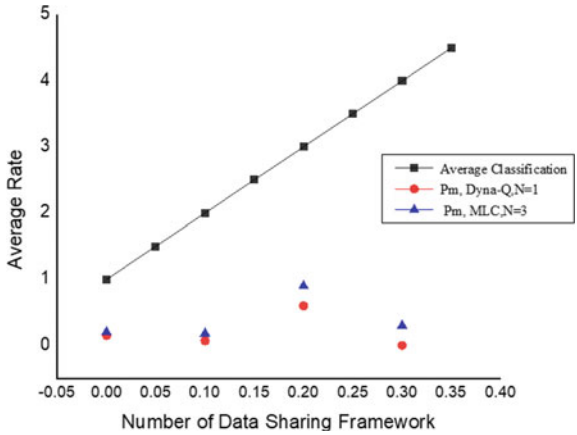

Fig. 3 Performance analysis for machine learning classification using data sharing in IoT framework

5 Conclusion

We suggested a surveillance data sharing framework for decentralized different parties manufacturing IoT systems that incorporate participants learned into permission. The outstanding statistical results demonstrated that our distributed ledger data are sharing structure security without authorizing centralized confidence. Furthermore, by incorporating federated learning further into the decentralised consensus process, we improved the utilization of computational services and the efficiency, including its data-sharing framework. Results from two extensive real-world experiments confirmed that our possible framework can allow protected information sharing to elevate efficiency.

The integration of cryptocurrency with cooperative learning appears to be a promising approach to enabling secure and intelligent information sharing in an IoT. Though, well how resourcefully ensure information isolation using cryptocurrency is an open question that requires investigation supplementary by analyzing the most security intimidation and initial extra innovative solutions.

References

1. Hossain E, Khan I, Un-Noor F, Sikander SS, Sunny MSH (2019) Application of machine learning and big data and in smart grid associated security concerns: a review. IEEE Access 7(3):13960–13988
2. Ali ES, Hasan MK, Hassan R, Saeed RA, Hassan MB, Islam S, Nafi NS, Bevinakoppa S (2021) Secure vehicular communication in internet of vehicles: advances. Secur. Commun. Netw. 21(2):1–23
3. Syafrudin M, Alfian G, Fitriyani N, Rhee J (2018) Big data processing for real-time monitoring system in automotive manufacturing. Sensors 8(9):1–24
4. Soe YN, Feng Y, Santosa PI, Hartanto R, Sakurai K (2020) IoT-botnet attack detection architecture. Sensors 20(16):4372–4472
5. Rehman A, Haseeb K, Saba T, Lloret J, Tariq U (2021) Big data analytics for internet of things. Electronics 10(11):1273–1278
6. Ganesh Babu R, Nedumaran A, Asefa S (2019) Machine learning in IoT security performance analysis of outage probability of link selection for cognitive networks. In: Third IEEE international conference on IOT in social, mobile, analytics and cloud (I-SMAC), pp 15–19. IEEE Press, Palladam, India
7. Chellaswamy C, Ganesh Babu R, Saravanan M, Abirami M, Boosuphasri R, Manjalam B (2020) Machine learning based condition recognition system for bikers. In: 7th IEEE international conference on smart structures and systems (ICSSS 2020), pp 1–6. IEEE Press, Chennai, India
8. Karthika P, Ganesh Babu R, Karthik PA (2019) Fog computing using interoperability and IoT security issues in health care. In: Sharma DK, Balas VE, Son LH, Sharma R, Cengi K (eds) Proceedings of third international conference on micro-electronics and telecommunication engineering. Lecture Notes in Networks and Systems, vol 106. Springer, Singapore, pp 97–105

Performance Analysis of Sign Language Recognition System Using Hybrid Feature Descriptor

Jatinder Kaur, Nitin Mittal, and Sarabpreet Kaur

Abstract The main objective of this paper is to analyze the classifier performance for the recognition of sign language using hybrid feature descriptor. Techniques for the recognition of sign language are becoming highly important because these recognition systems help to reduce the communication barrier between sensory impaired people and normal human beings. There are various methods are used for the same but there is still a need for robust methods to be Deployed to upgrade the recognition results. The sign Language system is used for the interpretation of hand gestures that are used by the sensory impaired persons. For analyzing the output of various classifiers for evaluating the best one, for the recognition of sign language, the proposed framework considers accuracy as the main parameter. The hybridization of features has been explored to fulfill the objective of this work. In this study, at the preprocessing stage (First stage of recognition process), two main parameters (PSNR, MSE) have been demonstrated for different filters for finding the appropriate filter to represent the effectiveness of a recognition model. The result of the work showed that the Median filter has a higher PSNR value. The finding of this article depicts that the Support Vector Machine has higher recognition accuracy as compared to the other classifiers using hybridization of features.

Keywords Pre-processing · Mean square error · Peak signal to noise ration · Gestures · Sign language · Segmentation · Classification

1 Introduction

Sign languages are an extremely important communication tool for sensory impaired people. Sign Language Recognition system has the possibility to reduce the communications barrier which exists between the sensory impaired people and normal

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people. The issue of effective hand gesture recognition is strongly connected to the difficulties of interaction between mute people (dumb and deaf) and ordinary human being. The fundamental objective of Hand gesture recognition is to improve the interaction between mute individuals and ordinary people [1].

When communicating with mute individuals, hand signals usually serve as a bridge for communication balance, and as a supportive mechanism for those in challenging situations. There is a need to hold a watch on the needs of the mute fraternity to maintain a harmony in terms of contact to assist them at the beginning of their growth [1]. The delay in the production of silent people-supporting structures leads to a huge loss in their early development as it can render them unable to communicate their views and opinions. Past studies in hand signal recognition concern the detection of hand signals that can be associated for objects that primarily involve hand occlusion or conditions of light [2]. It is very difficult to preserve the efficient identification of hand signals as it relies on accuracy and precision. The detection patterns are also heading towards automating the procedure and substituting smart detection for conventional manual methods [3].

With automation of recognition algorithms, image processing techniques [4] are gaining significance. There are several explanations why hand movements need to be remembered [5]. For decision-making at the management level, awareness of the extent of symbol datasets is needed since they are specifically related to groups of people [6]. Hand Gesture Recognition methods gains a lot of importance since algorithms helps to identify and interpret the input hand sign [7]. Sign recognition methods can be classifying into two categories based on two techniques viz. vision-based technique and contact-based that are using different input image acquiring way. In the case of vision-based sign language recognition system, sample input images are acquired sequentially with the help of camera [8]. For interpretation of the meaning of the hand gesture images based on the pose of hand in front of camera, passes through image processing stage. In contrast, the contact-based technique, used sensor-based gloves for acquiring the hand characteristics [9]. In actual, the contact-based technique is a glove-based system. In these system as the input is directly fed to the processing unit so for the instantaneous response this one is preferable method [10].

With a glove-based system, the user is needed to wear a sensor-based glove. The purpose of sensors in the gloves is to record hand characteristics like hand position. But these sensors affect the user's movement, and it can be inconvenient for the user. As the hands are of different shapes, it will result the misalignment of sensors comparative with the hand joints so the sensor-based method may not always be the best choice. Generally, the environmental conditions such as lighting conditions degrade the quality of image [11].

The vision-based technique used for sign language recognition are shown in Fig. 1. If the input to features extraction stage is from glove-based sensors instead of from dataset or camera then that technique is known as contact based technique. Therefore, the contact-based strategy is less flexible as user needs to wear a glove consistently. While vision-based technique permits user to cooperate distantly [12].

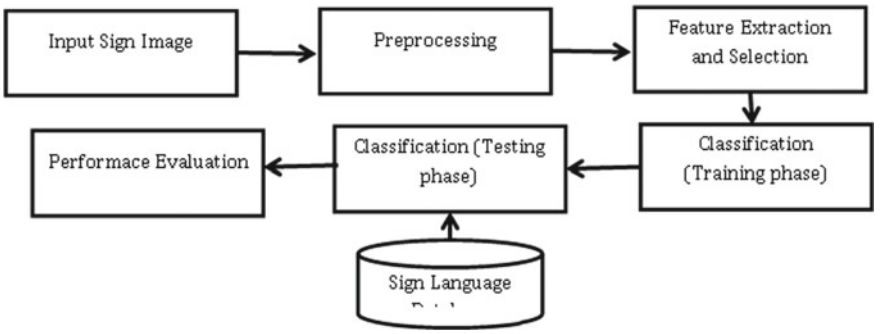

Fig. 1 Sign language vision based recognition technique

A Gesture is one of the main parts of physical behavior which is also known as an indication of emotional expression. It has body gestures in addition to hand gestures. The gesture on the hand and the form of an indication is indicated by the entire body. For the latter, the activity of the hand or the body communicates several messages [13]. The Fig. 2 depicts the exemplary hand symbol.

Each gesture can be categorized as dynamic and static gesture. Hand gestures whose position and orientation does not change within time will be referred to as static hand gestures [14]. When there are different modifications within the given time, these gestures are referred to as dynamic gestures [15]. The category of dynamic gestures like hand waving while static gestures incorporate hand movements to make signs like okay [16].

Sign language is not the same in different countries as in different areas within a world. Because of human characteristics, the same symbol is presented in a different way by different people. It is difficult to find a particular modeling technique that is strong enough to capture a specific language. It required to have a depth knowledge about the input acquired technology. The image sample requires conditioning in terms of denoising and removal of ghost artifacts. As sign varies in time and space, with the same person or person to person, there may be a shift in location and speed that makes

Fig. 2 Exemplary hand symbol

it difficult to identify gestures in real time. Design of systems for interpreting the meaning of symbols used in sign language for people with sensory impairments. It is generally not possible for a sign language interpreter to be always with the sensory impaired [15]. The rest of work is organized as follow: Sect. 2 present the relevant literature review. The next section discussed the methodology adopted in the present research and Sect. 4 present the findings. The last section presents the concluding remarks. Researchers have successfully attempted to implement different algorithm to improve the accuracy of Indian and American Sign Language.

2 Methodology

Automatic recognition research of sign language recognition is also in its infancy due to high precision and classification of hand gestures. However, to improve accuracy and classification, efficient strategies do need to be deployed. This Work will concentrate on upgrading the first stage of classification, i.e., pre- processing stage with the objective of improving the accuracy of classifier training. There is a need for high contrast images and noise reduction to design a highly accurate method for sign identification and classification. The main objectives of this work are to upgrade the preprocessing stage and Performance analysis of various classifiers in terms of Accuracy. The methodology adopted for achieving the objective as mentioned above is shown in Fig. 3.

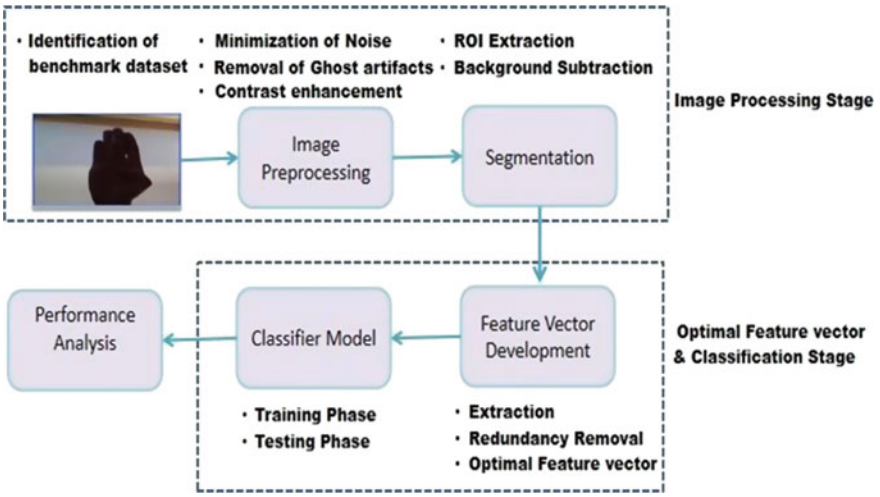

Fig. 3 Layout of proposed work

Table 1 Source data set details

Dataset	Prominent features	Source
ASL	26 Alphabets and 3 special character, 30 00 images per Alphabet	**Hand Symbol Dataset** https://www.kaggle.com/grassknoted/asl-alphabet
ISL	1320 samples	**Hand Gesture Dataset** https://lttm.dei.unipd.it/downloads/gesture/#senz3d

2.1 Identification of Benchmark Dataset

Before upgrading pre-processing stage, the main step is to identify validated data set. Details regarding dataset used in this work are shown in Table 1.

2.2 Minimization of Noise and Removal of Ghost Artifacts

Steps involved in pre-processing stage are shown in Fig. 4. After the identification of validated/benchmark dataset, next step is to process the sample inputs. Next step is to process the input samples. Considering in mind to design a highly efficient and accurate Sign Language Recognition System for classification of hand gestures there is a necessity of filtered, cropped and accurate size image. In actual, an image free of ghost artifacts and noise. For the same, three filters will be used in this work such as Median filter, Homomorphic fourier Butterworth filter and Homomorphic fourier ideal filter.

The median filter, non-linear type of digital filter whose main purpose is to help in minimizing the noise effect from an image. Such reduction of noise in actual is a typical step of pre-processing stage to upgrade the outputs of later processing stages.

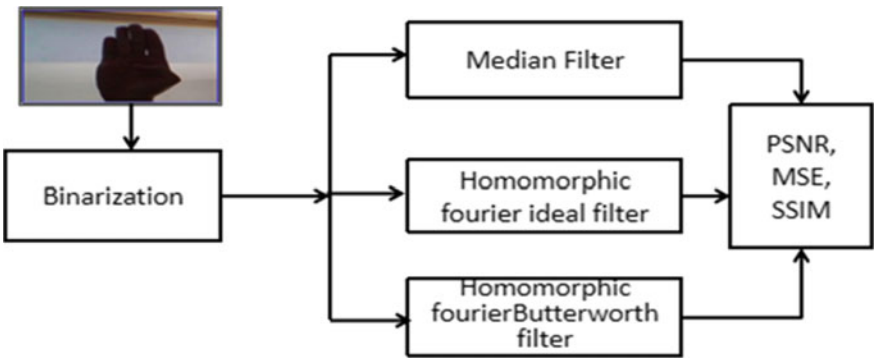

Fig. 4 Steps involved at preprocessing stage

The working of median filter depends on considering every pixel of a sample input images they consider the surrounding environment and identify the representative pixel of an image. Unlike the mean filter, the median filter simply replacing the pixel value by the median values of adjacent pixel values. Other filters used in this work are Homomorphic filters, these are hybrid filters which is used for correcting illuminations effects of an image samples.

2.3 Classification Stage

For achieving the best results at classification stage, the main step is to develop robust feature vectors with lower redundancy. A good feature vector is a need of a classifier and the classification process is reliant upon a large variety of decision-making tools to recognize the objects. The classification process includes categorizing the pixels and assigning them to class labels. The classification method identifies classes by analyzing images of the object. The classifier first analyses the statistical impact of different image features and then groups the data based on these values.

3 Results and Discussion

The proposed methodology has been tested on three samples of hand sign images (as shown in Table 2) taken from publicly available dataset as referenced in Table 2. These all-test samples include cluttered background, so making it suitable for recognition these samples are passing through pre-processing stage.

Performance on test sample inputs. This table helps to find the suitable filter for the successful implementation of pre-processing stage. After this stage, the output of

Table 2 Source dataset details

Sr. No	Cluttered input	Pre-processed output
Image1		
Image2		
Image3		

best filter is segmented and then prepare optimal feature set for making the database, that will act as input for various classifiers.

4 Conclusion

In this research, a comparative analysis of four different classifiers viz. SVM, K-nearest Neighbor, Decision Tree and Naïve Bayes have been used to enhance the image recognition process. It has been observed that, the output of the support vector machine classifier is better as compared to the other classifiers. The proposed work also depicted.

The information about finding the best filter in terms of higher PSNR and lower MSE by comparing three different filters. The best PSNR ratio not even provided the best filter but also helps to improve the results of subsequent stages. It has been noticed that results of feature vector cab be improved by improving preprocessing stage. The hybridization of features has ability to upgrade the results of classifier recognition. This work could be extended to examine the barriers, especially at the input stage of classifier, to upgrade sign recognition performance of classifiers.

References

1. Agada R, Akinlaja T, Yan J (2018) Multi sensor performance driven data fusion for sign language synthesis. In: Proceedings—2018 international conference on computational science and computational intelligence, CSCI 2018, pp 458–461. Institute of Electrical and Electronics Engineers Inc
2. Alonzo O, Glasser A, Huenerfauth M (2019) Effect of automatic sign recognition performance on the usability of video-based search interfaces for sign language dictionaries. In: ASSETS 2019—21st international ACM SIGACCESS conference on computers and accessibility, pp 56–67. Association for computing machinery, Inc
3. Bhavsar H, Trivedi J (2021) Performance comparison of svm, cnn, hmm and neuro-fuzzy approach for indian sign language recognition. Indian J Comput Sci Eng 12:1093–1101
4. Bhuiyan RA, Tushar AK, Ashiquzzaman A, Shin J, Islam MR (2018) Reduction of gesture feature dimension for improving the hand gesture recognition performance of numerical sign language. In: 20th international conference of computer and information technology, ICCIT 2017, pp 1–6. Institute of Electrical and Electronics Engineers Inc
5. Bragg D, Koller O, Caselli N, Thies W (2020) Exploring collection of sign language datasets: privacy, participation, and model performance. In: ASSETS 2020—22nd international ACM SIGACCESS conference on computers and accessibility. Association for Computing Machinery, Inc
6. Fayyaz S, Ayaz Y (2019) CNN and traditional classifiers performance for sign language recognition. In: PervasiveHealth: pervasive computing technologies for healthcare, pp 192–196. ICST
7. Gupta R (2019) A quantitative performance assessment of surface emg and accelerometer in sign language recognition. In: Chakrabarti S (ed) IEMECON 2019—9th annual information technology, electromechanical engineering and microelectronics conference, pp 242–246. Institute of Electrical and Electronics Engineers Inc

8. Hassan S, Alonzo O, Glasser A, Huenerfauth M (2021) Effect of sign-recognition performance on the usability of sign-language dictionary search. ACM Trans Access Comput 14
9. Kawaguchi K, Wang Z, Kuniwa T, Daraseneeyakul P, Veerakiatikit P, Ohta E, Nishimura H, Tanaka H (2020) Experimental study on improvement of sign language motion classification performance using pre-trained network models. Lect Notes Comput Sci (including Subser Lect Notes Artif Intell Lect Notes Bioinform). 12185 LNCS:433–446
10. Mohd Hashim MH, Tasir Z (2020) An e-learning environment embedded with sign language videos: research into its usability and the academic performance and learning patterns of deaf students. Educ Technol Res Dev 68:2873–2911
11. Myagila K, Kilavo H (2021) A comparative study on performance of SVM and CNN in Tanzania sign language translation using image recognition. Appl Artif Intell
12. Ozawa T, Okayasu Y, Dahlan M, Nishimura H, Tanaka H (2018) Investigation of sign language recognition performance by integration of multiple feature elements and classifiers. Lect Notes Comput Sci (including Subser Lect Notes Artif Intell Lect Notes Bioinform.) 10904 LNCS:291–305
13. Pirone JS, Henner J, Hall WC (2018) American sign language interpreting in a mainstreamed college setting: performance quality and its impact on classroom participation equity. Gallaudet University Press
14. Saqib S, Kazmi SAR, Masood K, Alrashed S (2018) Automatic sign language recognition: performance comparison of word based approach with spelling based approach. Int J Adv Comput Sci Appl 9:401–405
15. Tamer NC, Saraçlar M (2020) Improving keyword search performance in sign language with hand shape features. Lect Notes Comput Sci (including Subser Lect Notes Artif Intell Lect Notes Bioinform) 12536 LNCS:322–333
16. Tan ZY, Basah SN, Yazid H, Safar MJA (2021) Performance analysis of Otsu thresholding for sign language segmentation. Multimed Tools Appl 80:21499–21520

Research Trends and Applications of Artificial Intelligence in 3D Printing-A Scientometric Analysis

Rakesh Dadhwal, Raman Kumar, Jasgurpreet Singh Chohan, Sandeep Singh, and Sudhanshu Maurya

Abstract The traditional manufacturing methods have advanced greatly with the introduction of computers in the manufacturing sector. 3d printing is one of the most advanced and automated manufacturing techniques due to its capability to manufacture precise, complex, multi-functional and personalized designs. However, this process of selection of correct process parameters in 3d printing is affected by many attributes. So, the use of artificial intelligence in 3d printing has started to counter this problem at various stages of 3d printing process. In this work scientometric analysis of artificial intelligence in 3d printing is presented by the authors. The keywords visualization netrow is presented using VOSviewer software.

Keywords Artificial intelligence · 3d printing · Bibliometric study

1 Introduction

The use of computers in the manufacturing methods have greatly advanced the traditional manufacturing methods and are the symbol of industrial revolution. These advanced and automated manufacturing systems are very efficient in comparison to traditional machining and also promote consistency in fabrication [1]. 3d printing or three-dimensional printing also typically known as additive manufacturing stand out from all these advanced manufacturing systems [2]. In a typical 3d printing, a 3d CAD model of desired part is created using CAD software. This 3d model of the desired part is then sent to the 3d printer to make the part. There is need to specify some process parameters in order to complete the part [3]. These process parameters are often specified manually and corrected depending upon the condition of the

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part fabricated [4]. However, this process of selection of correct process parameters largely depends upon the experience and observations made by the operator about the anomalies [5–7].

In the past years various techniques like experimentation, simulation and sensor technologies have been used to resolve the above-mentioned problem [8, 9]. The recent studies on artificial intelligence driven 3d printing focuses mainly on three aspects. The topology optimization [10, 11] and machine learning is used for the geometrical designs of the parts. During fabrication, different anomalies occurs due to inappropriate selection of process parameters. So in situ monitoring system for defect detecting highly needed. Improved experimental setups, computer vision methods and novel simulation approaches are being used to detect these issues [12]. The quantitative data of various publications on artificial intelligence in 3d printing are presented.

2 Annual Publication Trends

To analyze and observe the trend of publications on artificial intelligence in 3d printing, the publication data of last 12 years i.e. from 2009 to 2020 is extracted from the Scopus data base. A total 279 documents have been extracted from the Scopus data base which were published on artificial intelligence in 3d printing from the year 2009 to 2020. It is observed that there is not a single document was published on artificial intelligence in 3d printing during the year 2010 & 2011. Table 1 shows that there are only six countries who have published more than 10 documents on artificial intelligence in 3d printing till the year 2020. United states have secured the first rank by publishing the highest documents till 2020 followed by the China who have published the highest documents after United states. The other four countries are far behind from the first two countries in number of published documents. The all other four countries are United Kingdom, Germany, India and south Korea which are at 3rd, 4th, 5th and 6th place respectively with published documents less than 50% of the documents published by the countries at 1st and 2nd rank.

Figure 1 shows that publications on artificial intelligence in 3d printing has increased much in last three years i.e. from 2018 to 2020 as compared to previous 09

Table 1 Top countries

SI. no	Country	Publications
1	United States	65
2	China	50
3	United Kingdom	24
4	Germany	23
5	India	19
6	South Korea	13

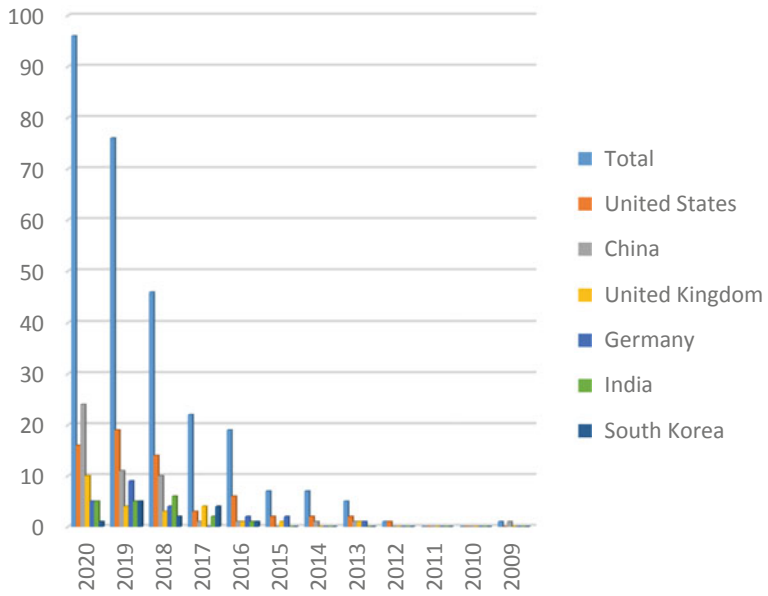

Fig. 1 Publications trends yearwise

years i.e. from 2009 to 2017. From Fig. 1 it can also be seen that during the year 2010 and 2011 no document was published by any of the country and from the year 2012 the overall trend of publication on artificial intelligence in 3d printing is increasing every year.

3 Top Source Titles

From Table 2 it is observed that out of top 10 source titles, two source titles are not on the scientific journals ranking list. From rest 8 source titles only three source titles have been assigned the quartile category while to the other source titles this quartile has not been assign yet. Out of top ten source titles only two source titles belong to Q1 category of quartile. All source title has been published by the 6 different publishers.

It can be seen in Table 2 and Table 3 that Journal of Physics Conference Series has published highest documents on Artificial intelligence in 3d printing and Wang Z.L is the top author not only of this institute but also the top author of Georgia institute of technology. Out of the rest 9 institutes of the top 10 list, 03 institutes have published the 04 documents each and 06 institutes have published the 03 documents each. Lianghua, Z. of Beijing Institute of Technology and Bailey, C., Stoyanov, S. of University of Greenwich are top authors of the list with 03 number of publications

Table 2 Top source titles

Source title	No of publications	H-index	Category	SJR 2020	Publication type	Publisher
Journal of physics conference series	12	85	Q4	0.21	Journals	IOP Publishing Ltd
ACM international conference proceeding series	11	123	Not yet assigned	0.18	Conferences and proceedings	Association for Computing Machinery (ACM)
Advances in intelligent systems and computing	4	41	Not yet assigned	0	Book series	Springer Verlag
International journal of production research	3	142	Q1	1.91	Journals	Taylor and Francis Ltd
Iop conference series materials science and engineering	3	44	Not yet assigned	0	Conferences and proceedings	IOP Publishing Ltd
Matec web of conferences	3	26	Not yet assigned	0	Conferences and proceedings	EDP Sciences
Matter	3	22	Q1	4.14	Journals	Cell Press

by each author, followed by Wang, Z.L., Hanemann, T., Ahn, S.H., Basit, A.W., Elbadawi, M. and Gaisford, S. with 02 publications by each author.

Table 3 Top affiliated institute

Institute Name	Publications	Top author of the Institute	No of Publications
Chinese Academy of Sciences	05	Wang, Z. L	02
Beijing Institute of Technology	04	Lianghu a, Z	03
Georgia Institute of Technology	04	Wang, Z. L	02
Universität Freiburg im Breisgau	04	Hanema nn, T	02
Ministry of Education China	03	Chen, F	01

(continued)

(continued)

Institute Name	Publications	Top author of the Institute	No of Publications
University Politehnica of Bucharest	03	Adrian Cartal, L	01
Nanyang Technological University	03	Basit, A	01
Seoul National University	03	Ahn, S. H	02

4 Keywords Analysis

Artificial intelligence, machine learning, and robotics have high relatedness to 3d printing while cloud computing, virtual reality, internet of things and block chain shows least relatedness with 3d printing. Out of 863 keywords only 15 keywords meet the threshold with minimum occurrence of 05. The final keyword network is printing (Fig. 2).

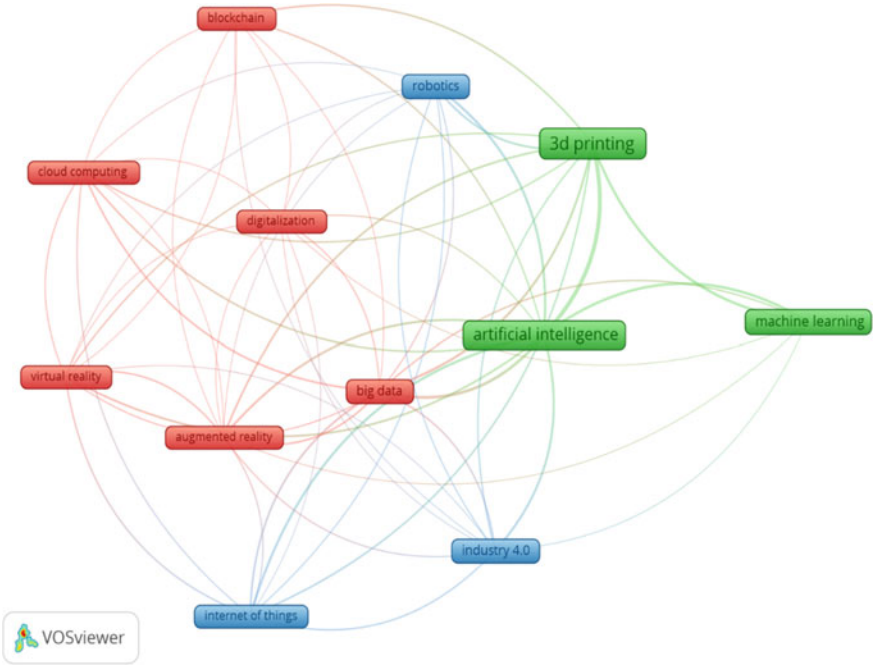

Fig. 2 Keywords analysis

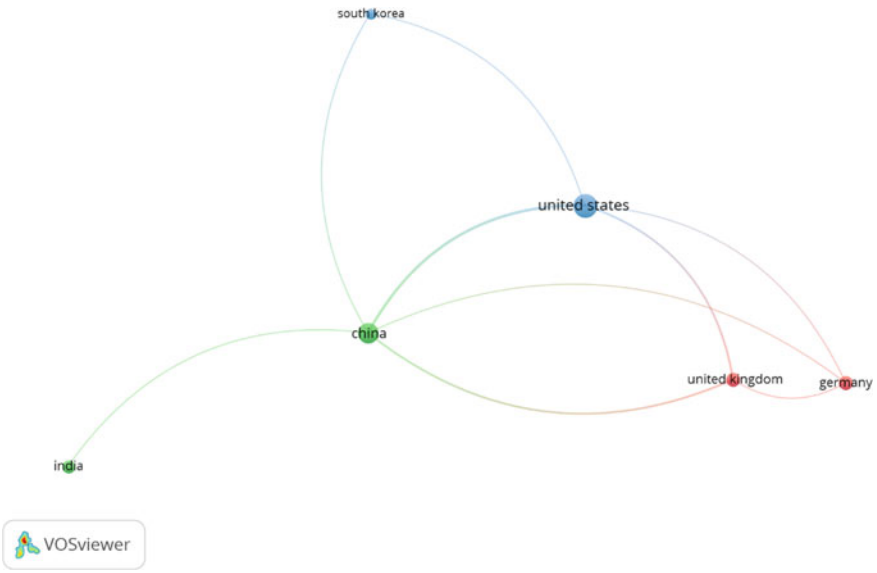

Fig. 3 Co-authorship analysis

4.1 Co-Authorship Analysis

VOSviewer software is used for co-authorship analysis as shown in Fig. 3. The publication data on artificial intelligence in 3d printing is extracted. Out of 69 countries who have published the documents on artificial intelligence in 3d printing only 06 countries meet the threshold. China has published the highest documents after USA, just 15 documents less than the USA but citation of documents published by China is less than half as compared to citation of documents published by USA. So, the researchers should also focus on co-authoring with the other countries also like USA and China.

5 Conclusions

Publications Trends on artificial intelligence in 3d printing has increased over the years from 2009 to 2020. Although this trend of publications has increased more than three times in the past three year i.e. after 2017. The source titles ACM International Conference Proceeding Series and International Journal of Production Research are at 2nd and 7th. Also there are only two titles International Journal of Production Research and Matter that belongs to Q1 category with SJR2020 as 1.91. Chinese Academy of Sciences has published the highest documents from 2009 to 2020 on artificial intelligence in 3d printing. Lianghua, Z., of Beijing Institute of Technology

and Bailey, C., Stoyanov, S. of University of Greenwich have published the highest documents on artificial intelligence in 3d printing.

References

1. Jeon JW, Ha YY (2000) A generalized approach for the acceleration and deceleration of industrial robots and CNC machine tools. IEEE Trans Ind Electron 47:133–139
2. Chen Y, Dong F (2013) Robot machining: recent development and future research issues. Int J Adv Manuf 66:1489–1497
3. Skylar-Scott MA, Mueller J, Visser CW, Lewis JA (2019) Voxelated soft matter via multimaterial multinozzle 3D printing. Nature 575:330–335
4. Gu GX, Libonati F, Wettermark SD, Buehler MJ (2017) Printing nature: unraveling the role of nacre's mineral bridges. J Mech Behav Biomed Mater 76:135–144
5. Cui H, Hensleigh R, Yao D, Maurya D, Kumar P, Kang MG, Priya S, Zheng X (2019) Three-dimensional printing of piezoelectric materials with designed anisotropy and directional response. Nat Mater 18:234–241
6. Zhang Z, Demir KG, Gu GX (2019) Developments in 4D-printing: a review on current smart materials, technologies, and applications. Int J Smart Nano Mater 10:205–224
7. Vangelatos Z, Zhang Z, Gu GX, Grigoropoulos CP (2020) Tailoring the dynamic actuation of 3D-printed mechanical metamaterials through inherent and extrinsic instabilities. Adv Eng Mater 22:1901586
8. Zohdi TI (2014) Additive particle deposition and selective laser processing-a computational manufacturing framework. Comput Mech 54:171–191
9. Frketic J, Dickens T, Ramakrishnan S (2017) Automated manufacturing and processing of fiber-reinforced polymer (FRP) composites: an additive review of contemporary and modern techniques for advanced materials manufacturing. Addit Manuf 14:69–86
10. Scime L, Beuth J (2018) Anomaly detection and classification in a laser powder bed additive manufacturing process using a trained computer vision algorithm. Addit Manuf 19, 114–126
11. Brackett D, Ashcroft I, Hague R. In Proceedings of the Solid Freeform Fabrication Symposium, pp 348–362
12. Rozvany G (2001) Aims, scope, methods, history and unified terminology of computeraided topology optimization in structural mechanics. Struct Multidiscipl Optim 21:90–108

Bibliometric Study and Visualisation of Research Trends in Hybrid Blockchain Technology

Raman Kumar, Jasgurpreet Singh Chohan, Sandeep Singh, and Sudhanshu Maurya

Abstract This paper is a summary of literature from the Scopus database on hybrid blockchain technology, since 2016. The bibliometric patterns of research trends were visualized using a VOS viewer and the scope for future research was discussed. The most active authors, countries, and organizations were identified. The most active author was Byun C and the most active country was China. The most active research organization was Beijing University of Posts and Telecommunications, China. Future research can be on implementation challenges of hybrid blockchain technology and finding newer horizons for application. This paper highlights the domination of China, Chinese authors, and Chinese research organizations on research related to hybrid blockchain technology.

Keywords Social media · VOS viewer · Bibliometrics · Wireless sensors · COVID 19

1 Introduction

There are various types of blockchain technology, like a public blockchain, private blockchain, and hybrid blockchain. Better performance and effect of blockchain technology can be ensured in a hybrid model, which has the benefits of both private and public blockchain technologies. The various aspects of hybrid blockchain technology had been discussed in the following paragraphs.

There are several applications for hybrid blockchain technology. Hybrid blockchain technology can be used for the proper and secured land records management. The mistakes, frauds, duplications, omissions, and other challenges associated

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with land records management can be rectified by the implementation of hybrid blockchain technology for land records management [1, 2]; fake news detection using hybrid blockchain technology [3]. Hybrid blockchain technology was also used in improving the effectiveness of mobile wallets [4].

Hybrid blockchain technology can be used for the exchange of health data. Sharing of health data maybe for better treatment or sharing with other stakeholders like health insurance companies. High-level data privacy and security can be ensured through the implementation of hybrid blockchain technology while sharing health care data [5–7].

Hybrid blockchain technology can create radical changes in energy sharing in microgrids [8]; for privacy-preserving and trusted energy transactions [9]; application of hybrid blockchain technology for marginal pricing for energy applications [10]; for load balancing in P2P energy trading markets [11].

The other applications of hybrid blockchain technology can be for better transparency and security to supply chain management [12]; hybrid blockchain technology can improve supply chain visibility [13]; ensuring trusted supply chain finance [14] the security and trust of networks can be ensured through hybrid blockchain technology [15]. The hybrid blockchain technology can be used for identity authentication [16]; authentication system for smart homes [17]; health of underground structures [18]; for the industrial internet of things [19–21]; for pre-owned electric vehicle supply chain management [22]; hybrid blockchain technology for crowdsourcing [23–25].

This paper had the objective of consolidating the literature on hybrid blockchain technology. The active authors, regions, and research organizations engaged in research on hybrid blockchain technology had been assessed through bibliometric analysis. VOS viewer software was used for the visualization of research trends. The future agenda for research on hybrid blockchain was noted in the concluding section.

2 Research Methodology

Scopus database was searched on 24/06/2021, with the Boolean "Hybrid blockchain" to draw resources. English documents were included and all the non-English documents were excluded from this review. The work in Refs. [26, 27] was the main motive for the development of the methodology of this paper.

3 Discussion

Four hundred and seventy-nine research papers from Scopus were used in this review. Four hundred and seventy-one English papers were used, and the non-English papers were in the Chinese language. The number of papers published on this research

domain since 2016 had been shown in Fig. 1. The details of various types of English documents used in this study was shown in Figs. 2, 3, 4 and 5.

The most dominant authors were highlighted in Fig. 3 and the co-authorship links of authors were highlighted in Fig. 4

The most active organization of the research domain was the Beijing University of Posts and Telecommunications, China as shown in Table 1.

The most influential keywords were highlighted in Fig. 6. The highly used keywords were blockchain, the internet of things, and network security. The recently used keywords were highlighted in red color (refer to Fig. 6).

The dominant country of this research domain was China, followed by the United States of America (refer to Fig. 7). The co-authorship links were shown in Fig. 8.

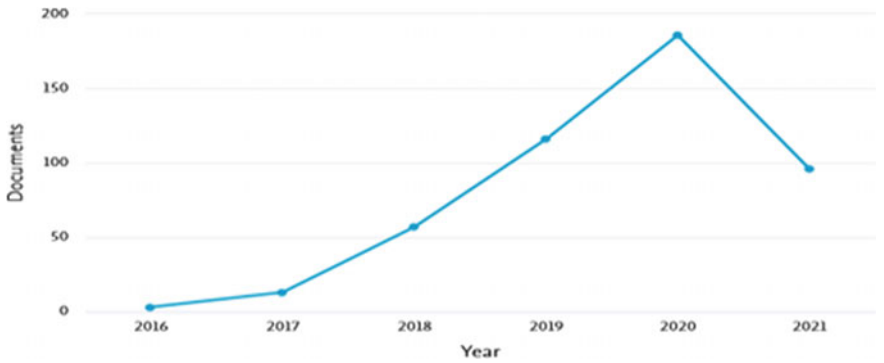

Fig. 1 Publication of documents since 2016

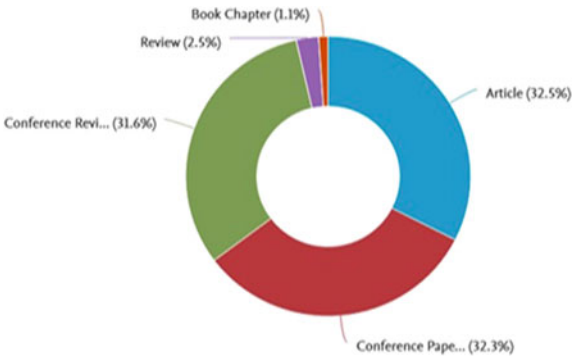

Fig. 2 Details of Documents used in this review; *Source* www.scopus.com

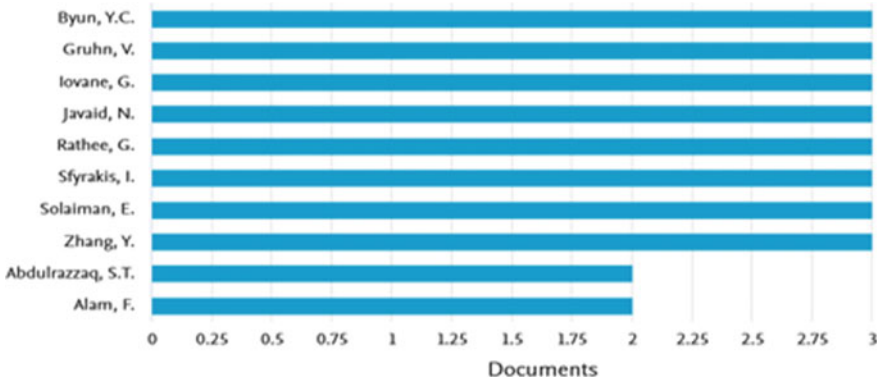

Fig. 3 List of dominant authors. *Source* www.scopus.com

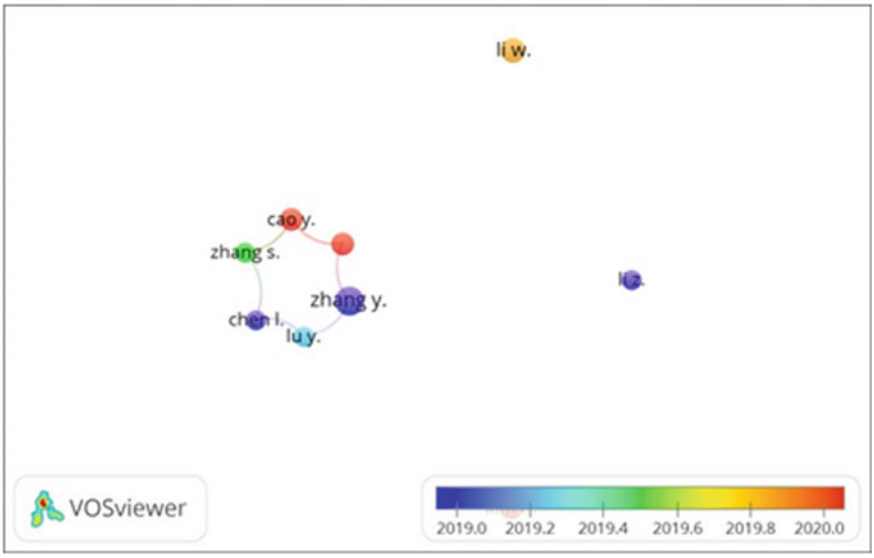

Fig. 4 Co-authorship links of dominant authors

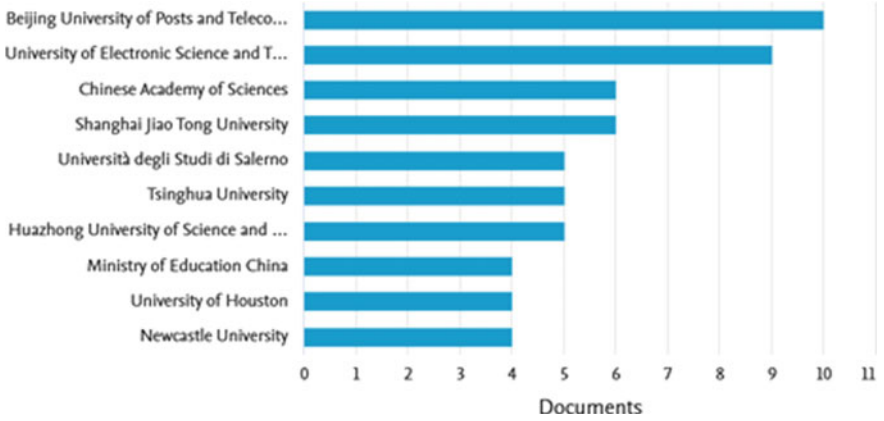

Fig. 5 Most active organizations of the research domain

Table 1 Active countries

Countries	Document	Citations	Average citations
China	94	141	15

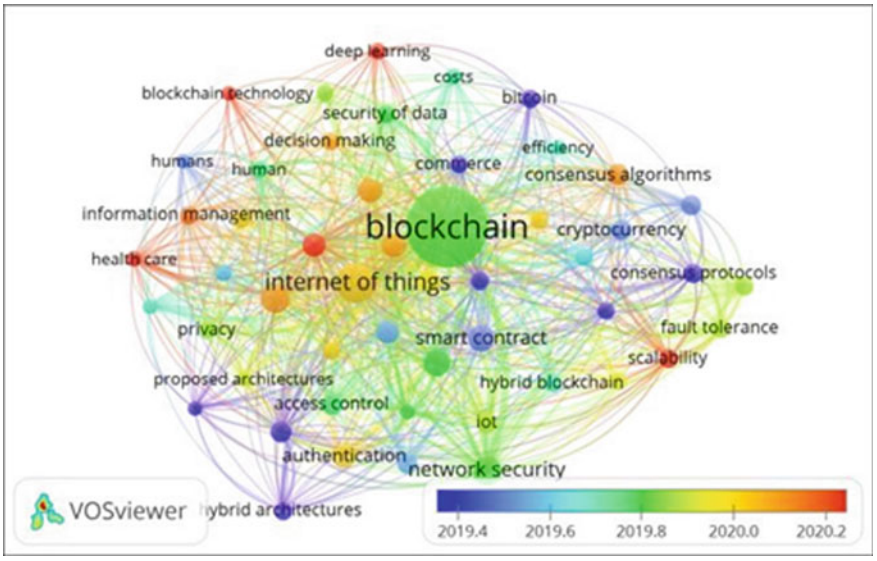

Fig. 6 Keyword analysis

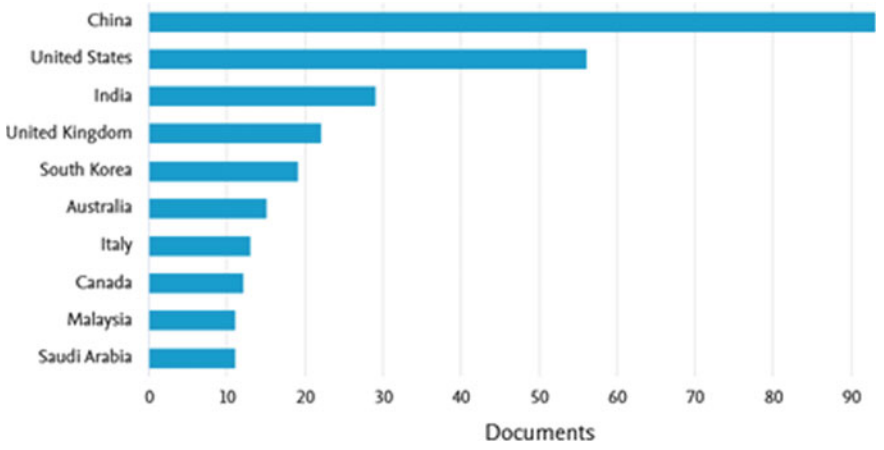

Fig. 7 Active countries

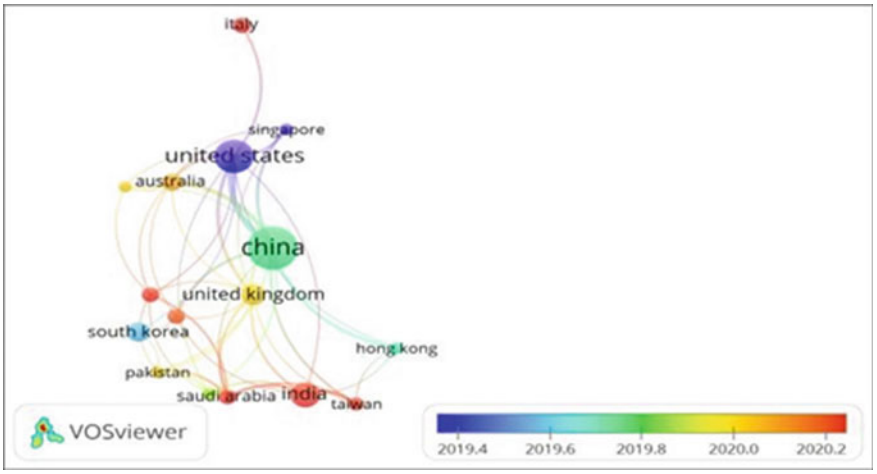

Fig. 8 Active countries and research collaborations

4 Conclusions

Four hundred and seventy-one research papers from Scopus were reviewed and the research trends were highlighted. Moreover, the research trends of this research domain were visualized using VoS viewer software. The various applications of hybrid blockchain technology had been reviewed in this paper and the scope for future research was discussed. This bibliometric analysis had identified the key authors, most promising research organizations, and highly active countries of this research domain. The most active author was Byun C and the most active country

was China. The most active research organization was Beijing University of Posts and Telecommunications, China.

This paper can be useful for practitioners and academicians to get a consolidated picture regarding research on hybrid blockchain technology. Future researchers can concentrate on active authors, organizations, and countries for further research on the topic. Future research can be on newer applications of this technology and solutions for meeting challenges associated with the implementation of this technology.

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References

1. Nartey C, Tchao ET, Gadze JD, Keelson E, Klogo GS, Kommey B, Diawuo K (2021) On blockchain and IoT integration platforms: current implementation challenges and future perspectives. Wirel Commun Mob Comput 2021
2. Liu J, Yan L, Wang D (2021) A hybrid blockchain model for trusted data of supply chain finance. Wirel Pers Commun
3. Zhang J, Tian R, Cao Y, Yuan X, Yu Z, Yan X, Zhang X (2021) A hybrid model for central bank digital currency based on blockchain. IEEE Access 9:53589–53601
4. Maaroufi S, Pierre S (2021) BCOOL: a novel blockchain congestion control architecture using dynamic service function chaining and machine learning for next generation vehicular networks. IEEE Access 9:53096–53122
5. Choi N, Kim H (2021) A novel blockchain-based authentication and access control model for smart environment. Adv Sci Technol Eng Syst 6:651–657
6. Dutta S, Saini K (2021) Statistical assessment of hybrid blockchain for SME sector. WSEAS Trans Syst Control 16:83–95
7. Hu J, Reed MJ, Al-Naday M, Thomos N (2021) Hybrid blockchain for IoT—energy analysis and reward plan. Sensors (Switzerland) 21:1–21
8. Zhang S, Cao Y, Ning Z, Xue F, Cao D, Yang Y (2020) A heterogeneous IoT node authentication scheme based on hybrid blockchain and trust value. KSII Trans Internet Inf Syst 14:3615–3638
9. Cao Y, Sun Y, Min J (2020) Hybrid blockchain–based privacy-preserving electronic medical records sharing scheme across medical information control system. Meas Control (United Kingdom) 53:1286–1299
10. Lee H-A, Kung HH, Udayasankaran JG, Kijsanayotin B, Marcelo AB, Chao LR, Hsu C-Y (2020) An architecture and management platform for blockchain-based personal health record exchange: development and usability study. J Med Internet Res 22
11. Celesti A, Ruggeri A, Fazio M, Galletta A, Villari M, Romano A (2020) Blockchain-based healthcare workflow for tele-medical laboratory in federated hospital IoT clouds. Sensors (Switzerland) 20
12. Zhao F, Chan WK (2020) When is blockchain worth it? A case study of carbon trading. Energies 13
13. Firoozjaei MD, Ghorbani A, Kim H, Song J (2020) Hy-bridge: a hybrid blockchain for privacy-preserving and trustful energy transactions in internet-of-things platforms. Sensors (Switzerland) 20
14. Marar HW, Marar RW (2020) Hybrid blockchain. Jordanian J Comput Inf Technol 6:317–325

15. Toapanta SM, Escalante Quimis OA, Mafla Gallegos LE, Maciel Arellano MR (2020) Analysis for the evaluation and security management of a database in a public organization to mitigate cyber attacks. IEEE Access 8:169367–169384
16. Alam KM, Ashfiqur Rahman JM, Tasnim A, Akther A (2020) A blockchain-based land title management system for Bangladesh. J King Saud Univ Comput Inf Sci
17. Xu R, Chen Y, Blasch E, Aved A, Chen G, Shen D (2020) Hybrid blockchain-enabled secure microservices fabric for decentralized multi-domain avionics systems. In: Chen G (ed) Proceedings of SPIE—The international society for optical engineering, SPIE
18. Iqbal J, Umar AI, Amin N, Waheed A (2019) Efficient and secure attribute-based heterogeneous online/offline signcryption for body sensor networks based on blockchain. Int J Distrib Sens Netw 15
19. Jones M, Johnson M, Shervey M, Dudley JT, Zimmerman N (2019) Privacy-preserving methods for feature engineering using blockchain: review, evaluation, and proof-of-concept. J Med Internet Res 21
20. Guo H, Li W, Nejad M, Shen C-C (2019) Access control for electronic health records with hybrid blockchain-edge architecture. In: Proceedings—2019 2nd IEEE international conference on blockchain, blockchain 2019, pp 44–51. Institute of Electrical and Electronics Engineers Inc
21. Wang X, Yu P, Yu G, Zha X, Ni W, Liu RP, Guo YJ (2019) A high-performance hybrid blockchain system for traceable IoT applications. Lect Notes Comput Sci (including Subser Lect Notes Artif Intell Lect Notes Bioinform) 11928 LNCS:721–728
22. Lu H, Huang K, Azimi M, Guo L (2019) Blockchain technology in the oil and gas industry: a review of applications, opportunities, challenges, and risks. IEEE Access 7:41426–41444
23. Kim B, Yoon Y (2019) Journalism model based on blockchain with sharing space. Symmetry (Basel) 11
24. Jo BW, Khan RMA, Lee Y-S (2018) Hybrid blockchain and internet-of-things network for underground structure health monitoring. Sensors (Switzerland) 18
25. Sagirlar G, Carminati B, Ferrari E, Sheehan JD, Ragnoli E (2018) Hybrid-IoT: hybrid blockchain architecture for internet of things-PoW sub-blockchains. In: Proceedings—IEEE 2018 international congress on cybermatics: 2018 IEEE conferences on internet of things, green computing and communications, cyber, physical and social computing, smart data, blockchain, computer and information technology, iThings/GreenCom/CPSCom/SmartData/Blockchain/CIT 2018, pp 1007–1016. Institute of Electrical and Electronics Engineers Inc
26. Wang D, Wang H, Fu Y (2021) Blockchain-based IoT device identification and management in 5G smart grid. Eurasip J Wirel Commun Netw 2021
27. Banerjee S, Bouzefrane S, Abane A (2021) Identity management with hybrid blockchain approach: a deliberate extension with federated-inverse-reinforcement learning. In: IEEE international conference on high performance switching and routing, HPSR. IEEE Computer Society

Detection of Unauthorized Access Points Based on Machine Learning Techniques

Challa Narasimham, Velamuri Manasa, Sujatha Karimisetty, N. Viswanadha Reddy, and Sudhanshu Maurya

Abstract Wireless networks were widely used, but they were actually a threat. Represents Recognized as a wireless AP (access point). In particular, unauthorized APs used by businesses, military installations, and government agencies can be exposed to hacking attacks. Therefore, to protect your information, it is significant to identify unauthorized APs. This paper addresses round-trip time (RTT) values as records to identify allowed and unallowed APs in a wireless integrated atmosphere. Machine learning techniques such as potential Dirichlet mapping, k nearest neighbors, naive bays, support vector machines, bagging, adapter boosting, gradient boosting machines, random forests, additional trees, and gradient descent techniques are employed to resolve these issues. Gradient Boosting algorithm is used for protection and identification. This is developed and tested on data set. Experimental results show that it offers the highest accuracy.

Keywords Hacking attacks · Gradient boosting algorithm · Machine learning

1 Introduction

Because of quick growth of devices employing cellular networks, it is difficult to locate places without wireless internet in present scenario. Wireless internet is currently present in corporation, coffee shop, armed forces establishments and public organizations. Wireless internet is accessed by numerous unspecified users, creating it tough to find everyone. And even when binding similar devices to hotspot that use legal wireless internet, discovery is problematic until this is observed with deep sense [1].

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Fig. 1 Authorized AP

Fig. 2 Unauthorized AP

In wireless networking, access point place communicates while accepting data. The access point connects clients to different clients in network when it serves as a component of the association among WLAN and the static wire network. Many intelligent devices require the presence of unauthorized APs. This method is unavoidable as there exist no protocols nor needs associated with unauthorized APs like hotspot or unlimited locations [2, 3]. This is an extremely weak point for wireless networks. Stealing data from various users who can access rogue APs or hacking your computer can damage your network (Figs. 1 and 2).

2 Machine Learning Based Techniques for Classification

Different techniques are practiced for categorization of rogue APs in unplanned scenerio. Allowed and unallowed APs is used as a way to select the characteristics of the RTT value. An algorithm report related to rogue AP detection has occurred. Exploration aims to generate and employ algorithms to recognize malicious wireless networks. The experimental outputs divulge that using proven algorithms, the method of identifying unauthorized APs could be applied in a variety of simple and versatile ways. The classification techniques employed for classifying rogue APs.

2.1 Naive Bayes

It is supervised algorithm built on Bayes theorem and most effective Classification algorithm that can make quick predictions.

2.2 Support Vector Machine

These are unique of the most standard supervised learning oriented machine learning techniques that are utilized for both classification & regression challenges. However, primarily, it is used for classification problems in machine learning.

2.3 K-Nearest Neighbor (kNN)

K-Nearest Neighbor (kNN) is a very unsophisticated, easy to understand, versatile and top most machine learning algorithms.

2.4 Random Forest

This technique is a widespread machine learning algorithm which belongs to supervised learning technique created on ensemble learning. Ensemble learning is a category of learning wherever diverse algorithms are merged or identical algorithm is used numerous times to develop more powerful prediction model.

2.5 Bagging Classifier

A Bagging classifier is an assemble machine learning procedure which fuse predictions from many decision trees.

2.6 AdaBoost

This is boosting technique discussed and introduced by Yoav & Schapire in 1996. This merges multiple classifiers to intensify the accurateness of classifiers. AdaBoost is an iterative method as a whole.

2.7 Gradient Boost

Gradient boost technique is a prevalent boosting algorithm applied classification problems that generates a forecast replica. Decision trees are applied in this model.

3 Data Set Description

KDD is the main commonly applied dataset for calculating inconsistency detection procedures. The KDD training dataset contains approximately 4.9 million different association vectors [4]. Each association vector contains 41 types, called ordinary or attack, and there is only one type of attack as listed.

1) DoS Attack: An attacker overloads some computer or memory resources, fills them to handle requests and protect from attacks.
2) U2R Attack: An exploit class that an attacker can invade by trying to get access to user account that are vulnerable.
3) R2L Attack: Intruder who can send packets to a processor via network without having an account on this computer shall exploit tries to acquire access as a user on this computer. Occurs when getting.
4) Exploratory Attack: An effort to congregate information related to computer network to circumvent security controls [5].

4 Results

Experimenting with various algorithms is required to classify this with high accuracy. Research into protocol APs and their threats has been actively investigated until recently. To avoid such losses, this is crucial to determine which AP is a rogue AP. Time consumed for Round Trip is employed as the data record. The dataset so created is given as input to machine learning techniques for getting results, and outputs derived are equalized to show whichalgorithm is more accurate (Figs. 3, 4 and 5).

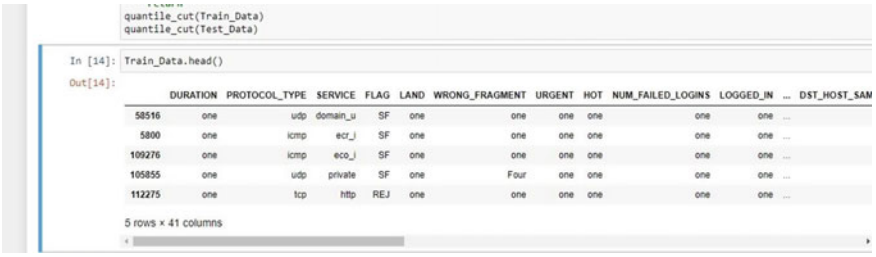
```
In [10]: # View top 3 train data
         Train_Data.head(3)
```

Out[10]:

	duration	protocol_type	service	flag	src_bytes	dst_bytes	land	wrong_fragment	urgent	hot	...	dst_host_srv_count	dst_host_same_srv_rate	dst_host_
0	0	tcp	ftp_data	SF	491	0	0	0	0	0	...	25	0.17	
1	0	udp	other	SF	146	0	0	0	0	0	...	1	0.00	
2	0	tcp	private	S0	0	0	0	0	0	0	...	26	0.10	

3 rows × 42 columns

Fig. 3 Applying attack class mapping to dataset



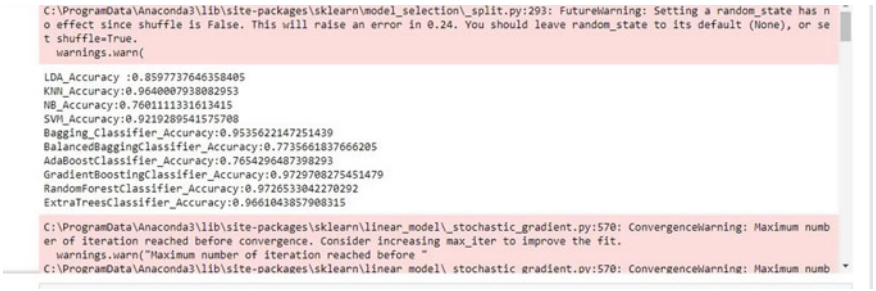
```
quantile_cut(Train_Data)
quantile_cut(Test_Data)

In [14]: Train_Data.head()
Out[14]:
```

	DURATION	PROTOCOL_TYPE	SERVICE	FLAG	LAND	WRONG_FRAGMENT	URGENT	HOT	NUM_FAILED_LOGINS	LOGGED_IN	...	DST_HOST_SAM
58516	one	udp	domain_u	SF	one	one	one	one	one	one	...	
5800	one	icmp	ecr_i	SF	one	one	one	one	one	one	...	
109276	one	icmp	eco_i	SF	one	one	one	one	one	one	...	
105855	one	udp	private	SF	one	Four	one	one	one	one	...	
112275	one	tcp	http	REJ	one	one	one	one	one	one	...	

5 rows × 41 columns

Fig. 4 Applying quantile cut function on dataset



```
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\model_selection\_split.py:293: FutureWarning: Setting a random_state has n
o effect since shuffle is False. This will raise an error in 0.24. You should leave random_state to its default (None), or se
t shuffle=True.
  warnings.warn(

LDA_Accuracy :0.8597737646358405
KNN_Accuracy:0.9640007938082953
NB_Accuracy:0.7601111331613415
SVM_Accuracy:0.9219289541575708
Bagging_Classifier_Accuracy:0.9535622147251439
BalancedBaggingClassifier_Accuracy:0.7735661837666205
AdaBoostClassifier_Accuracy:0.7654296487398293
GradientBoostingClassifier_Accuracy:0.9729708275451479
RandomForestClassifier_Accuracy:0.9726533042270292
ExtraTreesClassifier_Accuracy:0.9661043857908315

C:\ProgramData\Anaconda3\lib\site-packages\sklearn\linear_model\_stochastic_gradient.py:570: ConvergenceWarning: Maximum numb
er of iteration reached before convergence. Consider increasing max_iter to improve the fit.
  warnings.warn("Maximum number of iteration reached before "
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\linear_model\_stochastic_gradient.py:570: ConvergenceWarning: Maximum numb
```

Fig. 5 Calculated accuracies of algorithms

5 Conclusion

This concludes that the contrast among approved and unapproved APs can be characterized by Machine Learning calculations. If identification of attack as of unauthorized AP is done, detach it for security of the system. The techniques in this study will be able to differentiate the attacks on an unapproved AP, remove this declaration of the framework. Strategies in relevant study are useful to assurance of data, in individual life log information. We will separate the future work into two sections first on remote AP and on base stations. In both the cases, the calculation could utilize lopsided encryption utilizing public and private keys.

References

1. Jana S, Kasera SK (2010) On fast and accurate detection of unauthorized wireless access points using clock skews. IEEE Trans Mobile Comput 9(3):449–462
2. Han H (2011) A timing-based scheme for rogue AP detection. IEEE Trans Parallel Distrib Syst 22(11):1912–1925
3. Awad F, Al-Refai M, Al-Qerem A (2017) Rogue access point localization using particle swarm optimization. In: 8th international conference on information and communication systems (ICICS), Irbid, Jordan. https://doi.org/10.1109/IACS.2017.7921985

4. Han D, Andersen, DG, Kaminsky M, Papagiannaki K, Seshan S (2009) Access point localization using local signal strength gradient. Passive and Active Network Measurement, pp 99–108
5. Agarwal M, Biswas S, Nandi S (2018) An efficient scheme to detect evil twin rogue access point attack in 802.11 wi-fi networks. Int J Wirel Inf Netw 25(3):120–135

GAIT Recognition Technique Using Gait Energy Decomposition Method

B. T. Archana, A. V. S. L. Ramya, and T. Surendra

Abstract Gait recognition technique is a biometric approach adopted for identifying the user at a distance by the way they are walking. This is very helpful in surveillance environments such as banks, offices. Here two challenges in gait recognition technique are addressed one unknown walking pattern and dissimilarity in appearance due to items carrying or clothes wearing. From the Gait Energy Image (GEI) PHash values are computed and are compared with database to authorize the user. Further the appearance change issues are addressed by decomposing images into horizontal sections and comparing these with database. This method proposes an inexpensive way of user recognition. One distinctive way of identification and confirming one person identity is biometrics. The physiological or behavioral characteristics can be considered for selecting the appropriate features of a person. The selection of suitable biometric method depends on its high precision and low prying or meddlesome. The physiological ways of identification like finger print, DNA involves the joint effort but behavioral features like voice and the gait recognition, the cooperation user is not required. In this paper gait recognition method is proposed.

Keywords Gait · PHash values · Gait energy image

1 Related Work

Gait recognition implies the method of identifying a person depending on the style of walking. The significance of gait recognition lies in ability to offer better results in low resolution and from long distance. Gait recognition finds its applications in condition monitoring of patients and security. Gait defines the movement of a human

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being. Gait recognition is done in accordance with the appearance and the manner individual is walking. Recent year many works were going under gait recognition. Individual identification by Hidden Markov model, gait recognition is done with respect to the feature selected by canonical transformation and eigen transformation, measuring the correlation between frame pairs. Model based method is one common method used. From the feature obtained a three-dimensional model is made. But these methods require a greater number of cameras which are set to achieve the external and internal cameral calibration needs. The exactness of the method relies on the features that are selected. From the gait sequence lower body regions are obtained to construct a gait sequence model. The angular postures obtained from gait cycle helps in setting up a 3D gait recognition model. But the features whichever are selected should be invariant so that efficiency of the system can be improved. Almost all methods are performed on con-trolled environmental conditions.

In this proposed method silhouettes obtained from video sequence is used. The main challenges are recognizing the user when he prefers to walk in a random direction, here the silhouettes will not match with database. [1] Moreover, problems occur in recognizing individual depending on the dress he is wearing and items he is carrying. Appearance based methods use spatial temporal features; it relies entirely on the sequences of image captured by camera [2]. Here singular value decomposition methodology is adopted to evaluate the features of gait from GEI. Initially walking pattern of gait is traced out and the user is recognized based by using extracted features. Here for walking direction identification Gait Energy Image (GEI) of the leg region is taken and user recognition can be done by any learning algorithms like Random Space Learning (RSL), Linear Discriminant Analysis (LDA). [4, 5] There were works performed on identifying the walking direction by using Poisson random walk and by using mask which assigns weights higher and lower depending on unaltered and altered areas.

1.1 Motivation

This paper proposes a unique way for identifying the walking direction and recognition of user when imposed to change in appearance. PHash values over the leg region is computed for identifying walking direction and GEI decomposition is per-formed for user recognition. This entire paper can be classified into two parts consists for walking pattern and user identification.

2 Proposed Work

The entire work can be sectioned into testing and training section. First the database is designed by including silhouette and walking patterns of users. For computing the PHash values from the entire GEI leg region of silhouette is separated. For reducing

the dimension Linear Discriminant Analysis (LDA) and Principal Component Analysis (PCA) are used. When training is completed for all data set walking patterns are identified by performing K-nearest neighbor (k-NN). For user recognition the dissimilarity between test and trained images are calculated. Finally, the majority voting decides user recognition.

2.1 Identification of Walking Pattern

The general shape of leg region is obtained by calculating the PHash values of the GEI. The values so obtained are used are compared to compute hamming distance. In this method the entire silhouette is not considered specifically the leg region of GEI is filtered out so that computational complexity can be reduced to some extent. To this GEI Discrete Cosine Transforms (DCT) are applied. DCT coefficients separate image into low frequency elements which contain the relevant information and high frequency elements which can be discarded. By concatenating the selected coefficients of DCT the unidirectional PHash descriptor can be obtained. PHash can be converted into binary by following equation (Fig. 1).

$$\text{PHash(Ic)} = \begin{cases} 0, \ if \ DCT(Ic) \leq DCT \\ 1, \ if \ DCT(Ic) > DCT \end{cases} \tag{1}$$

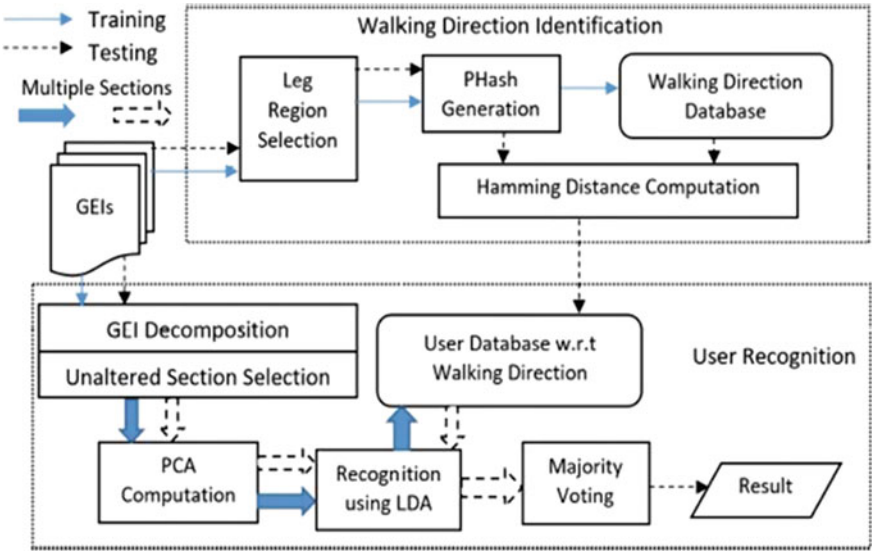

Fig. 1 Proposed method for user recognition using gait

The PHash values of the testing GEIs are compared with dataset stored for training, the walking pattern is identified by using k-NN.

2.2 User Recognition

The PHash values will be compared with dataset if there is no difference then GEI of leg region matches and thereby walking direction can be identified. After identifying the walking direction next steps involve matching it with database. But GEI obtained is of different walking direction, database stored features will not match. The reason for mismatch may be the user is wearing a coat or a bag. So, the GEI is de-composed into horizontal sections with a thought that the entire GEI will not change because of a coat and bag. So, decomposing allows removing the part having coat and bag and rest of the region can be compared. All the GEI section are added together to form a one-dimensional vector. All the vectors together form a matrix. The dimensionality of matrix cane is reduced by PCA, as it selects components having high variance. The data decorrelation is obtained by LDA using the projections obtained from PCA.

In this proposed method average GEI is computed for all training data sequence considering walking direction. A threshold is applied to average image and test GEI so that unaltered section can be traced out. The sections so obtained are projected to selected principal components. In User recognition the last step involves majority voting among the selected parts levels.

3 Experimental Results

In this work CASIA Gait database is used. GEI is obtained for 11 different angles varying from 0 to 180°, with every step 18° is set between adjacent angles. For every angle 10 different images were taken one with normal walking in others person carrying a bag or a coat. For each image one is set for testing and other is reserved for training. The steps involved prior to walking direction identification are (i) selecting the per-centage of GEI required at leg region (ii) DCT coefficients required and (iii) value of k in k-NN. It is observed that better results are obtained when 33% GEI is selected to use in leg region, DCT coefficients selected are 22×22 lower which can be further used to evaluate PHash values and k values for k-NN algorithm.

Figure 2 GEI selected, GEI obtained for leg region, Horizontal sections division, leg region selection, DCT coefficients obtained, PHash values generated. User is recognized by training four sequences of images obtained and six among the image sequence obtained is used for testing. Among the images two of them indicates the normal walking direction and rest out of four two is where the person is wearing a coat and in other two people is wearing a bag. Figure 3 shows the outcome when user walking normally. In 11 different angles images are captured and it is observed that accuracy is above 95%. The output obtained when user is carrying a bag is shown

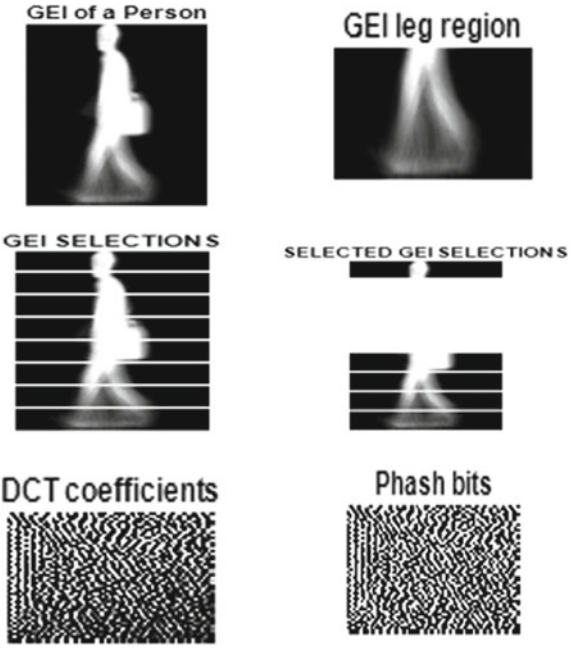

Fig. 2 GEI obtained and DCT and PHash bits

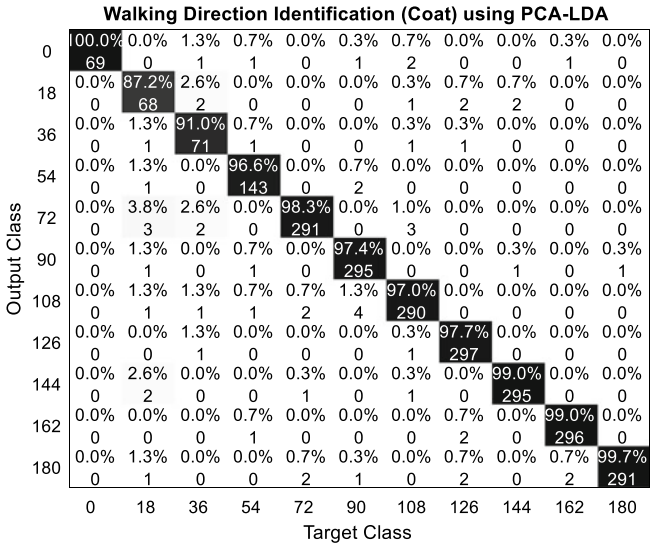

Fig. 3 Normal walking direction accuracy obtained in 11 different angles

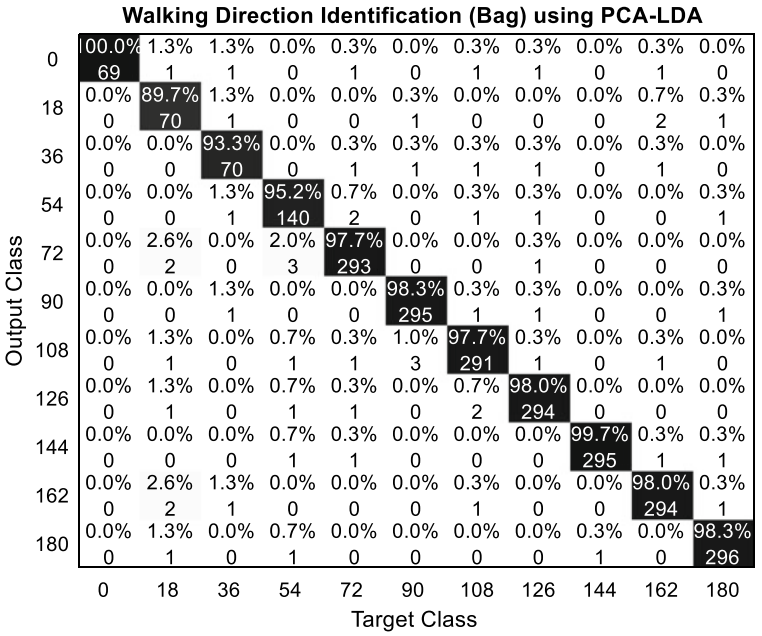

Fig. 4 Accuracy results obtained in 11 different angles while carrying a bag

in Fig. 4. For different angles the accuracy is measured. All results show it is above 95%. The accuracy obtained while carrying a bag is available in Fig. 5. Same as before the accuracy calculated for 11 different angles. The result accuracy is beyond 90%

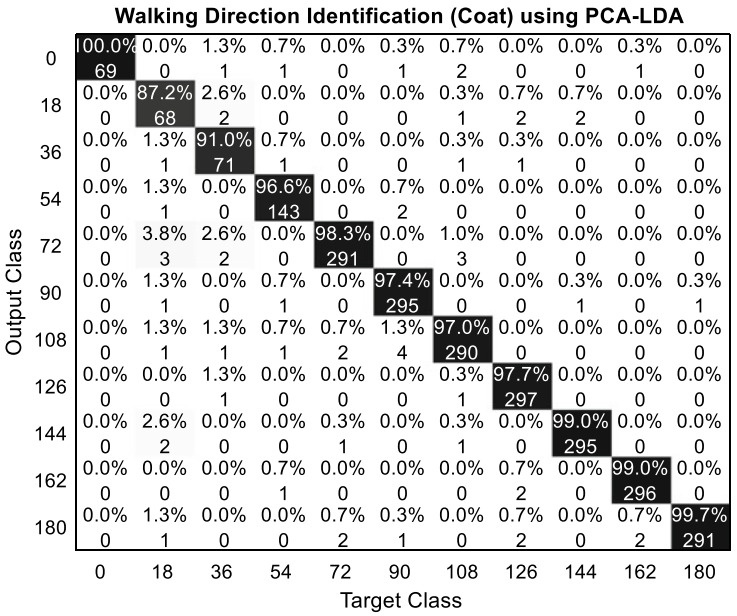

Fig. 5 Accuracy results obtained in 11 different angles while carrying a bag

4 Conclusion

This paper comes up with a new methodology of identification of human, based on the pattern of walking. Usually in all biometric methods such as finger prints and retina the user cooperation is essential. But gait recognition can identify a subject from his body postures so here active participation of subject is not needed. This particular work can be further extended to criminal investigation and security, as from analyzing the video samples obtained from surveillance camera and radar images can also be processed to identify the subject.

References

1. Verlekar TT, Correia PL, Soares LD (2018) View-invariant gait recognition system using a gait energy image decomposition method. In: The international workshop on biometrics and forensics (IWBF2016) IET Biometrics, vol 6, issue 4, pp 299–306
2. Makihara Y, Matovski D, Nixon M et al (2015) Gait recognition: databases, representations, and applications. Wiley Encyclopedia of Electrical and Electronics Engineering
3. Gafurov D (2007) A survey of biometric gait recognition: approaches, security and challenges. In: Proceedings of annual norwegian computer science conference

4. Tardi T, Sruti CD (2012) Silhouette-based gait recognition using Procrustes shape analysis and elliptic fourier descriptors. Pattern Recognit 45(9):3414–3426
5. Wang L, Tan T, Ning H, Hu W (2003) Silhouette analysis-based gait recognition for human identification. In: IEEE transactions on pattern analysis and machine intelligence, vol 25, no 12

Survey of Comparative Analysis of Different Routing Protocols in MANETs: QoS

Anil Kumar, R. K. Shukla, and R. S. Shukla

Abstract In the Ad Hoc network transmit data through wireless channels. In multiple nodes communicate with each other without an established network. A node sends a packet form source to destination with the help of router. MANET is a pliable and stable network that we can simply put up at any time and in any location, but the primary difficulty with this topology is the ability to swiftly modify the nodes. We will focus on existing routing protocols, their characteristics, and performance in this survey article. Multipath, stability, reserve bandwidth, load balancing, and energy efficiency methodologies are used to classify the protocols. The relative strengths and shortcomings of the methods have also been investigated, allowing us to pinpoint potential study topics. Finally, find a realistic bandwidth approach, energy consumption, end-to-end delay, and performance indicators.

Keywords ZRP · DSR · AODV · DSDV

1 Introduction

MANET [1] is a group of communication networks without provisional network and centralised management. These networks are self-organizing and reconfigure. Multiple hop wireless networks with a dynamic network structure. On recent years, it has been a more research in QoS founded on adjustment node and multipath. Researchers are engrossed on the multipath discovery postponement of on-demand routing protocols to ease alone-root glitches in mobile ad hoc networks which is developing area. AODV is an extension of Multipath. In AODV, these provide those

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links that are relatively prime and loop free pathways, the multi root source Routing protocol [2] is a multipath variant "Dynamic Source Routing" that improves delay and throughput by using weighted round robin packet distribution. Split Multipath Routing [3] is a technique for routing many paths in a single path. Is there another DSR modification that picks a hop count limit and disjoints several paths maximally? Node-Disjoint Multipath Routing (NDMR) [3] provides numerous pathways that are node-disjoint. There are two major phase of the dynamic source routing protocol as route detection and route upkeep stage [4]. Source node examines its route cache first before sending a packet. The source node consists of routing message to the data packet before sending it, if the required path is present. Otherwise, the source node starts a route discovery activity by transmitting route request packets. A route request packet comprises the source and destination addresses that identifies the request. A node examines its route cache when it receives a route request packet. If does not have routing information for the requested destination to reduce route request packet communication cost, a node methods route appeal packets that it has never seen earlier and for which the destination address is not mentioned in the route record field. He routes reply packet is generated by the destination and comprises the addresses of nodes visited by the route request packet. Otherwise, based on the Generalized Regression Neural Network and Radial Basis function, Bashandy et al. [4] presented the forecast of packet delay in MANET employing AODV, DSDV, and DSR routing. Here is no accounting for connection rescue, however. Lee and Gerla [1] presented a system that employs an alternate method only when the original route fails to deliver data packets. However, this technique is based on the shortest path algorithm, which was the first algorithm for wireless networks. Artificial neural networks (ANNs) have lately been recognized as a viable alternative method for modelling complicated systems and are now commonly employed for forecasting. The major goal of this project is to look at the application part and capabilities of ANNs for delay prediction of mobile ad hoc networks. Neural network models generally higher to standard undeviating forecasting models, according to more research's [5]. NNs have a number of characteristics that make them useful and appealing for forecasting. Artificial neural networks have a number of advantages, including (i) the fact that they are non-parametric data-driven self-adaptive approaches with few a priori assumptions. (ii) Despite the fact that the underlying links are indefinite or hard to articulate, neural networks may study after examples and reply to delicate useful relationships within data [6]. (iii) The ability to generalize is the most significant aspect of neural networks. The NNs can usually foretell an incidence, even if the sample data is blaring [6]. (iv) With high accuracy, NNs can be applied to estimate non-linear functions of several variable. (v) NNs can be utilized once first cause-and-effect correlations are ambiguous (Fig. 1).

In this study, delay in MANET networks employing several routing protocols is measured using a generalized regression NNs and radial basis networks, which can be applied on available data of experiments. To anticipate latency, a model based on the grouping of two input data are built.

Fig. 1 Mobile ad hoc network [7]

2 Characteristics of MANETs

2.1 Dynamic Network Topologies

Every node free to move independent & randomly anywhere in the entire network. Network topology has change randomly at unpredictable time and primarily consist of bidirectional links.

2.2 Low Bandwidth

2.2.1 Unfixed Infrastructure

Networks have a higher capacity and a longer transmission range than these networks. Because of effects of many admission, disappearing, noise, and intrusion, wireless communication has a lower throughput than cable communication.

2.2.2 Limited Battery Power

Small batteries and other non-renewable energy sources power the nodes or hosts. As a result, the most significant design optimization objective is energy conservation.

2.2.3 Scalability

When considering a big network size, scalability is a major issue due to the limited memory and processing one of the key design concerns, with networks of 10,000 or even 100,000 nodes being envisaged.

2.2.4 Limited Resources

The bandwidth and power of the MANET are both constrained. Furthermore, mobile node battery life is a limiting issue in their operation.

2.2.5 Security

The wireless links are vulnerable to threats due to a lack of definition. Denial of service attacks and eavesdropping are both conceivable. MANETs are source constrained, and the topology of the network changes on a regular basis.

3 MANET Routing Protocols

Routing protocol is categorised in proactive routing protocol [4], reactive protocol and hybrid protocol. In which routing techniques keep paths to all nodes and the reactive routing protocol has created route with two nodes [2] while hybrid routing protocols work to comprise in proactive and reactive routing approaches to generate routes between nodes. The DSDV is a node-by-node course routing system that necessitates regular broadcasting of routing updates by each node. In dynamic source routing, the node only builds routes when the source requests them. It keeps track of the route cache, which keeps track of newly discovered routes. The routing overhead is lower because it is an on-demand routing technology [9,10]. A source node S consults its route cache first before sending a packet to destination. Source utilises the accessible path in cache if it detects the route [11]. It starts the route finding procedure if the route isn't located. During this process, 5 fields are required: source ID, destination ID, Request ID, Address list, and Acknowledgement list. The packet is then broadcast by the source node to its neighbour. Dynamic Source Routing can keep track of the path, maintaining information between routes, however it is slow. It is hard for the data packets header to hold all of the route information when a network has a high number of pathways.

4 Comparison of QOS Routing Protocols

Later recognizing all types of protocols in MANET, we can't conclude that one is superior in every situation. In some cases, proactive routing protocol DSDV is better, such as when an end–to–end communication path is always available in table driven or proactive routing. A thorough examination of the literature is necessary to gain a current grasp of the issue and its relevance to practice, as well as to identify the methodologies utilized in prior research on the subject and to make comparisons between research findings. Tables 1, 2 and 3 present a comparison routing protocols.

Table 1 Protocols for proactive routing compariso

Parameter	WRP	OLSR	DSDV
Routing overhead	Low	High	High
Throughput	Medium	Low	Low
Loop free	Yes	Yes	Yes
Route updates	Periodically	Periodically	Periodically

Table 2 Protocols for reactive routing comparison

Parameters	TORA	DSR	AODV
Periodic	No	No	No
Route creation	By source	By source	Locally
Throughput	Low	High	Low
Cashing overhead	High	Low	Medium
Routing overhead	High	High	High

Table 3 Protocols for hybrid routing comparison

Parameters	ZHLS	ZRM
Information of route stored	Inter zone table	Intra zone table
Structure	Flat	Hierarchical
Advantage	Reduced transmission	Unique node Id
Performance metric	Shortest path	Shortest path
Routes	No multiple	Multiple

Table 1 illustrates a comparison of QoS routing systems based on various criteria [8]. Table 2 compares the QoS routing protocols based on specific characteristics and Table 3 QoS based result.

5 Conclusion

We have given a full description of MANET in this study, as well as its classification of routing protocols into proactive, reactive, and hybrid. Protocols are classified using casting methodologies that are entirely reliant cardinality of the destination set. The complexity of procedures is compared. However, DSDV outperforms AODV means delay. DSDV protocol sends message to all nodes entire domain. Because, table in the DSDV routing protocol is constantly updated, the main advantage of DSDV is that nodes may quickly obtain routing information. This does not identify which routing protocol is superior or not because, in the case of a big network, the time it takes to transmit a protocol rises over time. We will improve the performance QoS protocols in the future based on several factors.

References

1. Lee S, Gerla M (2000) AODV-BR: backup routing in ad hoc networks. Wireless Adaptive Mobility Laboratory, Computer Science Department, University of California, pp 1311–1316
2. Singh JP, Dutta P, Pal A (2012) Delay prediction in mobile ad hoc network using artificial neural network. Proc Technol 4:201–206
3. Ghadimi E, Khonsari A, Diyanat A, Farmani M, Yazdani N (2011) An analytical model of delay in multi-hop wireless ad hoc networks. Int J Wireless Netw 5:1–11
4. Bashandy AR, Chong EK, Ghafoor A (2005) Generalized quality-of-service routing with resource Allocation. IEEE J Select Areas Commun 23:450–463
5. Kaaniche H, Kamoun F (2010) Mobility prediction in wireless ad hoc networks using neural networks. J Telecommun 2:95–101
6. Wang J, Tang Y, Deng S (2001) QoS routing with mobility prediction in MANET. In: Proceedings of the IEEE Pacific rim conference on computers and signal processing, Victoria, BC, Canada, pp 357–360
7. Bansal E (2013) Improving performance of AODV using ANT agents
8. Apostolopoulos G, Guerin R (1998) Quality of service based routing. a performance perspective. In: Association for computing machinery's special interest group on data communication, vol IV, no 11, pp 17–28
9. Lin CR, Liu J (1999) QoS routing in ad hoc wireless. IEEE J Select Areas Commun 17(10):1426–11438
10. Chen S, Nahrstedt K (1999) Distributed quality-of-service routin in ad hoc networks. IEEE J Select Area Commun 17(5):1488–1505
11. Lin L (1999) QoS routing in ad hoc wireless networks. IEEE Select Areas Commun 17:1426–11438
12. Abdrabou A, Zhuang W (2006) A position based QoS routing scheme for UWB mobile ad hoc networks. IEEE J Select Areas Commun 24:850–856

Comparative Analysis of Energy Efficiency of Logic Gates on FPGAs

Neeraj Bisht, Sandeep Kumar Budhani, Bishwajeet Pandey, Shilpi Bisht, and Pankaj Singh

Abstract Energy efficiency is a major concern of manufacturers while designing any electronic device. The motive of our research is to assess energy requirements of different logic gates and to find the best performing FPGA. The experiments are conducted on XILINX Vivado 2020.1 simulator with six different FPGA on seven logic gates. The experimental results are then used to find the best performing FPGA on all logic gates in terms of power efficiency. Also, a comparative study is done to suggest the average lowest power consuming gate. It is observed that the on chip power consumption of AND, OR, NAND and NOR gates are the same and least on all FPGA. The On chip power required for XOR and XNOR is the same and more than AND, OR, NAND and NOR gates on all FPGA. NOT gate takes different amounts of on chip power as compared with the above two groups of gates. This variation in the power utilization is due to the different number of transistors on these gates. Difference of average chip power consumption of these two FPGA is 53.7%. Our study paves a way to design energy efficient flip-flop, register, memory, processing unit and other complex computer hardwares.

Keywords Energy efficiency · FPGA · Logic gates · On chip power consumption · Spartan-7

1 Introduction

In today's world the term energy efficiency has become universal to several kinds of applications, be it an automobile, a building, or any electronic device. Energy efficient environment comes with a bundle of benefits like low electricity consumption, and

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reduction in greenhouse gas emission, which are the major concerns of the future world.

The foundation of any digital circuit is the logic gate. An electronic circuit which has one or more inputs and single output designs a logic gate. A logic gate takes logical decisions on the basis of input condition i.e. signal present on its inputs.

The digital logic gates are available in two families: Transistor-Transistor Logic (TTL) and Complementary Metal-Oxide-Silicon (CMOS). 7400 is a popular series of TTL. Second family of logic gates CMOS is the 4000 series of chips. CMOS and TTL are used for manufacturing the Integrated circuits (IC), commonly called chips. CMOS 4000 family of logic gates improved the circuit design in terms of less power consumption, switching speed, and reduced propagation delays.

Field programmable gate arrays (FPGAs) are the semiconductor devices which have configurable logic blocks (CLB). These CLB are connected via programmable interconnections and configurable I/O cells. FPGA can be programmed easily on our personal computers. Different FPGAs have their own architecture but in general they all follow a common base design. In addition, a clock circuitry is also present which drives the clock signals to each logic block. ALU, memory and decoders may also be present in a FPGA.

VERILOG and VHDL are the hardware description languages which are used in reprogramming of FPGA. The feature of reprogram ability makes them different from Application Specific Integrated Chip (ASIC). ASIC are programmed and designed for a specific task whereas FPGA can be reprogrammed to as per the logic requirements.

In this work, we have analyzed the power consumption of logic gates on six different FPGAs using state of the art XILINX Vivado 2020.1 simulator. This paper is divided into five sections. Section 1 provides an introduction to FPGA and logic gates. In Sect. 2 a brief literature review has been presented. Section 3 gives a brief introduction of schematic details of logic gates. Detailed analysis of results obtained by performing several experiments is done in Sect. 4. Section 5 provides conclusion of the work done and future scope.

2 Literature Review

Many researchers are working on energy efficient design of circuits. Zeidman [1] did a review on design and implementation of FPGA based systems focusing on neural networks and also performed a study of FPGA based control systems design for different applications. Sulaiman et al. [2] used Nano-Electro-Mechanical Switches (NEMS) for designing ultra energy efficient logic gates, and introduced NEMS based circuit topologies to device close packed inverter, NAND, NOR and XOR gates. Dadgour et al. [3] proposed 2 full adder cells of low power and high speed which has a different internal logic structure and pass transistor logic design. Their experiment gave an average PDP advantage of 60%. Aguirre-Hernandez et al. [4] proposed Hybrid-CMOS design style which utilized various CMOS logic style circuits to build

new full adders with desired performance. Their circuit outperforms its counterparts showing 5–37% improvement in the power-delay product (PDP). Goel et al. [5] worked on a novel MTJ/CMOS design, which consumed low power and had lower delay than the existing LIM-based MTJ/CMOS designs. Thapliyal et al. [6] used clock gating techniques which is latch free in ALU and achieved substantial reduction in junction temperature by varying the operating frequency when compared to temperature of the device without clock gating techniques. Pandey et al. [7] proposed that quantity of leakage power is directly proportional to number of logic elements. Castro et al. [8] proposed a design procedure to integrate and device approximate adders for the FPGA based system by considering the primary means and architectural differences between ASICs and FPGA devices. Prabakaran et al. [9] proposed a design in which heat dissipation issues in larger desktop and parallel machines are discussed. Burd and Brodersen [10] have proposed 2 hardware accelerators BIC64K8 and BIC32K16 based on FPGA for bitmap index creation. Nguyen et al. [11] worked on supply voltage scaling and studied the circuit behavior at low voltage. They suggested some new approaches for energy—efficient design. Farabet et al. [12] have developed energy efficient mathematical model for scroll type Air Motor. Hanson et al. [13] also focused on energy efficiency of residential sectors. Several authors [14–20] have designed FPGA based models in their research work.

It has been found through literature review that energy efficiency analysis of logic gates is not yet considered by the researchers which became motivation to carry out this work.

3 Schematic Design of Logic Gates

A schematic, or schematic design of a logic gate, is a representation of the elements of a system using abstract, graphic symbols rather than actual pictures.

3.1 AND Gate Schematic Design

A LOW output will be produced for a AND gate for a LOW input. A two-input logic AND gate can be made up using Resistor-transistor logic (RTL) switches connected directly to the transistor bases. Both transistors must be saturated ON for an output at Y. Figure 1 gives a schematic design of AND gate.

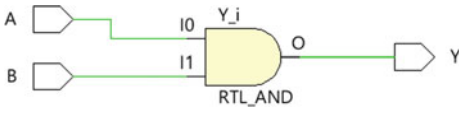

Fig. 1 Schematic design of AND gate

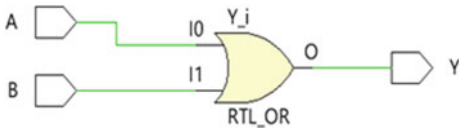

Fig. 2 Schematic design of OR **gate**

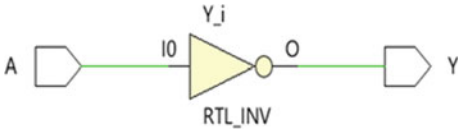

Fig. 3 Schematic design of NOT gate

3.2 OR Gate Schematic Design

A logic OR gate will produce a HIGH output for any HIGH input. Figure 2 shows that OR gate with two inputs can be designed by connecting RTL switches whose inputs are directly connected to the transistor bases. To attain an output at Y, one of the transistors must be at ON state.

3.3 NOT Gate Schematic Design

Figure 3 explains the schematic design of single input NOT Gate. A single input NOT gate produces an output of logic level 1 at input of logic level 0 and vice versa. A NOT gate with two inputs can be constituted with Resistor-transistor (RTL) switches when its input is connected to bases of transistor directly. The transistor should be kept at ON stage to achieve an output off at Y.

3.4 NAND Gate Schematic Design

The NAND gate gives an output that becomes LOW when all the inputs are kept HIGH. Figure 4 shows A NAND gate with two inputs can be constituted with

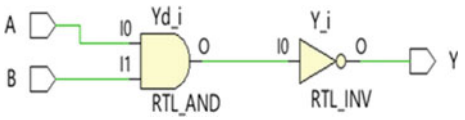

Fig. 4 Schematic design of NAND gate

Fig. 5 Schematic design of NOR gate

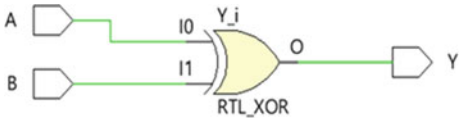

Fig. 6 Schematic design of XOR gate

Resistor-transistor (RTL) switches when its input is connected to bases of transistor directly. To achieve an output at Y, one of the transistors should be kept at OFF state.

3.5 NOR Gate Schematic Design

The NOR gate gives an output that becomes LOW when any of its inputs is HIGH. The NOR Gate can be obtained by taking complement of the logic OR gate. A NOR gate with 2 inputs can be constituted with Resistor-transistor (RTL) switches when its input is connected to bases of transistor directly. To achieve an output at Y, both the transistors should be kept at OFF state. Figure 5 shows schematic design of NOR gate.

3.6 XOR Gate Schematic Design

There are some other digital logic gates which are a combination of other basic logic gates. Their output Boolean function is very important, so they are considered as integral parts to complete logic gates. One of these hybrid logic gates shown in Fig. 6 is Exclusive-OR (Ex-OR). When the input levels are different then only it produces HIGH output.

3.7 XNOR Gate Schematic Design

The Exclusive-NOR gate combines the NOT gate and X-OR gate, while it's truth table is similar to that of NOR gate except in the case when both the inputs are HIGH. Schematic design of XNOR gate is given in Fig. 7

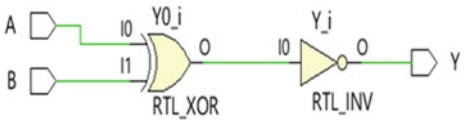

Fig. 7 Schematic design of XNOR gate

4 Experiments and Result Analysis

The experiments have been performed on XILINX Vivado 2020.1 simulation software. All FPGA are implemented with their default values. Six different FPGA families are used randomly to analyze the performance of logic gates.

4.1 Analysis of Power Consumption of Logic Gates on Different FPGA

On chip power consumption analysis of different gates on FPGA families under study is carried out in this subsection.

4.2 Power Consumption of AND, OR, NAND and NOR Gate on Implementation with Different FPGA

Table 1 compile the results of this experiment. Results clearly show that these gates perform best with Spartan-7 with a total on chip power consumption of 0.258 W. Artix-7 Low Voltage performs next with a total on chip power consumption of 0.304 W. Kintex UltraScale has the worst performance for these gates. Average on chip power consumption of these four gates for all FPGA families used in the experiment is 0.359 W.

Table 1 Power consumption of AND, OR, NAND and NOR gate on implementation with different FPGA

Family	Package	Total on chip power (W)
Artix-7	Cpg236	0.31
Artix-7 low voltage	Cpg236	0.304
Kintex-7	Clg225	0.321
Kintex-7 low voltage	Fbg484	0.312
Kintex Ultrascale	Fbva676	0.649
Spartan-7	Cpga196	0.258

Table 2 Power consumption of XOR and XNOR gate on implementation with different FPGA

Family	Package	Total on chip power (W)
Artix-7	Cpg236	0.506
Artix-7 low voltage	Cpg236	0.5
Kintex-7	Fbg484	0.517
Kintex-7 low voltage	Fbg484	0.507
Kintex Ultrascale	Fbva676	0.763
Spartan-7	Cpga196	0.454

4.3 Power Consumption of XOR, and XNOR Gate on Implementation with Different FPGA

Analysis of XOR and XNOR on different FPGA shows that Spartan-7 is the best FPGA for implementation of these two gates. On chip power consumption with Spartan-7 is 0.454 W.

Next performing FPGA is Kintex-7 which is consuming on chip power 0.517 W. Kintex UltraScale performed worst with these gates also with on chip power consumption 0.763 W. XOR and XNOR gates consume an average 0.541 W power for above FPGA. Results of the section are summarized in Table 2.

4.4 Power Consumption of NOT Gate on Implementation with Different FPGA

Results of different FPGA with NOT gate are shown in Table 3. It is evident from the table that Spartan-7 again performs best with on chip power consumption of 0.256 W. Artix-7 Low Voltage is consuming 0.313 W on chip power for NOT gate. Kintex UltraScale is again consuming more power than any other FPGA. Average on chip power consumption of these four gates for all FPGA families used in the experiment is 0.366 W.

Table 3 Power consumption of not gate on implementation with different FPGA

Family	Package	Total on chip power (W)
Artix-7	Cpg236	0.318
Artix-7 low voltage	Cpg236	0.313
Kintex-7	Fbg484	0.329
Kintex-7 low voltage	Fbg484	0.321
Kintex UltraScale	Fbva676	0.651
Spartan-7	Cpga196	0.266

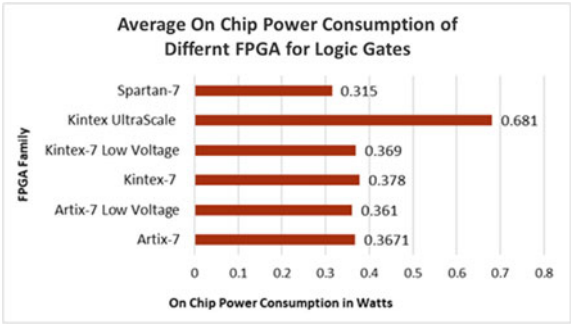

Fig. 8 Average on chip power consumption of different FPGA for logic gates

4.5 Analysis of Different FPGA on Different Logic Gates

It is evident from the above results that Spartan-7 with default parameters is the best performing FPGA for logic gates in terms of power consumptions. Average on chip power consumption of Spartan-7 is 0.315 W. Artix-7 Low Voltage is the next best performing FPGA for the logic gates with 0.361 W on chip power consumption.

Artix-7, Kintex-7 and Kintex-7 Low Voltage are performing almost the same for the logic gates in terms of on chip power consumption. These FPGAs are taking an average of 0.367 W, 0.378 W and 0.369 W on chip power respectively. Observing the on chip power consumption of the above FPGA, Kintex UltraScale with default parameters has not performed well for any of the gates in any of the FPGA. Its average on chip power consumption is 0.681 W which is much higher as compared with other FPGA families. These results are summarized in Fig. 8.

5 Conclusion and Future Scope

The analysis based on results of our experiments on XILINX Vivado 2020.1 simulator, suggests that power consumption of AND, OR, NAND and NOR gates are the same in all FPGA. Power consumption of XOR and XNOR is same in all FPGA and power consumption of NOT gate is different from all other gates in all FPGA. Also, it is evident from results that AND, OR, NAND and NOR gates consumed least power, NOT gate consumed slightly more power than these and XOR and XNOR consumed maximum power.

The logic in support of this difference in the power consumption can be given as a NAND gate has one transistor per input.

A NOR gate also has one transistor per input. An AND gate can be constructed with the combination of a NAND gate and a NOT gate, so it takes one transistor more than a NAND gate. XOR and XNOR have around eight transistors. Therefore,

the difference in the number of transistors is the prime factor affecting the on chip power consumption of different gates.

Also, Spartan-7 performed best in terms of power utilization for all the gates, in comparison to other FPGAs. It takes 53.7% less power than the maximum power consuming FPGA Kintex UltraScale and 12.7% less power than the Artix-7 Low Voltage, which is the next best performing FPGA.

This work is on making energy efficient logic gates. There is an open horizon to make energy efficient flip-flop, register, memory, processing unit and other complex computer hardware. There is also open scope for hardware implementation of AES/DES security algorithms on FPGA. Here, FPGA under consideration is 7-series FPGA, based on 28 nm Technology. In future, we can implement these gates or any hardware design on UltraScale FPGA, based on 16/20 nm Technology.

References

1. Zeidman B (2020) All about FPGA. https://www.eetimes.com/all-about-fpgas. Accessed on 2 Sep 2020
2. Sulaiman N, Obaid ZA, Marhaban MH, Hamidon MN (2009) Design and implementation of FPGA-based systems-a review. Aust J Basic Appl Sci 3(4):3575–3596
3. Dadgour HF, Hussain MM, Smith C, Banerjee K (2010) Design and analysis of compact ultra energy-efficient logic gates using laterally-actuated double-electrode NEMS. In: Proceedings of 47th design automation conference 2010, pp 893–896
4. Aguirre-Hernandez M, Linares-Aranda M (2010) CMOS full-adders for energy-efficient arithmetic applications. IEEE Trans Very Large Scale Integr (VLSI) Syst 19(4):718–721
5. Goel S, Kumar A, Bayoumi MA (2006) Design of robust, energy-efficient full adders for deep-submicrometer design using hybrid-CMOS logic style. IEEE Trans Very Large Scale Integr (VLSI) Syst 14(12):1309–1321
6. Thapliyal H, Sharifi F, Dinesh Kumar S (2018) Energy-efficient design of hybrid MTJ/CMOS and MTJ/nanoelectronics circuits. IEEE Trans Magnet 54(7):1–8
7. Pandey B, Yadav J, Pattanaik M, Rajoria N (2013) Clock gating based energy efficient ALU design and implementation on FPGA. In: 2013 IEEE international conference on energy efficient technologies for sustainability 2013, pp 93–97
8. Castro J, Parra P, Acosta AJ (2010) Optimization of clock-gating structures for low-leakage high-performance applications. In: Proceedings of 2010 IEEE international symposium on circuits and systems 2010, pp 3220–3223
9. Prabakaran BS, Rehman S, Hanif MA, Ullah S, Mazaheri G, Kumar A, Shafique M (2018) DeMAS: An efficient design methodology for building approximate adders for FPGA-based systems. In: IEEE design automation & test in Europe conference & exhibition (DATE) 2018, pp 917–920
10. Burd TD, Brodersen RW (1995) Energy efficient CMOS microprocessor design. In: Proceedings of IEEE twenty-eighth annual Hawaii international conference on system sciences 1995, vol 1, pp 288–297
11. Nguyen XT, Hoang TT, Nguyen HT, Inoue K, Pham CK (2018) An FPGA-based hardware accelerator for energy-efficient bitmap index creation. IEEE Access 6:16046–16059
12. Farabet C, Poulet C, Han JY, LeCun Y (2009) Cnp: An fpga-based processor for convolutional networks. In: IEEE international conference on field programmable logic and applications 2009, pp 32–37
13. Hanson S, Zhai B, Bernstein K, Blaauw D, Bryant A, Chang L et al (2006) Ultralow-voltage, minimum-energy CMOS. IBM J Res Dev 50(4.5):469–490

14. Yang L, Wang J, Mangan S, Derby JW, Lu N (2008) Mathematical model and energy efficiency analysis of a scroll-type air motor. Int J Appl Mathe 38(1)
15. Jayaraman C, Kottayil SK, Santhosh S (2018) End use energy efficiency in residential sector—an integrated trans-disciplinary study. Lecture notes in engineering and computer science: proceedings of the world congress on engineering and computer science 2018, pp 229–234
16. Verinaz HI, Vela EM, Ponguillo RA (2018) Implementing a standard gradient descent algorithm on FPGA embedded processor for two-dimensional field sensor calibration. In: Lecture notes in engineering and computer science: proceedings of the international multi conference of engineers and computer scientists 2018, pp 629–634
17. Poonilavu A, Reddy SG, He L (2019) License plate number recognition using FPGA based neural network. In: Lecture notes in engineering and computer science: proceedings of the world congress on engineering 2019, pp 208–211
18. Yildiz A, Goren S, Fatih Ugurdag H, Aktemur B, Akdogan T (2020) Crucial topics in computer architecture education and a survey of textbooks and papers. IAENG Int J Comput Sci 47(3):404–419
19. Hassan MY, Sharif WF (2007) Design of FPGA based PID-like fuzzy controller for industrial applications. IAENG Int J Comput Sci 34(2):192–198
20. Singh P, Pandey B, Bhandari N, Bisht S, Bisht N (2021) Output load capacitance scaling-based energy-efficient design of rom on 28 nm FPGA. In: Singh PK, Wierzchoń ST, Tanwar S, Ganzha M, Rodrigues JJPC (eds) Proceedings of second international conference on computing, communications, and cyber-security. Springer, pp 987–995. https://doi.org/10.1007/978-981-16-0733-2_69

To Combat the Menace of Forest Fires at Nainital and Almora District in Uttarakhand Using Internet of Things

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Abstract Nainital and Almora districts in Uttarakhand are rich in vegetation. Light fires in the forests generally aid in unlocking the accumulated nutrients in the biomass and make them accessible to the colonizing plants. Light fires also facilitate in breaking the latency of various seeds and buds of many species. However, the frequent occurrences of forest fires at these districts in Uttarakhand are hazardous to the fauna and flora of the area. The soaring incidents of unequalled forest fires in these vulnerable districts have placed Uttarakhand at the apogee. Nowadays, smart, and intelligent environments are created through IOT. The present paper brings into light, the need for environmental monitoring and management through IOT and the usage of wireless sensor networks to control wildfires in Nainital and Almora Districts.

Keywords IOT · Forest fires · Uttarakhand · Smart environment · Wireless sensor network · Detection · Alarm · Control

1 Introduction

Uttarakhand, 'Dev Boomi' the land of God is positioned in the northern section of our country, India. Its neighboring countries are China and Nepal in the North and the East respectively. Uttarakhand extends to an area of 53,483 km^2 and is located between 28°43′ N to 31°27′ N latitude and 77°34′ E to 81°02′ E longitude. The forest area of Uttarakhand state is 34,651 km^2, which comprises 64.79% of its total topographical area of this state [1].

The duration amid winter and monsoon, which is generally referred to as the 'forest fire season' is increasing rapidly at Nainital and Almora districts in Uttarakhand [2]. Each year wildfires begin with the commencement of spring season- mid of February and continuous till summer season-mid of June. The forests of Nainital and Almora

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districts widely comprise oak and pine trees. The dry leaves that fall from the trees specially Chir Pine needles (which are highly inflammable) accumulate on the ground catch fire because of some natural reasons like lightening, meteors, etc. or due to some human activity [3]. This fire spreads rapidly in the forests resulting in disasters leading to alarming situations. This negatively affects the ecosystem and the economy of the country. As per the Forest Survey report of India, the major forest fire in the history of Uttarakhand occurred in 1999 in which a loss of around 50 lakh was assessed. It affected about 5085.6 km^2 area. Of the total area 1225 km^2 got rigorously ruined [4]. The economic loss further directly impedes the growth and development of the hilly regions. Moreover, it is a peril to the endangered species of the region. It affects the microbiological and geo-hydrological cycles of the region. The zone of rare and rich variety of herbs with medicinal properties found in abundance in Uttarakhand region also gets targeted by such wild unattended fires.

This menace has transformed pristine hill stations into death valleys. The serene and composite environment has been engulfed by the toxic smoke resulting into air pollution in the region. This smoke further reduces the visibility which has even caused accidental deaths. Moreover, in covid-19 pandemic times when the mass was battling against respiratory infections, the forest fires added in the worsening of the condition [5]. Forest fires have long term everlasting effect on the productivity and prosperity of the biodiversity encompassed in these districts of Uttarakhand. They have altered the actual functioning of the forests resulting in global warming and natural catastrophe.

It is observed that the major reason for increasing forest fires or wildfires is the climatic change of the Uttarakhand state. High temperature, scarce rainfall and no atmospheric moisture during the forest fire season are some important reasons for forest fires in Uttarakhand [6]. The major wildfires in Uttarakhand was recorded in 1911. This was followed by the initiation taken in 1912 by the Forest Department to protect the forests from fires. They employed various methods for controlled burn down (In December-January and then in May) [7]. To combat the fire menace, Fire danger models have also been employed to ameliorate and curb wildfires [8].

Nowadays, IOT (Internet of Things) is creating smart environment- (water and air pollution detection, forest fire detection) smart homes, smart cities, smart logistic and smart industry (smart cars, smart watches, smart phones, etc.). The embedded sensors and microcontrollers used in streetlights, door locks, image recognition devices and many other applications of IOT which are making energy, transportation, towns, and cities intelligent. IOT uses various types of technologies such as ZigBee module, RFID etc. and wired connections like 3g, LTE [9]. The WSNs- wireless sensor networks are IOT based connections which are capable to sense temperature, light, pressure etc. therefore also employed in traffic surveillance, security, and military application etc. [10]. The present paper brings into light, the need for environmental monitoring and management and the use of wireless sensor networks to control wildfires in Nainital and Almora Districts. A model using Internet of Things that detects smoke, temperature, humidity and is capable to notify the perilous situation of forest fire is proposed in the paper so that the wildfires in the aforesaid districts can be controlled. The reason for developing this model is that the forest fire gets noticed

when it has already stretched over a colossal area. It reaches at an uncontrolled stage and leads to shocking consequences [11]. The IOT based system on sensing the fires sends the location to the stakeholders who in turn begin to extinguish wildfires at the identified location [12]. Thus an effective 'event driven and time driven scheme' for firerecognition and reporting system can be useful in minimizing the flora and fauna losses due to wildfires [13]. A study of air pollution sensors that used IOT and are employed in smart cities [14] also proved helpful to design the model for detection of forest fires.

2 Methodology

The researchers selected Nainital and Almora district for the study as they are fire sensitive areas in Uttarakhand. The present study involves perception analysis related to happening and imminent forest fire.

Study: Empirical and Scientific.

Sample Size: 62 residents (Nainital and Almora District).

Tools.

The researchers collected the data for perception analysis related to forest fire through questionnaire.

They utilized MAT Lab simulator for the simulation and result analysis (Fig. 1).

3 Hardware Requirement

The hardware that we utilised in the proposed model is shown in Fig. 2.

1. The Raspberry Pi 3: Though it is tiny, it possesses all the elements of a standard computational system, with some sensors that is MQ2-XGas sensor, IR infrared flame sensor and DHT22 gas humidity sensor is used. A buzzer alarm is also utilised for alarming the situation.
2. MQ-X Gas Sensor: The MQ-X gas sensor module detects CH_4, CO_2, H_2, CO, propane, and LPG, among other gases. Measurement is carried out as quickly as feasible because to its high sensitivity and quick reaction time. This yields a rough estimate of gas concentration.
3. DHT22 Gas Humidity Sensor: It is a minimum cost relative humidity and temperature sensor. It measures the air in the surrounding area with a thermistor sensor and a humidity sensor before sending a digital signal to the neural data port. The drawback of the aforesaid sensor is that it sends fresh information/data in every 2 s, thus sensor readings can be up to 2 s outdated.
4. IR Infrared Flame Sensor: This module is made up of an integrated circuit with a spark/fire sensor (IR receiver), capacitor, register, comparator LM393,

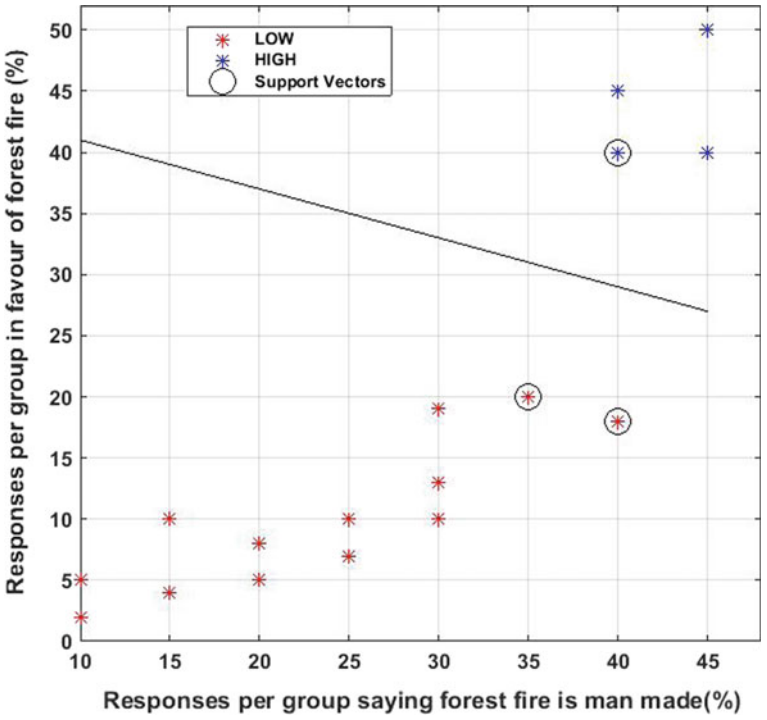

Fig. 1 SVM classification on forest fire data

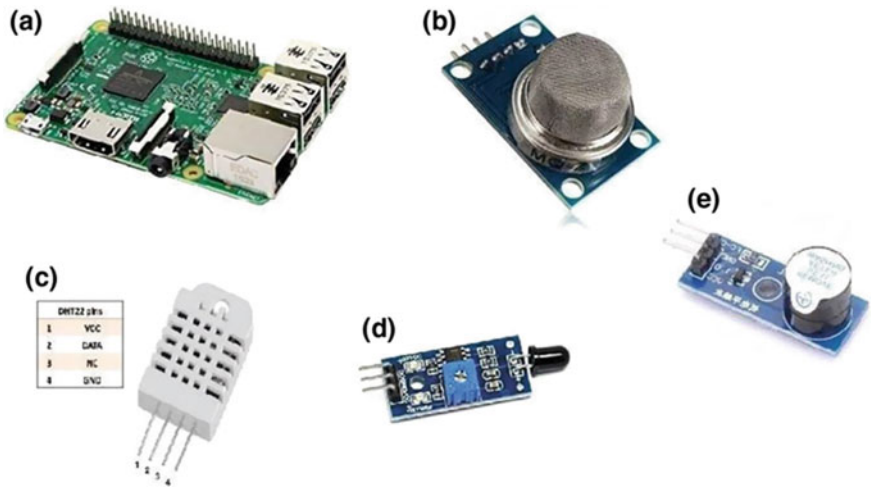

Fig. 2 Hardware incorporated in the model: **a** Raspberry Pi 3, **b** MQ-X gas sensor, **c** DHT22 temperature sensor, **d** IR flame sensor, **e** DIY buzzer alarm

and potentiometer. The infrared light detected by the sensor is converted into current changes using the far-infrared lame probe method.

5. Buzzer: This buzzer is active. It necessitates the inclusion of an extra circuit that facilitates its deployment. One of the digital pins can be used to create the signal. To adjust volume, a series resistor of 100–400 Ω is necessary, with 200 being preferred. Only a DC current source is required for an active buzzer alert.

4 Proposed IoT Based Forest Fire Detection Model

Figure 3 depicts the fundamental IoT model for initial forest-fire recognition. This model comprises three typical sensors: a gas sensor, a flame sensor, a temperature/humidity sensor, and a buzzer alert. The sensors are controlled by a Raspberry Pi 3 microcontroller. The site of fire will be identified through global positioning system (GPS). The internet connection, message alerts, data storage (acquired from the sensors server) are done with the help of GSM module. Data analysis is carried out on the server using a feed-forward, completely connected neural network, thereafter, an alarm is delivered to the appropriate individual through text message/gmail.

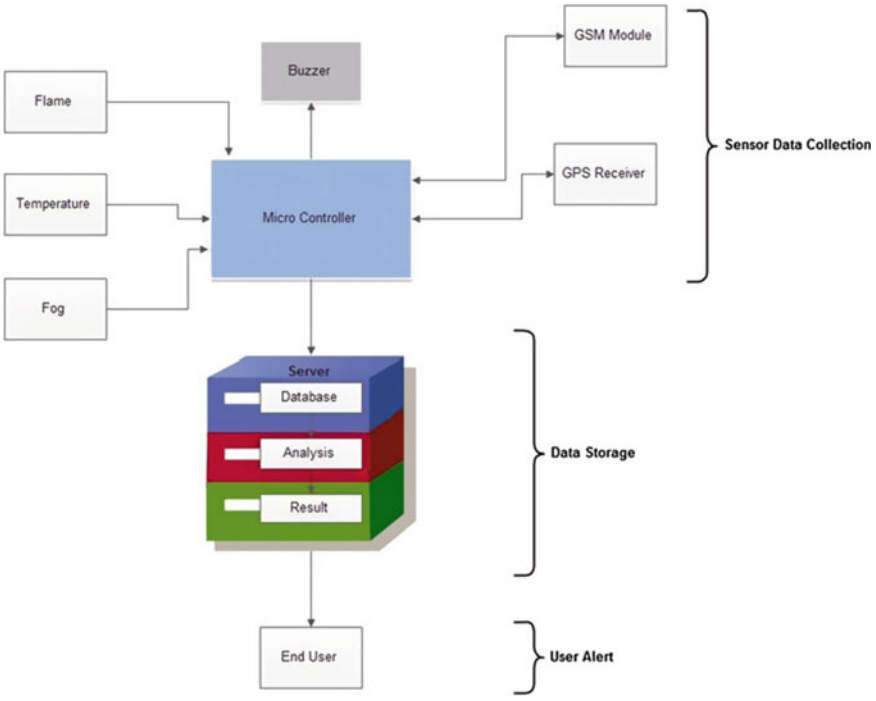

Fig. 3 IoT based forest fire detection model

We'll talk about how the model works now. Connect all the sensors and buzzer/alarm to the Raspberry Pi 3 microcontroller, and programme every sensor and buzzer in Python. The sensors begin collecting data after observing the surrounding surroundings. The temperature (T) is sensed using a DHT22 temperature sensor, which transmits information (signals) to the Raspberry Pi when the recording/reading hits a maximum value. The IR flame sensor detects flame (F) in the surrounding environment and delivers signal 1 if there is a flame present, else it transmits signal 0. The MQ-X fog sensor detects the presence of gases (G) in the surrounding environment, such as CO_2, CO, CH_4, and propane. It gives a notification to the Raspberry Pi if it exceeds the threshold value. There is data transmission from the Raspberry Pi to a central server for optimal selection. A feed-forward completely connected neural network is employed on the server side for analysis and optimization. In addition, we forecast the fire in that region based on data analyses obtained from sensors. Since the GPS tracker detects the position of the fire, we communicate the position of that specific region along with the alarm message. The message alert is delivered to the end user using the Global System for Mobile (GSM) module and SMIT protocol to send mail.

The forest fire detection model is shown in Fig. 4.

The forest has the following three sensors: an IR flame sensor, a MQ2 gas sensor, and DHT22 sensor. Heat (temperature) and fog sensors continuously monitor and gather information from the nearby settings. The information gathered is split into four categories. Extreme High, Moderate, and Low, are the four categories. The temperature measurement of the DHT22 sensor is measured every 2 s to provide the most recent data. The condition (T > Th) is consistently checked; the temperature value is larger than the threshold/maximum value; if NO, we monitor the environment; if YES, we examine the flame sensor value to see if it is present or not. If it isn't there, it sends signal 0 to the server; if there is, it sends signal 1 to the server. The server sends a notification to the fire department's admin and other personnel through email and text message. The position of the fire is determined using a GPS tracker.

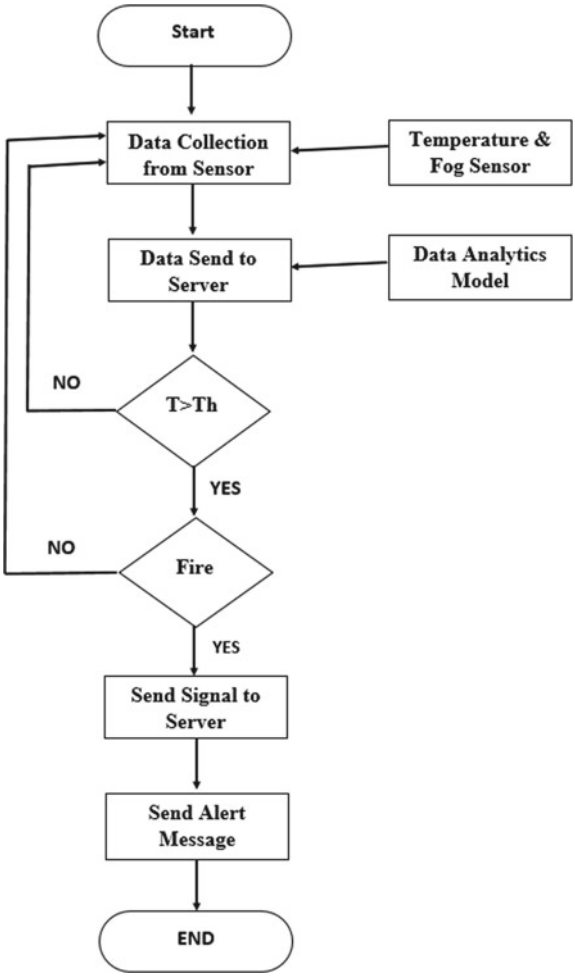

Fig. 4 Flow chart of the proposed model

5 Conclusion

As per the perception analysis related to reasons of the forest fires, a satisfactory sample size believes man made reasons to be the prominent raison d'être. The menace has been frequently witnessed by the residents and have been manifested clearly as animals moving down to residential area in search of water and food, increase in temperature around the affected areas, loss of biodiversity of the affected areas, loss of wildlife habitat. People are unaware about the public or government body checking upon forest fires in the region. There are apprehensions pertaining to responsibilities taken by the authorities at the time of need. People strongly believe that there is a requirement to have a local body with local people of the area in order to take necessary actions regarding forest fires and preventive measures. A majority of selected

sample prominently believe to step forward with local community to restore the affected areas. They desire to stand up as a volunteer and contribute in the forest fires in Uttarakhand.

References

1. SFR (2011) State of Forest Report. Forest Survey of India, Dehradun
2. https://www.downtoearth.org.in/video/climate-change/still-burning-forest-fires-continue-to-rage-in-uttarakhand-76487Published: Wednesday 14 Apr 2021
3. Pyne SJ, Andrews PL, Laven RD (1996) Introduction to wild land fire. Wiley, Toronto. 769 p
4. Gcs N (2021) Forest fire in Uttarakhand: causes, consequences and remedial measures
5. http://5.timesofindia.indiatimes.com/city/dehradun/forest-fires-worsen-air-pollution-elderly-finding-it-difficult-to-breathe-in-smoke-filled-hills/articleshow/81918594.cms
6. Diwakar A (2016) Assessment of increasing threat of forest fires in Uttarakhand, using remote sensing and GIS techniques. Glob J Adv Res 3:457–468
7. Rawat AS (ed) (1991) History of forestry in India. Indus Publishing, New Delhi, 369 p
8. Suresh Babu KV, Roy A, Ramachandra Prasad P (2016) Forest fire risk modeling in Uttarakhand Himalaya using TERRA satellite datasets. Eur J Remote Sens 49:1, 381–395. 5721/EuJRS20164921
9. Raun NF (2016)Smart environment using internet of things(IOTS)—a review. In: 2016 IEEE 7th annual information technology, electronics and mobile communication conference (IEMCON), 2016, pp 1–6. https://doi.org/10.1109/IEMCON.2016.7746313
10. Verma MK, Dwivedi RK (2020) A survey on wormhole attack detection and prevention techniques in wireless sensor networks. In: 2020 international conference on electrical and electronics engineering (ICE3), 2020, pp 326–331. https://doi.org/10.1109/ICE348803.2020.9122944
11. Saldamli G, Deshpande S, Jawalekar K, Gholap P, Tawalbeh L, Ertaul L (2019) Wildfire detection using wireless mesh network. In: 2019 Fourth international conference on fog and mobile edge computing (FMEC), 2019, pp 229–234. https://doi.org/10.1109/FMEC.2019.8795316
12. Jayaram K, Janani K, Jeyaguru R, Kumaresh R, Muralidharan N (2019) Forest fire alerting system with GPS co-ordinates using IoT. In: 2019 5th international conference on advanced computing & communication systems (ICACCS), 2019, pp 488–491. https://doi.org/10.1109/ICACCS.2019.8728383
13. Ghosh M, Sushil R, Ghosh K (2019) Detecting and reporting forest fire through deployment of three dimensional multi-sink wireless sensor network. In: 2019 4th international conference on internet of things: smart innovation and usages (IoT-SIU), 2019, pp 1–5. https://doi.org/10.1109/IoT-SIU.2019.8777485
14. Duangsuwan S, Takarn A, Jamjareegulgarn P (2018) A development on air pollution detection sensors based on NB-IoT network for smart cities. In: 2018 18th international symposium on communications and information technologies (ISCIT), 2018, pp 313–317. https://doi.org/10.1109/ISCIT.2018.8587978

Frequency Control Using Captive Generation and Demand Response

Nagendra Kumar, Sachit Rathee, Akhilesh Singh, Sukanta Halder, and Anubhav Agrawal

Abstract Reliability and quality of power system requires the balance between power generation and load demand. Nowadays, frequency deviations have become an important challenge to resolve, due to the integration of several energy sources and deregulation. This paper addresses automatic generation control (AGC) incorporating the contribution of demand response (DR) and captive generation (CG) i.e., any distributive generation source, which indicate that apart from supplementary control, 2 more control actions are also available to provide optimal operation. Indeed, DR will become a significant entity of electrical grid network in future. The ongoing research suggests significant impacts of DR in power system domain of load frequency control (LFC) problem. Power system optimization through appropriate power sharing between DR (with communication delay), CG and supplementary control has been implemented in this paper. A PID controller tuned by Big bang big crunch (BBBC) has been used as a secondary controller. The entire study has been carried out on interconnected power systems having one and two areas respectively.

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Keywords AGC · DR · CG · Power system · Deregulation

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1 Introduction

The main purpose of this complex power system is to sustain the stability between load-generation, scheduled and actual tie-line flow stability. The major purpose of AGC is to maintain the frequency constant along with regulation of tie-line flow [1–3]. In general, auto-generation control deploys traditional text book controllers, like: Integral, PI and PID generally are not fast enough and poor in dynamic functioning. The estimation of AGC in a deregulated scenario has been examined in [4]. In addition to that, a brief evaluation of the content and the simulation of an AGC system after deregulation are presented. Mainly, based on regulation of frequency in electrical grid is extracted by the power stability between generation and load pattern [5]. Load based control of frequency or Auto-generation control is the core and key clause while designing an electric power system with optimal considerations along with aspects of quality and reliability in electric power supply. As the load demand varies, the Gencos keep/regulates their generated output at its stable condition. When Gencos are running at on their full capacity, frequency is fluctuated in order to maintain the additional load demand. Therefore, CG comes into picture to take care of the additional demand. However, generally large storage devices have limited availability, low efficiency, and high cost, therefore, in this study, CG is used as a source of real power (an extra generation) available at Disco side to take care of any unwanted (uncontracted) load demand and to limit the use of conventional power generation mechanisms and schemes having less economical and adverse environmental aspects. Nowadays power system is expected to generate power by renewable energy (RE), which is variable in nature. To ensure appropriate power balance between load variation and power generation DR is considered where consumer participation is necessary [6]. In other words, these systems are designed to extract/generate power using two or more sources. Load based control of frequency or Auto- generation control is the core and key clause while designing an electric power system with optimal considerations along with aspects of quality and reliability in electric power supply [7–9]. Now it is well established that in order to tackle with the undetermined and irregular nature of power system due to RE integration, DR is employed to ensures cost effective, efficient, reliable and flexible operation of power system. Till date the literature reveals that control of AGC model has been done on the generation end, and CG, excluding the concept of DR. Motivation behind this study is to check the impact and contribution of captive generation and demand response in load frequency regulation of power system along with the conventional power output change in the generators. In this paper, modified power system model which incorporate the CG, DR and supplementary control (AGC-CG-DR) is used for frequency regulation. As controller has significant influence the scheme of AGC, so a supplementary control i.e., PID controller has been used. The parameters of PID controller have been determined using BBBC optimization technique. Communication delay associated with DR has also been considered. The concept of DR is implemented in this study. The detailed explanation regarding DR i.e., comprehensive central DR algorithm for frequency regulation, minimization of manipulated

load, in a single-area power system, a DR control loop in the conventional LFC model (called LFC-DR), Microgrid can be referred from [10]. The proposed scheme is tested on conventional single area and deregulated 2-area thermal power system [11]. The results ensure both suitability and compatibility of AGC-CG-DR to provide grid frequency stability.

2 Problem Statement

The general power balance equation for frequency control analysis and synthesis can be written as (1),

$$\Delta P_{Tur}(s) - \Delta P_{Load}(s) = 2H.s.\Delta f(s) + D.\Delta f(s) \tag{1}$$

where, s = laplace operator, D = Load damping coefficient; H = inertia constant, $\Delta P_{Tur}(s) - \Delta P_{Load}(s)$ = incremental power mismatch, $\Delta f(s)$ = frequency deviation.

Since DR and CG perform like reserve, if frequency deviation becomes negative (or positive) for once then it becomes necessary to turn OFF (or ON) a certain amount of DR and CG to regulate the frequency and (1) after modification to include DR and CG results in (2).

$$\begin{aligned} \Delta \mathrm{P_{Tur}(s)} - \Delta \mathrm{P_{Load}(s)} + \Delta \mathrm{P_{DR}(s)} + \Delta \mathrm{P_{CG}(s)} \\ = 2\mathrm{H.s.}\Delta \mathrm{f(s)} + \mathrm{D.}\Delta \mathrm{f(s)} \end{aligned} \tag{2}$$

Since D is an inherent parameter of the system so its impact should be excluded as it is uncontrollable but DR is the signal which has intentionally controllable. For an improved controller design with realistic approach the control loop for DR and CG needs to be decoupled. In Fig. 1 the block diagram of a single-area power system including simplified non-reheat steam turbine is shown with respect to power demanded by controllable loads, it can be instantly regulated via control signal. So, the sole parameter for DR that could affect the instant performance of system adversely is latency, which is also known as communication delay.

2.1 State-Space Dynamic Model for LFC-DR

Modern or robust control theory is significant mathematical application of state-space representation for LFC model as analysis tool. By obtaining the dynamic structure of power system with state space representation including DR, an impact of DR on LFC can be analyzed. However, the Fig. 1 represents the model of proposed LFC-DR scheme with non-reheat steam turbine-based power system and similar modeling

of power systems can be done with hydro or reheat-steam turbine to analyze and obtain significant conclusions. The mathematical model of state-space realization DR included in power system having one area (Fig. 1) is given below.

$$\begin{aligned} \dot{x} &= Ax + Bu + \Gamma w \\ y &= Cx \end{aligned} \tag{3}$$

From (3) System matrix is represented by A, Control input matrix by B, Disturbance matrix by Γ, Observation matrix by C, state and input vector by x and u respectively, disturbance variable by w and y as the system output. For the purpose of analysis and study of proposed system its state space model is required to be linearized. As evident from Fig. 1, the system has only time delay in the DR control loop as the sole nonlinear element. So, this time delay is required to be linearized for the system to have a linearized mathematical model of state-space representation.

2.2 *Steady-State Error Evaluation with DR Only*

Indeed, frequency droop control is fastest in power system as shown in Fig. 1, is not sufficient to eliminate frequency deviation under steady-state conditions. So, another frequency control loop is included as shown in Fig. 1, for better controller design. Since the DR control loop is included in the proposed system for analysis and design purpose, it becomes essential to analyze how for the proposed power system the error under steady state (Fig. 1) is detrimentally affected under the action of DR control loop. So, by appropriate distribution among DR as well as supplementary control loops, the error under steady state is calculated to synthesize the design of controller. Equations (4)–(11) show the frequency deviation calculation for the system under study.

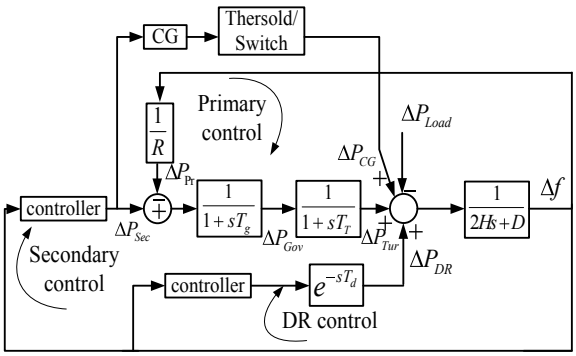

Fig. 1 Representation of control scheme

$$\Delta f(s) = \frac{1}{2Hs + D}[\Delta P_{Tur}(s) - \Delta P_{Load}(s) + G(s).\Delta P_{DR}(s)] \tag{4}$$

where

$$\Delta P_{Tur}(s) = \frac{1}{(1 + sT_t)(1 + sT_g)}\left[\Delta P_{\text{sec}}(s) - \frac{1}{R}.\Delta f(s)\right] \tag{5}$$

On substituting (5) into (4) yields

$$\Delta f(s) = \frac{1}{2Hs + D}\left[\begin{array}{l}\dfrac{1}{(1 + sT_t)(1 + sT_g)}\left(\Delta P_{\text{sec}}(s) - \dfrac{1}{R}.\Delta f(s)\right) \\ - \Delta P_{Load}(s) + G(s).\Delta P_{DR}(s)\end{array}\right] \tag{6}$$

Let $H(s) = \frac{1}{(1+sT_t)(1+sT_g)}$.
Therefore (6) becomes

$$\Delta f(s) = \frac{1}{2Hs + D}\left[H(s)\left[\Delta P_{\text{sec}}(s) - \frac{1}{R}.\Delta f(s)\right] - \Delta P_{Load}(s) + G(s).\Delta P_{DR}(s)\right] \tag{7}$$

On solving (7) for $\Delta f(s)$ will obtain the equation of deviation of frequency as below,

$$\Delta f(s) = \frac{1}{\psi(s)}[H(s).\Delta P_{\text{sec}}(s) + G(s)\Delta P_{DR}(s)] - \frac{1}{\psi(s)}\Delta P_{Load}(s) \tag{8}$$

where,

$$\Psi(s) = 2Hs + D + \frac{H(s)}{R} \tag{9}$$

In LFC for the purpose of analysis a step load perturbation is commonly used for $\Delta P_{Load}(s)$ as,

$$\Delta P_{Load}(s) = \frac{\Delta P_{Load}}{s} \tag{10}$$

Applying the final value theorem along with substitution of (10) into (8), the value of frequency deviation under steady-state for the proposed system can be expressed as given in (11)

$$\Delta f_{ss}(s) = \lim_{s\to 0} s\Delta f(s) = \frac{\Delta P_{\text{sec},ss} + \Delta P_{DR,ss} - \Delta P_{Load}}{\Psi(0)} \tag{11}$$

$$\begin{aligned} \Delta P_{\text{sec},ss} &= \lim_{s\to 0} sH(s)\Delta P_{\text{sec}}(s) \\ \Delta P_{DR,ss} &= \lim_{s\to 0} sG(s)\Delta P_{DR}(s) \end{aligned} \tag{12}$$

$$\Psi(0) = D + \frac{H(0)}{R} = D + \frac{1}{R} \approx B \tag{13}$$

Therefore, $\Psi(0)$ corresponds to response characteristics of frequency of system under study, and so the deviation of system frequency under steady state can be expressed by (14).

$$\Delta f_{ss}(s) = \frac{\Delta P_{\text{sec},ss} + \Delta P_{DR,ss} - \Delta P_{Load}}{B} \tag{14}$$

As evident from (14), that to eliminate the frequency deviation (FD) the supplementary control and/or DR control loop is required which subsequently gives one more degree of freedom for regulation of frequency of system. As such, the following conclusions are drawn from (14): Due to enhanced controlling of DR loop in model of LFC it becomes possible to achieve highly reliable frequency regulation, since controlling of DR loop can enhance the control of supplementary loop. If supplementary control does not exist, still better regulation of frequency can be ensured alone with DR control loop even if sufficient resources of DR are present in system. In order to completely eliminate the deviation in frequency under steady-state, the desired controlling operation is shared among the loops consisting of supplementary as well as DR loop appropriately. In other-words, an ISO/RTO can willingly regulate the services in an economical manner and hence quickly analyze the systems frequency response characteristics, which can only be achieved through proposed mathematical formulation (14) with an additional control loop for DR.

In addition to above remarks if there is no availability of DR sources then for the error tin frequency to be zero under steady-state the necessary condition will be $\Delta P_{\text{sec},ss} = \Delta P_{Load}$.This reveals that supplementary control action must ensure sufficient spinning and/or non-spinning reserve at the instant of perturbation. In LFC model with DR the adequate control action of DR is represented by Ω_c in this study and the control action is divided among aforesaid two controlling loops as per their cost at electricity market as given in (15).

$$\begin{cases} \Delta P_{\text{sec},ss}(s) = \alpha\Omega_c \\ \Delta P_{DR,ss}(s) = (1-\alpha)\Omega_c \end{cases} \tag{15}$$

where $o < \alpha < 1$ represents the extent of conventional regulation services in the desired control action. Then $\alpha = 1$ signifies that complete desired regulation has to

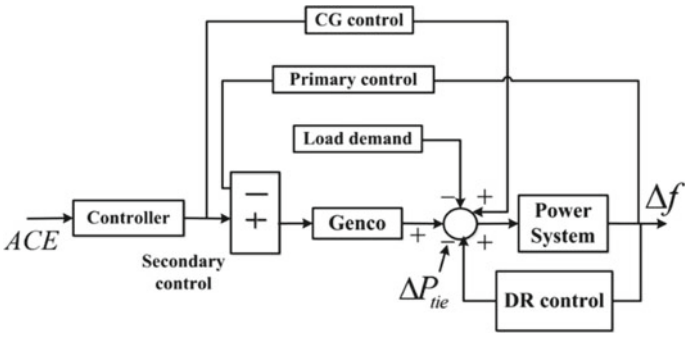

Fig. 2 Block diagram representation of control scheme

be given by conventional regulation services such as reserves represented as spinning and non-spinning, $\alpha = 0$ signifies that instant of time when DR provides the necessary control action. So, it becomes possible to do quick and effective analysis of various aspects of LFC to enumerate system's performance when subjected to critical circumstances by ISO/RTO. Ultimately, the two inputs values under steady-state will be as (16).

$$\begin{cases} \Delta P_{\text{sec},ss} = \alpha \Delta P_{Load} \\ \Delta P_{DR,ss} = (1-\alpha)\Delta P_{Load} \end{cases} \tag{16}$$

2.3 DR and CG Available

In Fig. 1, the power output from CG sources comes into action when DR and supplementary sources are at their maximum, and cannot further increase the power generation. Control scheme is represented in Fig. 2. the overall representation of ith area of AGC scheme, having CG and DR control loops is shown in Fig. 3.

3 Results and Discussion

3.1 Single-Area Power System

Initially a load perturbation of 0.01 pu has been given to power system having one area both with pre-existing LFC as well as the model of LFC-DR proposed for study. Figure 4 represents the corresponding deviation in frequency of system both with

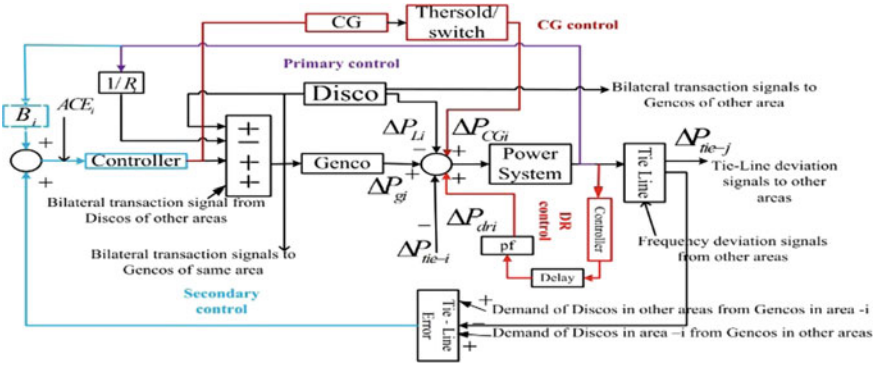

Fig. 3 AGC scheme for ith area power system

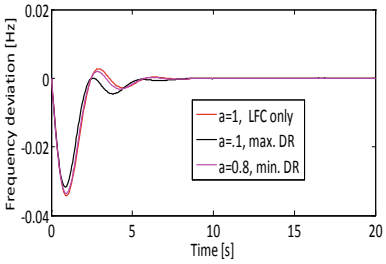

Fig. 4 Deviation in frequency

pre-existing LFC as well as the model of LFC-DR proposed for study. The variables that are used for studying the simulation have been mentioned in Table 1.

It is evident that for $\alpha = 0.1$ (i.e., 10% of regulation is supplied by supplementary control and 90% by DR), the LFC-DR model has an enhanced performance as compared to the existing LFC model under transient condition. Most significantly, it has been observed that the overshoot in frequency deviation is reduced under study. As a result, the settling time of frequency response has improved significantly. When the simulation was repeated for $\alpha = 0.8$ implying less DR control action which resulted in comparatively small improvement in system's performance under dynamic conditions.

The performance of the proposed system with LFC-DR approaches that of LFC for values of α close to unity. In Fig. 5 both the supplementary as well as DR control inputs are represented for the same simulation. The values of control inputs under

Table 1 Parameters of single area system

T_g (s)	T_t (s)	R (Hz/pu)	H (pu s)	D (pu/Hz)	ΔP_{Load} (pu)	T_d (s)
0.3	0.8	2.4	3.0	0.0083	0.01	0.1

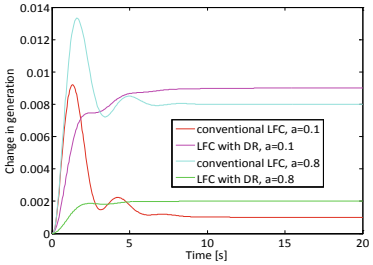

Fig. 5 Change in generation (single area system)

steady state are based on distribution of α between DR and the other control loops, which is eventually by figured out by the regional ISO/RTO in context of actual existing electricity market. All the calculations of steady-state value are given in Fig. 5 which matches with (16). A significant aspect of model of LFC-DR proposed for study is that it enables ISO/RTO to calculate the effect of communication delay on the system performance. To analyze the extent of effect of latency for its various values with $\alpha = 0.1$, a simulation case is studied with its results shown in Fig. 6. It was observed that the minimum communication delay (i.e., lowest T_d) is always for such a power system which is small and have a two-way fast communication link, like wireless communication as the communication link amid Discos and individual loads. The LFC-DR model is found to be higher in performance in comparison to existing LFC model if delay time $T_d \leq 0.2$ s and poor in performance if time delay exceeds 0.2 s. If the power system to be analyzed is large having limiters in rate of generation with slow system of turbine-governor then the expected response under dynamic conditions is relatively with supplementary control but it is consistently higher in performance even with high values of communication latencies, up to $T_d \leq 0.5$ s under the LFC-DR control. So far in this paper the performance of proposed model of LFC-DR is investigated in terms of frequency regulation for a single-area power system at transmission level. But in general, complex interconnected power systems consists of multiple-areas having different GENCO's and Discos present in

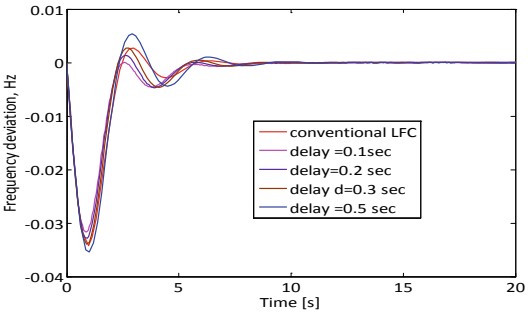

Fig. 6 Effects of communication delay

Table 2 Parameters of two area power system

$Tg_i = 0.08$ s Governor time constant	$T_{Pi} = 24$ s Power system time constant
$K_{Pi} = 120$ Hz/pu MW Power system gain constant	$Tt_i = 0.3$ s Turbine time constant
$R_i = 2.4$ Speed regulation	$B_i = 0.425$ Frequency bias constant
$Ti_j = 0.0707$, synchronizing constant	

each areas, so the proposed AGC-CG-DR scheme is actually applied on two-area [7] power system for analyzing its performance and effectiveness of regulating frequency deviation.

3.2 Two Area System

To analyze the response of system with AGC-CG and AGC-DR control scheme, two area system based on Fig. 2 is considered. Area-1 has Genco_{11}, Genco_{12}, Disco_{11} and Disco_{12} and Area-2 has Genco_{21}, Genco_{22}, Disco_{21} and Disco_{22}. The parameters of AGC scheme are taken from [7] (Table 2)

3.2.1 Case 1: With Supplementary Controller

In this case, load of 0.2 pu has been considered in *area-1* (0.1 pu in Disco_{11} and 0.1 pu in Disco_{12}), and 0.2 pu load in *area-2* (0.1 pu in Disco_{21} and 0.1 pu in Disco_{22}). Discos contracts are taken from the given DPM.

$$DPM = \begin{bmatrix} 0.5 & 0.5 & 0 & 0 \\ 0.5 & 0.5 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

At time instant t = 0 of area 1 an increase of step is considered for the Discos. The deviation in frequency in both areas is represented in Fig. 7a. The results given in Fig. 7a shows frequency deviation. The required change in generation of a Genco in pu could be represented as given in (17),

$$\Delta P_{gi} = \sum_j cpfi_j \Delta P_L j \tag{17}$$

where, ΔP_{Lj} = total load demand of jth Disco and cpf_{ij} are given by DPM. The expansion of (17) can be written as (18).

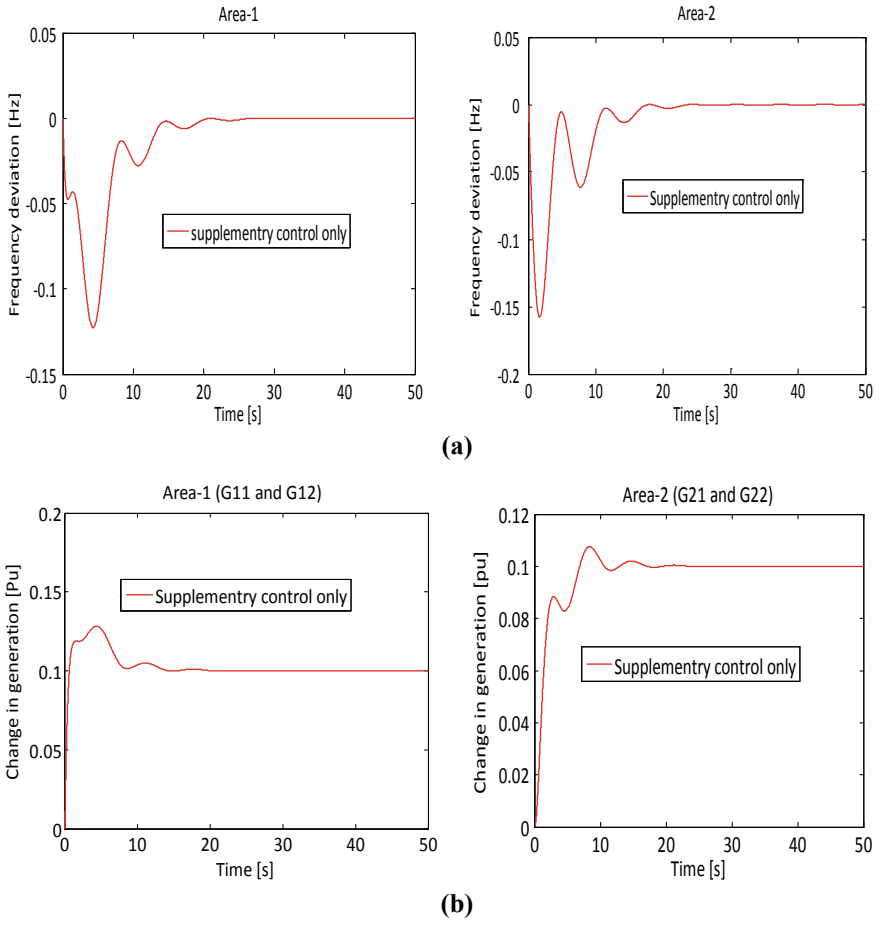

Fig. 7 **a** Frequency deviations. **b** Change in generation

$$\Delta Pgi = cpf_{i1}\Delta P_{L1} + cpf_{i2}\Delta P_{L2} + cpf_{i3}\Delta P_{L3} + cpf_{i4}\Delta P_{L4} \tag{18}$$

For the case under consideration, (18) can be determined as (19),

$$\Delta P_{g11} = 0.5 * \Delta P_{L1} + 0.5 * \Delta P_{L2} = 0.1\,\text{pu} \tag{19}$$

Similarly, $\Delta P_{g12} = 0.1$ pu (area-1), $\Delta P_{g21} = \Delta P_{g22} = 0.1$ pu (area-2). Figure 7b represents the generation change for each Genco in area-1 and area-2, which settled to 0.1 pu.

3.2.2 Case 2: With Demand Response (DR)

It is a case where DR is applied in area-2. The results exhibit how well DR is effective in AGC scheme. For $\alpha = 0.1$ (i.e., 10% of desired regulation is supplied by supplementary control and remaining 90% from DR), the AGC-DR model is found to have higher performance than conventional LFC in transient time instant, as shown in Fig. 8. There is significant decrease in overshoot as well as improvement in the settling time of frequency deviation. And for $\alpha = 0.5, 0.7$ the same simulation is carried out with the expected result that lower DR control action will lead to detrition in dynamic performance of system as compared to the system performance for higher values of α. It is evident that the system's dynamic performance approaches as that of conventional AGC for values of α close to unity. In Fig. 9 both the inputs of supplementary control and DR control are shown considering the same simulation model under study. However, the values of control inputs under steady state are decided by the sharing of α between the DR and supplementary control loops, which in turn is decided by the regional ISO/RTO referring to actual electricity market.

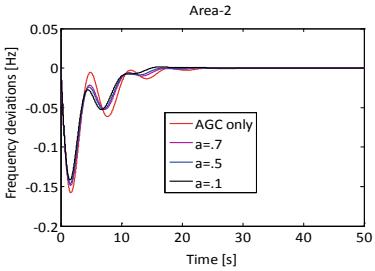

Fig. 8 Frequency deviations with AGC only

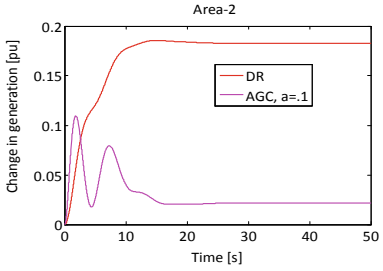

Fig. 9 Change in generation (Two area system using DR)

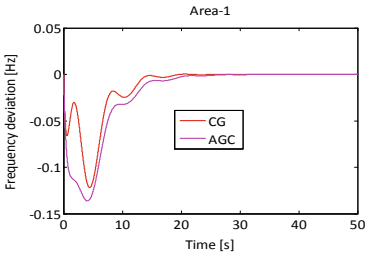

Fig. 10 Frequency deviations with AGC and CG

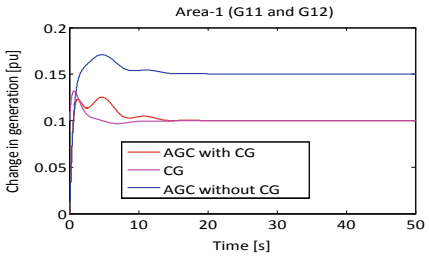

Fig. 11 Change in generation (two area system using CG)

3.2.3 Case 3: With Captive Generation (CG)

It is a case where CG available with Disco_{11} is applied in area-1. It is considered that Discos of area-1 demand additional load of 0.1 pu. Figure 10 shows that this additional demand fluctuates the frequency, however when CG comes into picture frequency deviation has lower magnitude than the earlier one. Figure 11 shows the change in generation values of Gencos of area-1. It is seen that the additional demand satisfied smoothly when CG and AGC both are in use. Gencos of area-1 have to generate additional power if AGC is alone in use. The results show the effectiveness of CG in AGC scheme.

4 Conclusion

This paper investigates about the performance and effectiveness of AGC-DR-CG model for single area and 2-area deregulated power system for regulating frequency deviation at the transmission level. Generally, power systems are quite large and interconnected with multi-area where various Gencos and Discos are present in each area. This work can be further expanded based on implementation of AGC-DR-CG in power systems having multiple area for frequency deviation regulation and its elimination under steady state simulations, the output of every controller is inspected

from the dynamic action of generation, ACE, frequency, Output of DG sources and tie-line power. It is clear in every aspect from the above comparison that the control scheme based on BBBC provides time domain with better characteristics in terms of settling time and undershoot/ overshoot, and it can be effective choice of hybrid system in AGC/LFC control scheme.

References

1. Elgerd OI, Fosha C (1970) Optimum megawatt- frequency control of multi-area electric energy systems. IEEE Trans Power Syst 89:556–563
2. Jaleeli N, Ewart DN, Fink LH (1992) Understanding automatic generation control. IEEE Trans Power Syst 7:1106–1122
3. Kumar N, Tyagi B, Kumar V (2017) Multi-area deregulated automatic generation control scheme of power system using imperialist competitive algorithm based robust controller. IETE J Res 64:528–537
4. Bakken BH, Grande O (1998) Automatic generation control in a deregulated environment. IEEE Trans Power Syst 13(4):1401–1406
5. Doherty R, O'Malley M (2012) A new approach to quantify reserve demand in systems with significant installed wind capacity. IEEE Trans Power Syst 20(2):587–595
6. Pourmousavi SA, Nehrir MH (2012) Real-time central demand response for primary frequency regulation in microgrids. IEEE Trans Smart Grid 3(4):1988–1996
7. Singh BK, Kumar N, Singh A, Joshi BP (2018) BBBC based frequency controller for solar thermal–wind hybrid power system generation/energy storage system. J Intell Fuzzy Syst 35(5):5063–5070
8. Singh A, Kumar N, Joshi BP, Singh BK (2018) AGC using adaptive optimal control approach in restructured power system. J Intell Fuzzy Syst 35(5):4953–4962
9. Singh A, Kumar N, Joshi BP, Singh BK (2018) Load frequency control with time delay in restructured environment. J Intell Fuzzy Syst 35(5):4945–4951
10. Kumar N, Tyagi B, Kumar V (2015) Optimization of PID parameters using BBBC for multi-area AGC scheme in deregulated power system. Turkish J Electr Eng Comput Sci 24:4105–4116
11. Huang H, Li F (2013) Sensitivity analysis of load-damping characteristic in power system frequency regulation. IEEE Trans Power Syst 28(2):1324–1335

Load Frequency Control in Multiarea Power System Using TID Control Scheme

Nagendra Kumar, Suman Lata, Akhilesh Singh, Sachit Rathee, and Pardeep Sangwan

Abstract Load Frequency Control (LFC) is necessary for stable power system (PS) operation. LFC's main task is to maintain the generator's output in response to changes in frequency; to restore the frequency and power exchange within prescribed limits. Tilted Integrated Derivative (TID) controller is designed in this paper. To evaluate the response of the designed control, scheme a step load perturbation is used. The results of TID control scheme is compared with proportional integral derivative (PID), Model Predictive Control (MPC), and Fuzzy PID on four-area and six areas thermal reheat system. Optimal gains of PID and TID controllers are determined using Big bang big crunch (BBBC). The comparison of performance of the controllers is carried in terms of overshoot (M_p), undershoot and settling time (T_s). It is seen that for all cases, TID performs better than other controllers specifically in terms of settling time.

Keywords Area control error (ACE) · Fuzzy logic control (FLC) · Tilted integrated derivative (TID) · Load frequency control (LFC) · Model predictive control (MPC) · Proportional integral derivative (PID)

1 Introduction

Load frequency control (LFC) is liable for frequency control in power systems, in a scenario of imbalance between generation and load demand. The LFC purpose is to maintain the frequency and tie-line power stable under normal circumstances [1]. LFC is a system that takes care of frequency regulation in an electrical system. It keeps

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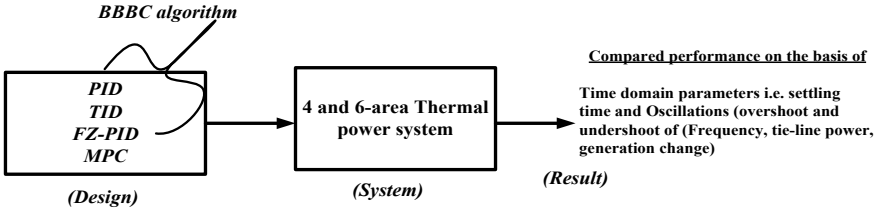

Fig. 1 Graphical abstract of the work

an area's generation-load within a predetermined range and handles any unbalance in frequency and power exchange that occurs when the load changes [2–4]. A controller is an important element in LFC scheme, therefore, a suitable control system for a networked power system is included in an LFC scheme. As shown in literature, power system performance is influenced by control structure and fitness function. Several control schemes including as classical, adaptive, optimum, nonlinear and so on, have been applied in the literature [5, 6]. However, the role and responsibility of control approaches in the power systems has been increased. Control scheme i.e. Fuzzy, Model predictive control (MPC) predicts future response of the system and produces optimal control and find its suitability to control the frequency of power systems [7–9]. Load based control of frequency or Auto- generation control is the core and key clause while designing an electric power system with optimal considerations along with aspects of quality and reliability in electric power supply [10–12]. Since different control approaches have their merits and limitations, therefore, in this study authors have carried out a comparison of performances of PID, TID, Fuzzy PID and MPC on a four area and six area reheat thermal power system. The graphical abstract of the work carried out in this paper is shown in Fig. 1.

2 Test System

Four and six-area thermal power systems used as test systems to ensure that the designed controllers worked properly. Generation and load must be under balance condition if any of them is unbalance it gives rise to area control error (ACE). Area control error is eliminated in (1) by controller.

$$\mathrm{ACE_i} = \mathrm{B_i}\Delta\mathrm{F_i} + \Delta\mathrm{Ptie_i} \tag{1}$$

3 Control Schemes

In LFC, the secondary control technique is critical for restoring frequency and tie-line power to normal. Many approaches have been employed in the past, however in this study, PID, TID, Fuzzy PID, and MPC controllers have been constructed and tested for the system shown in Fig. 2.

3.1 Fuzzy-PID Control Scheme

Fuzzy logic controller is centered on fuzzy logic and offers a procedure which converts the expert knowledge-based linguistic strategy into an automatic control strategy. To design this control scheme, membership function and rule base has been referred from [5].

3.2 PID and TID Control Schemes

For the given test systems, PID and TID control methods have also been designed. The parameters of both control techniques are determined using BBBC algorithm, which minimizes the fitness function provided in (2). The structures of PID is taken from reference [6] and TID control scheme is given in Fig. 3.

$$\begin{aligned} F &= \frac{1}{m}\sum_{i=1}^{m}[(ACE_i)^2] \\ &= \frac{1}{m}\sum_{i=1}^{m}[(B_i\Delta f_i + \Delta Ptie_{i\text{ - error}})^2] \end{aligned} \tag{2}$$

The steps of determining parameters of PID and TID using BBBC are taken from [5, 6] and given as:

- The population is generated.
- Fitness function is evaluated.
- Center of mass is calculated.
- New population around center of mass is generated.
- Next parameters are generated.
- Error is calculated and if it is less than the specified, algorithm stop.

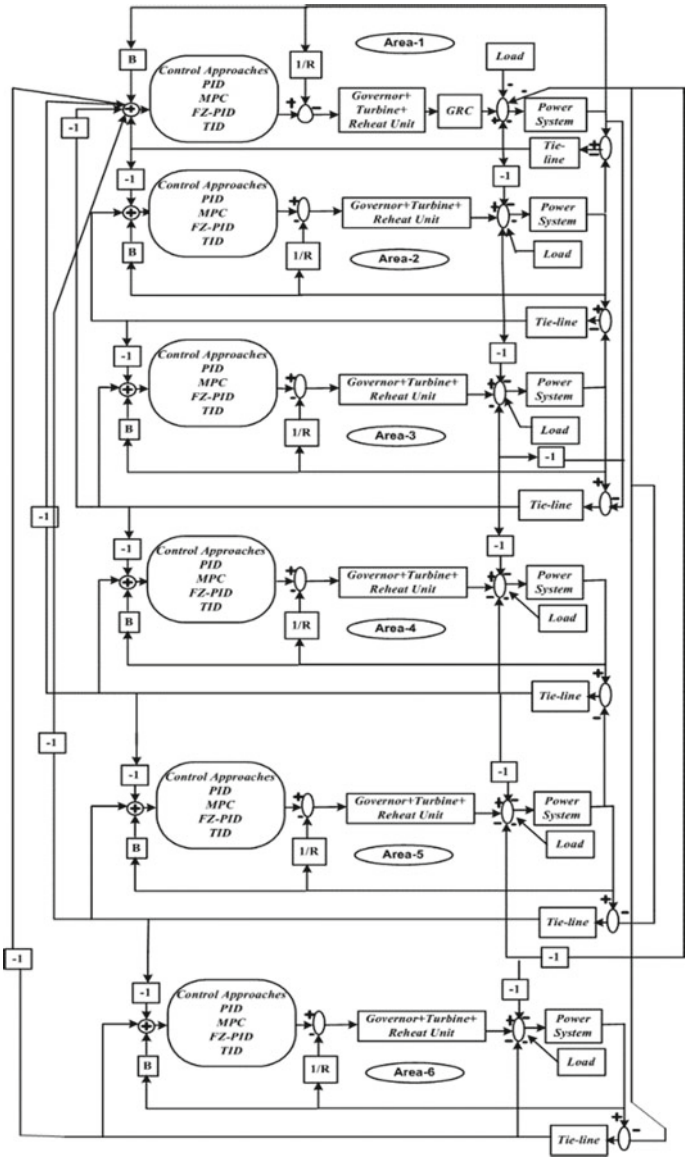

Fig. 2 Block diagram representation of six area system

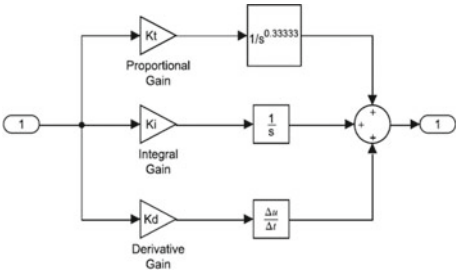

Fig. 3 Simple structure of TID scheme

3.3 Model Predictive Control (MPC) Scheme

MPC control scheme has been used as a suitable control application in industries. The structure of MPC is referred from [6]. On the basis of past-present I/O and future control actions, MPC predicts the system's future output. The objective function that is optimized by MPC is given as:

$$J(L_1, L_2, N_u) = \sum_{j=L_1}^{l_2} \alpha(j)\left[\hat{y}(k+j|k) - w(k+j)\right]^2 + \sum_{j=1}^{N_u} \beta(j)[k+j-1]^2 \tag{3}$$

where, L_1/L_2 are lower/upper prediction horizons (UPH), N_u/control horizon (CH), $\alpha(j) - \beta(j)$/weighting factors. $w(k+j)$/Trajectory over the future horizon. $\Delta u(k+j) = 0\, for l \geq N_u$ is the relation used to give the number of future control. The detailed explanation of MPC scheme can be referred from [8, 9].

$$\begin{aligned} u_{\min} &\leq \Delta \mathrm{u(k)} \leq u_{max} \\ y_{\min} &\leq \Delta \mathrm{y(k)} \leq y_{max} \end{aligned} \tag{4}$$

4 Results and Discussion

The above approaches have been designed for four-area and six-area LFC schemes based on Fig. 2.

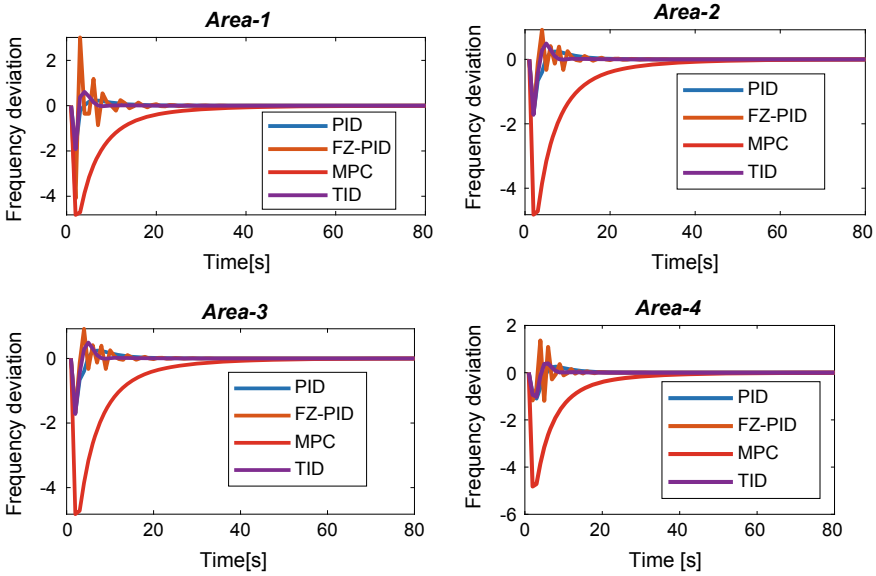

Fig. 4 Frequency deviation in all areas (four area system)

4.1 Step Load Disturbance in All Areas of Four Area System

In this case 1.2 pu is assumed to be a step load. On load perturbation the frequency of region-1 and region-2 deviates from its nominal value, as seen in Fig. 4. To restore the frequency to its specified value, the LFC performs a generation change. All the controllers exhibit oscillations in the frequency disparity region-1 and region-2. MPC control technology, on the other hand, quickly eliminates both areas of deviation. Figures 5, 6 and 7 shows the changes in output, tie-line flow and field control error, respectively.

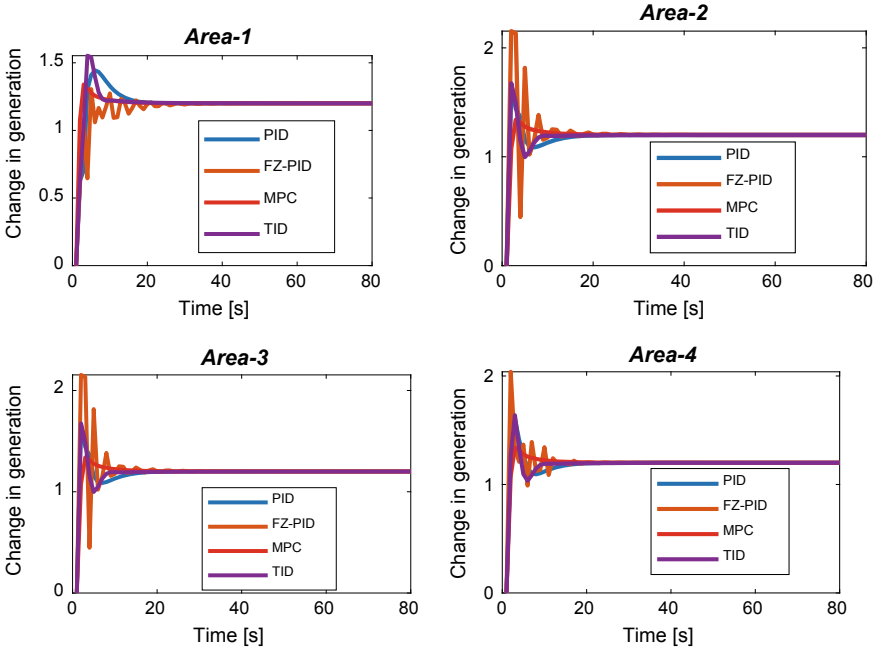

Fig. 5 Change in generation in all areas (four area system)

4.2 Step Load Disturbance in All Areas of Six Areas System

In this situation, a step load of 1.2 pu has been taken into account in each location. To restore frequency to its pre-programmed level LFC is the catalyst for generational change. Figures 8, 9, 10 and 11 depict the frequency deviation, change in generation, tie-line flow, and area control error (ACE), respectively. It is observed that Genco, frequency and tie-line power deviations settled down towards steady state.

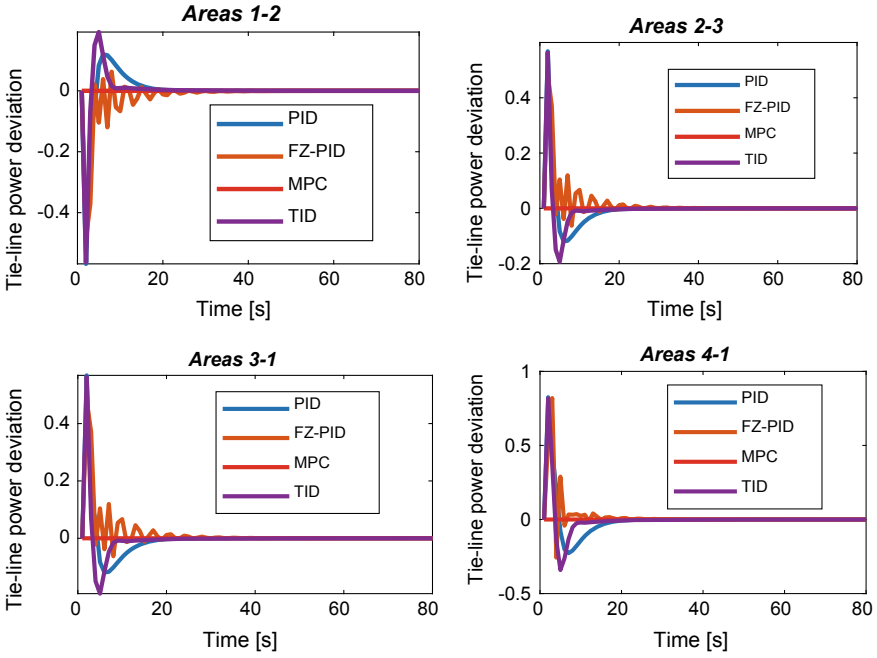

Fig. 6 Tie-line power deviations (four area system)

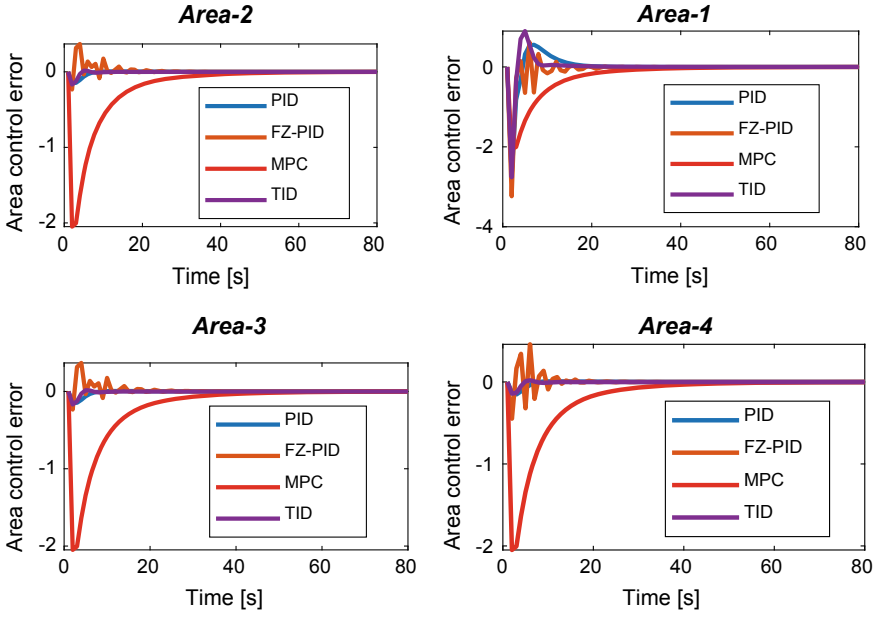

Fig. 7 Area control errors (four area system)

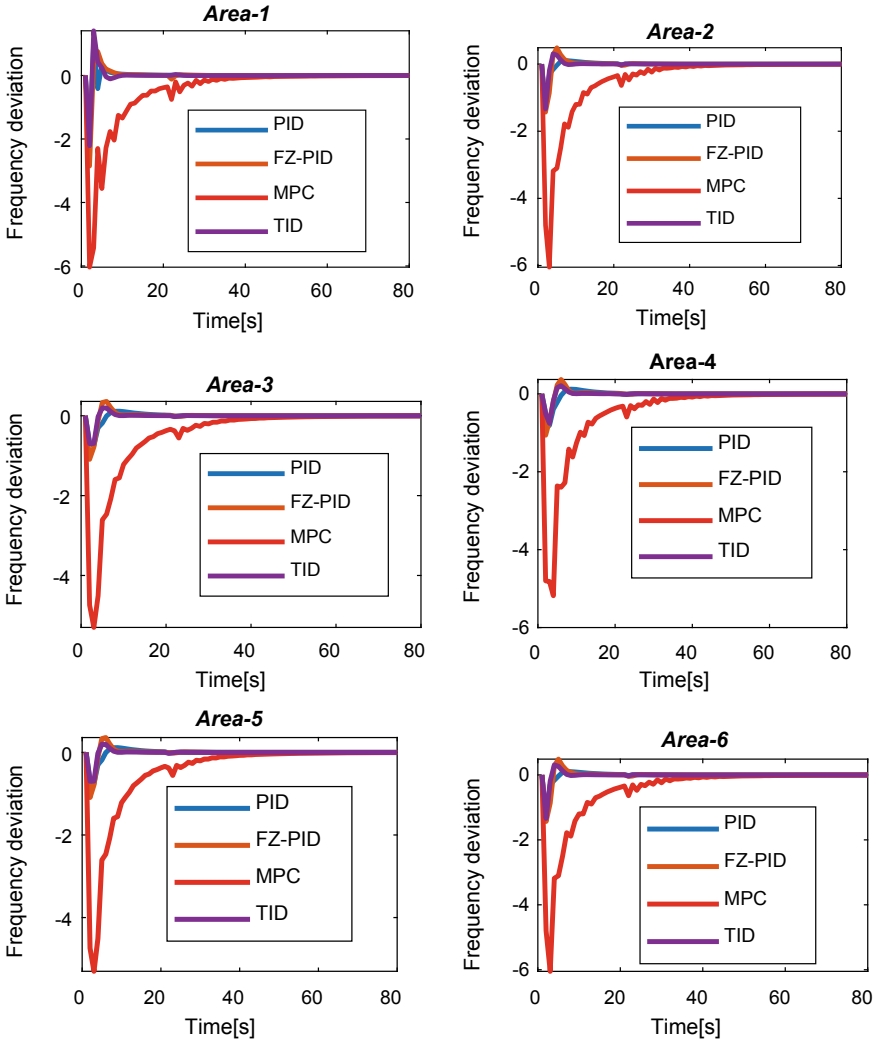

Fig. 8 Frequency deviation in all areas (six area system)

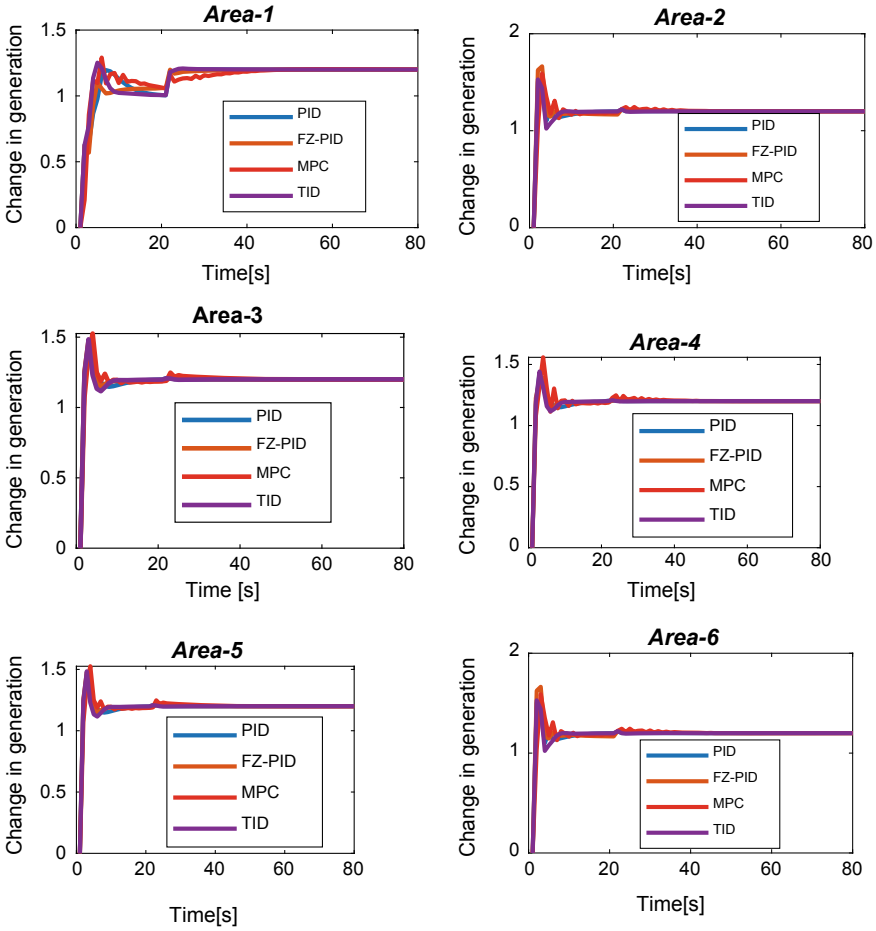

Fig. 9 Change in generation in all areas (six area system)

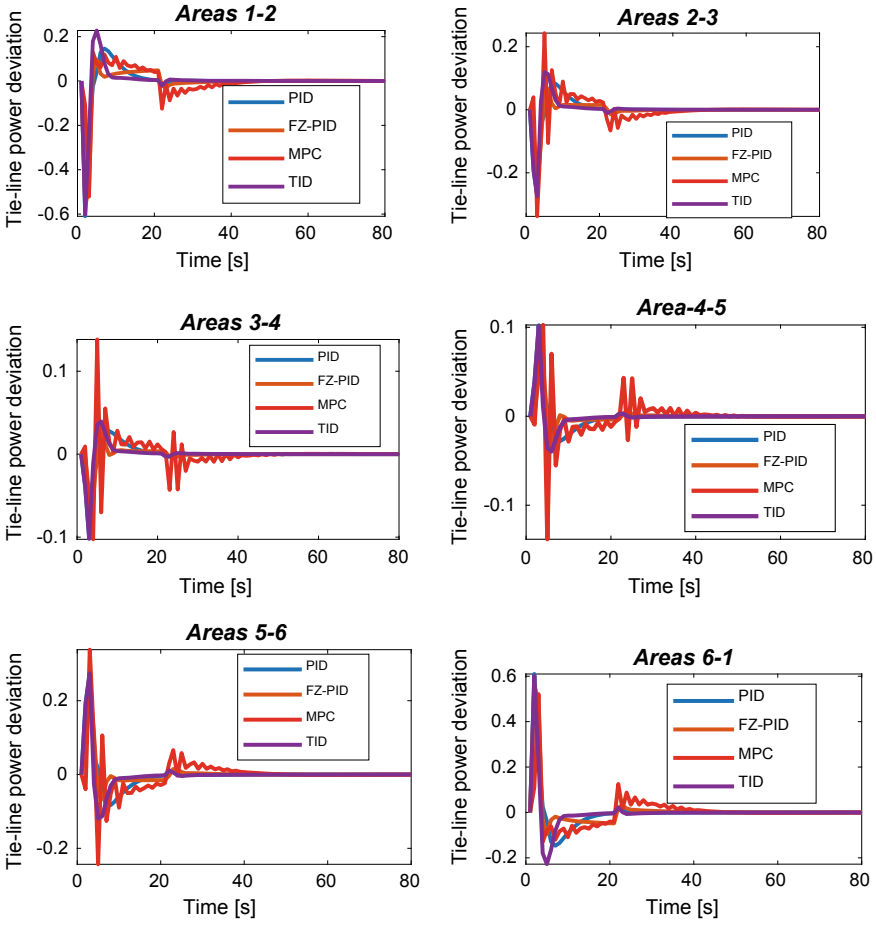

Fig. 10 Tie-line power deviations (six area system)

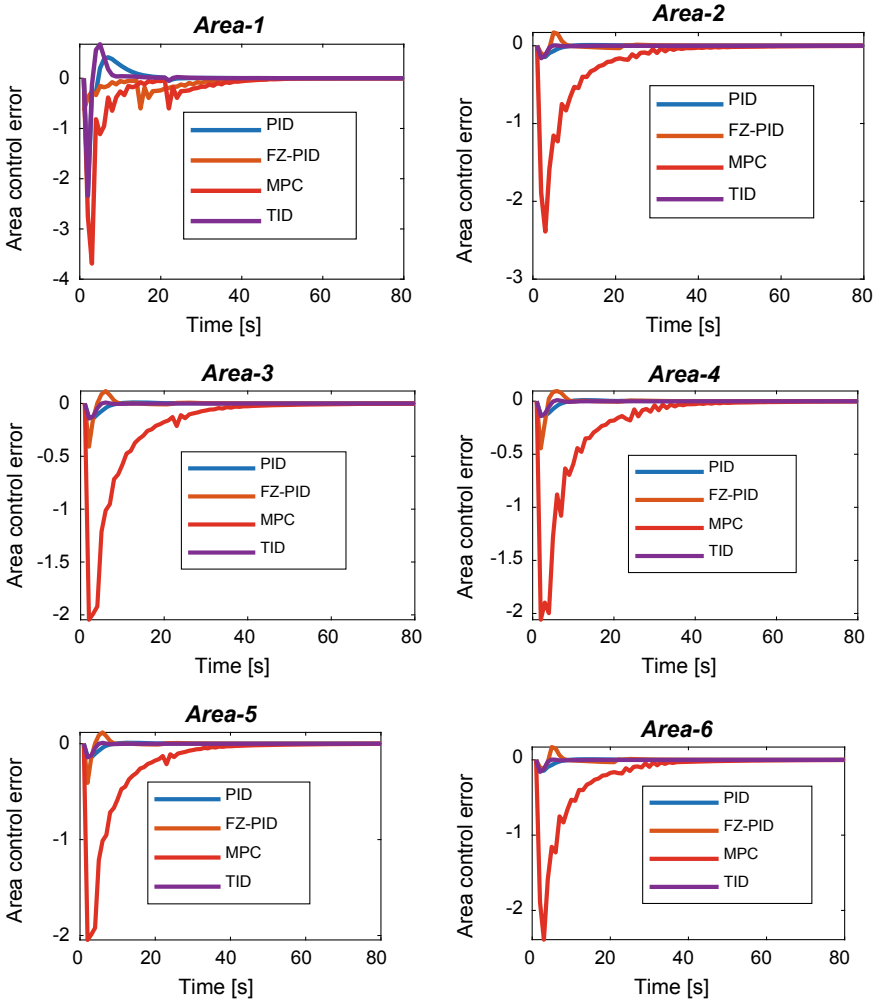

Fig. 11 Area control errors (six area system)

Table 1 Comparative analysis of six area power system

Controller	Signal	Overshoot	Undershoot	Settling time (s)
PID	Δf_1	1.2	−2.1	40
	Δf_3	0.18	−0.88	42
	Δf_6	0.2	−1.3	40
	$\Delta Ptie_{1\text{-}2}$	0.18	−0.61	35
	$\Delta Ptie_{3\text{-}4}$	0.038	−0.1	38
	$\Delta Ptie_{6\text{-}1}$	0.6	−0.15	35
MPC	Δf_1	0.0	−6	65
	Δf_3	0.0	−5.2	60
	Δf_6	0.0	−6	60
	$\Delta Ptie_{1\text{-}2}$	0.15	−0.55	55
	$\Delta Ptie_{3\text{-}4}$	0.14	−0.1	60
	$\Delta Ptie_{6\text{-}1}$	0.55	−0.12	55
Fuzzy PID	Δf_1	0.8	−2.9	45
	Δf_3	0.35	−1.1	45
	Δf_6	0.5	−1.5	40
	$\Delta Ptie_{1\text{-}2}$	0.9	−0.58	45
	$\Delta Ptie_{3\text{-}4}$	0.04	−0.07	40
	$\Delta Ptie_{6\text{-}1}$	0.59	−0.09	40
TID	Δf_1	1.3	−2.1	30
	Δf_3	0.2	−0.8	32
	Δf_6	0.3	−1.4	30
	$\Delta Ptie_{1\text{-}2}$	0.21	−0.6	30
	$\Delta Ptie_{3\text{-}4}$	0.045	−0.1	32
	$\Delta Ptie_{6\text{-}1}$	0.59	−0.22	30

5 Conclusion

The study of frequency deviation in four and six area reheat thermal interconnected power system with different control schemes has been carried out in this paper. A step load perturbation in both the test systems has been considered to check the performance of the designed control schemes. Authors have compared PID, TID, Fuzzy PID and MPC control approaches for above considered cases. The minimization of area control error(ACE) has been chosen for an objective function. Comparing the results obtained by all the approaches which is demonstrated in Table 1, it is apparent that TID based control scheme provides better time-zone characterization in terms of overshoot/undershoot and settlement time.

Appendix

Four and Six area power system parameters

Governor time constant—0.08 s.
Turbine time constant—0.3 s.
Reheater parameters—5 and 10 s.
Power system gain—120.
Power system time constant—20 s.
Bias constant—0.425, Synchronizing constant—0.545, Saturation limit—1.2

References

1. Farahani M, Ganjefar S, Alizadeh M (2012) PID controller adjustment using chaotic optimisation algorithm for multi-area load frequency control. IET-Control Theor Appl 6(13):1984–1992. https://doi.org/10.1049/iet-cta.2011.0405
2. Kumar N, Tyagi B, Kumar V (2017) Multi-area deregulated automatic generation control scheme of power system using imperialist competitive algorithm based robust controller. IETE J Res 64:528–537. https://doi.org/10.1080/03772063.2017.1362965
3. Kumar N, Tyagi B, Kumar V (2016) Multi area AGC scheme using imperialist competition algorithm in restructured power system. Appl Soft Comput 48:160–168. https://doi.org/10.1016/j.asoc.2016.07.005
4. Kumar N, Tyagi B, Kumar V (2016) Deregulated multiarea AGC scheme using BBBC-FOPID controller. Arab J Sci Eng 42:2641–2649. https://doi.org/10.1007/S13369-016-2293-1
5. Kumar N, Kumar J, Chaurasia R, Sharma H (2021) Comparison of various load frequency control schemes in restructured power system environment. J Phys: Conf Ser ICCEMME 2021. https://doi.org/10.1088/1742-6596/2007/1/012028
6. Kumar N, Singh A (2021) Load frequency control for multiarea power system using secondary controllers. Walailak J Sci Technol, accepted-June 20
7. Sambariya DK, Prasad R (2013) Design of harmony search algorithm based tuned fuzzy logic power system stabilizer. Int Rev Electr Eng (IREE) 8(5):1594–1607. https://doi.org/10.15866/iree.v8i5.2117
8. Mir AS, Senroy N (2018) Adaptive model predictive control scheme for application of SMES for load frequency control. IEEE Trans Power Syst 6:526–533. https://doi.org/10.1109/TPWRS.2017.2720751
9. Namara PM, Milano F (2018) "Model predictive control based AGC for multi-terminal HVDC-connected AC grids. IEEE Trans Power Syst 6:526–533. https://doi.org/10.1109/TPWRS.2017.2694768
10. Singh BK, Kumar N, Singh A, Joshi BP (2018) BBBC based frequency controller for solar thermal–wind hybrid power system generation/energy storage system. J Intell Fuzzy Syst 35(5):5063–5070
11. Singh A, Kumar N, Joshi BP, Singh BK (2018) AGC using adaptive optimal control approach in restructured power system. J Intell Fuzzy Syst 35(5):4953–4962
12. Singh A, Kumar N, Joshi BP, Singh BK (2018) Load frequency control with time delay in restructured environment. J Intell Fuzzy Syst 35(5):4945–4951

Implementing Internet of Things Driven Water Tank Controlling

Sujatha Karimisetty, Talari Surendra, B. G. Poornima Himaketan, A. Arjuna Rao, and Sudhanshu Maurya

Abstract This is to implement Internet of Things for controlling and observe water levels by using Water Tank Controlling System. At present IOT should be observed as a vision wherever "object", particularly everyday used things, like nearly home appliances used in everyone's home. However conjointly piece of furnishings, garments, automobile, transportation and sensible equipment, and much more, area unit decipherable, recognizable, physically identifiable, available and/or governable via the net. Water is consumed since ancient times as an emblem which is treated as divine and necessity. Since water is important in day by day life has most considerable position in human life, thus wastage of water ought to be avoided. By implementing IOT in the water tank controlling system, client easily monitors the streaming of water. Consumer can switch ON/OFF the motor by using the IOT driven application at anytime and from anywhere. This is employed with the assistance of sensors.

Keywords Internet of things · Sensors · Water tank controlling sytem (WTCS) · IOT driven application

1 Introduction

Internet has created vital impact in our financial system and culture by conveyance that lies outstanding message and networking physical infrastructure. The worldwide internet has been a chief constraint of worldwide processed data and media distribution. Local set of connections is constant to become lots of persistent, by

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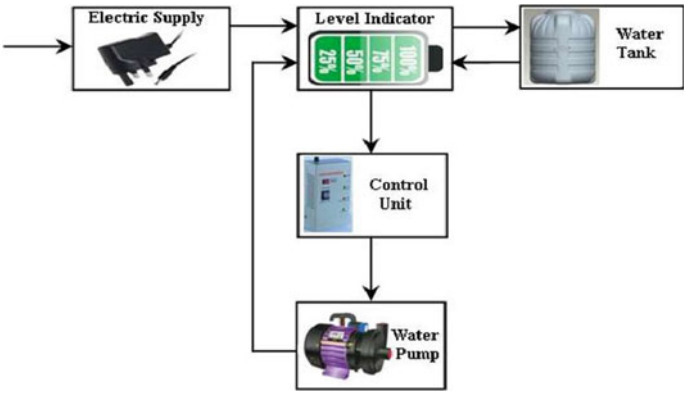

Fig. 1 Architecture of existing water tank controlling system

linking to novel embedded devices and devices which are handheld. In the existing system, the monitoring of water level is done manually. Whenever the tap is dried or empty, the consumer recognizes that the water tank is empty and it needs to be switched ON and when the tank is overfilled, the wastage of water occurs and then the consumer switches OFF the motor. Thus, everything is done manually.

The embedded system came into existence system that the consumer is provided with an LED display near the motor which depicts the position of the water tank using sensors. Whenever tank shall be empty the consumer shall get notification in the LED display and goes near motor and switch ON the motor and again gets notified when it is filled then switch OFF the motor. In some embedded systems it automatically switches ON/OFF whenever the tank is empty/filled but this cannot work every time if the consumer wants to get the tank empty inorder to clean the tank or for any additional purpose the consumer faces trouble. Many times farmers lost their lives due to snake bites when they went to switch on the motor. Figure 1 depicts the architecture of Water Tank Controlling System.

2 IOT Driven Water Tank Controlling System

2.1 IOT Driven WTCS

At present (IOT) should be observed as a vision wherever "things", particularly on a daily basis objects, like almost all home appliances however conjointly piece of furnishings, garments, automobile, roads and sensible materials, and more, area unit decipherable, recognizable, traceable, available and governable via the net. This may offer the idea for several new applications, like energy observance, transport safety systems or building security. This vision can sure as shooting modification with time, particularly as synergies between Identification Technologies, Wireless

device Networks, Intelligent Devices and engineering science can modify variety of advanced applications [1, 2].

Since water plays a most significant role in human life, thus wastage of water ought to be avoided. To implement web of things (IOT) in saving the water. Usually, human's store water in water tanks, they collect the underwater and store them in tanks. However most of the time tanks gets overfilled and there would be vast quantity of wastage in water. This happens in society, industrials areas even people that collect water in water vehicles [3].

So by implementing IOT for maintenance of such things, whenever it effects over these storage containers like implementing devices inbuilt with IOT. Wherever the consumer is there, the consumer can access and supervise level of water by the handheld devices like Mobile phones, tabs etc. This application comforts the consumer by means of application and also shows the position of tank over time through internet. Consumer can operate the ON/OFF from the mobile application at anytime and from anywhere. This is designed with the help of sensors. The control unit and mobile application are updated only through internet. Operation of the application of the control unit gets updated and makes the motor work with respect to the consumer's command. The application also provides an option 'automatic' which make the system work automatically in which the motor will automatically ON/OFF whenever the water tank is empty/filled to decrease manual work for storing water [1].

Proposed Algorithm: IOT driven WTCS.

Step 1: Initially the water tank is empty the ultrasonic sensor alerts client by sending notification to mobile application through internet.

Step 2: The consumer can switch ON the water tank motor through the link in WTCS application depending up on the requirement.

Step 3: If the consumer wants to impede the water in the middle which is filling the tank, where consumer may directly OFF the switch through the application.

Step 4: Whenever the water get through to the top edge of tank, the sensor makes the motor switch OFF through the internet [4].

Step 5: Once the tank is filled the consumer need not OFF the switch again. The consumer will accept notification as Tank filled' and motor is switched automatically OFF.

Step 6: The application also provides an option 'AUTOMATIC' that formulates the system work automatically basing on consumer's comfort.

Figure 2 depicts the design of IOT driven WTCS.

In the above figure, whenever the water tank is about to get overfilled, consumer will receive an acknowledgement. After receiving acknowledgement, consumer can switch off the motor by using mobile. The consumer can examine the position of the water tank by using mobile at anytime and anywhere [6, 7].

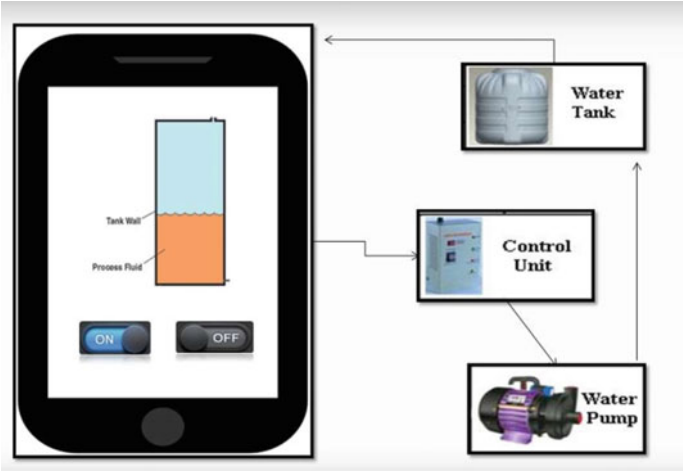

Fig. 2 Architecture of IOT driven

3 Result

The following graphs depicts the power consumed for 30 days generated by Manual system, embedded system and IOT driven WTCS (Fig. 3).

Table 1 illustrate the comparison between Manual system & embedded system with IOT driven WTCS.

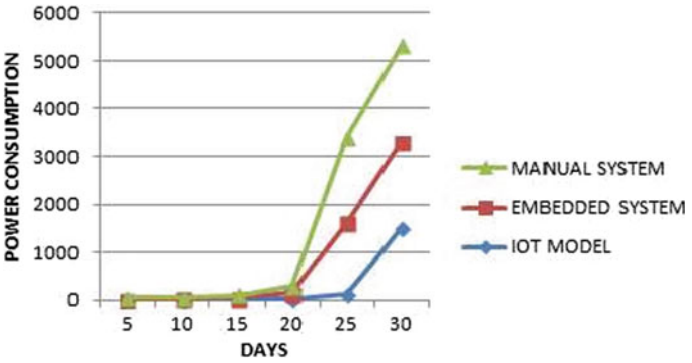

Fig. 3 Power consumption in manual, embedded and IOT model

Table 1 Manual WTCS and embedded WTCS with IOT driven WTCS table

Feature	Manual system	Embedded system	IOT model
Man power	High	High	Less
Electricity consumption	High	High	Less
Maintenance	High	Low	No Maintenance
Monitoring	Unavailable	Monitoring system with LED display	Anytime available monitoring on Desktop and mobile
Advantage	Used for years as this is easy process	Saves water	Anytime available monitoring on desktop and mobile
Disadvantage	Wastage of water and electricity	Wastage of electricity and physical presence is required near the system	Cannot run without internet

4 Conclusion & Future Scope

Thus by developing and implementing IOT based Water Tank Management System, the prevailing system will be ameliorated. Wastage of water and manual work would be reduced. The power necessities are quite low. The future scope is that it can be implemented for consuming electricity thereby sending acknowledgements to the consumer and the consumer can use same controls from the application.

References

1. Nuno B, Paulo R, Filomena S, Carlos M, Vitor C, Rosa V (2009) A remote system for water tank level monitoring and control - a collaborative case-study. In: 3rd IEEE international conference on e-learning in industrial electronics, ICELIE '09
2. Panindra B, Eswaran P (2013) Metro overhead tanks monitoring system using zigbee based WSN. In: 2013 IEEE conference on information & communication technologies (ICT)
3. Yogita P, Ramandeep S (2014) Smart water tank management system for residential colonies using Atmega128AMicrocontroller. Int J Sci Eng Res 5(6):355. ISSN 2229-5518
4. Vinay Sagar KN, Kusuma SM Home automation using internet of things. Int Res J Eng Technol (IRJET)
5. Abhishek V, Verma S, Shahani T (2012) Embedded web server for home appliances" international journal of engineering research and applications (IJERA). In: National conference on emerging trends in engineering & technology (VNCET-30 Mar'12). ISSN: 2248-9622
6. Bhide VH A survey on the smart homes using internet of things (IoT). Int J Adv Res Comput Sci Manage Stud
7. Raghavendra RM, Uttara Kumari S, Hari Prasad A Implementation of simulated water level controller. Int J Adv Res Comput Sci Softw Eng

Utilizing Technology and Management of Fog Computing

Suchita Tewari, Naveen Tewari, and Mukesh Joshi

Abstract Distinction between fog and cloud computing with security issues is studied in this paper. Fog Computing is prototypical that raises the Cloud Computing model by giving the registering assets at the edges of an organization. In general, it will be depicted as a cloud-like phase taking comparable data, computation, and submission, yet from an overall perspective different in that it is decentralized. As the facilities are provided at the edge of the system the communication is reckless and takes less time. In Fog Computing a layer of intelligence is added at the edge of the grid to do some analytics and tasks rather than completely processing in the cloud. Also, from a security point of view, the proper authentication should be done as the nodes will be at the user end and require data to be protected and be safe from malicious attacks. It is important to analyze the distribution of computational resources to have the option to assess this sort of design. The security concern arises with the use of haze figuring, as the number of gadgets is related to the haze hubs. The disadvantages of using mist registering might potentially hamper the general presentation. Thus, there is a need to organize legitimate designs for working on the presentation.

Keywords Fog computing · Cloud computing · Security

1 Introduction

Fog Computing is the dispersed registering plan whereby evidence is handled and put, and hence, works on the exhibition of registering in Cloud stages by diminishing the prerequisite to measure and stock bulks of useless data. The practice of Fog Computing is largely encouraged because of the increase of the Internet of things which in turn results in an increasing amount of data coming from the array of devices.

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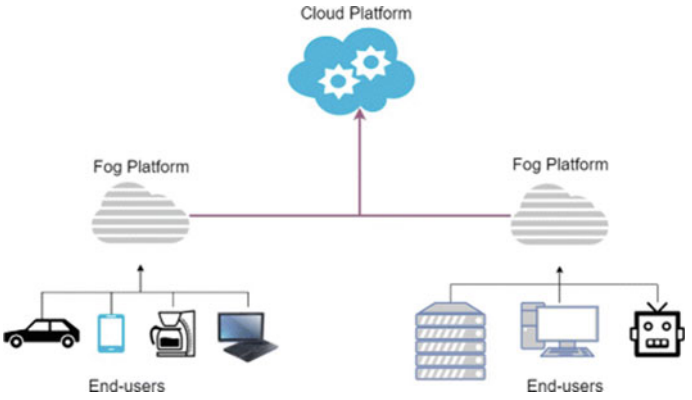

Fig. 1 The communication with cloud using fog computing using a diversified set of devices

We can also say that in Fog Computing a layer of intelligence is added at the edge of the network to do some analytics and tasks rather than completely processing in the cloud. If we research customary client–server approaches where expecting server moves past stacked then a critical number of the resources are left unusable, yet fog handling, gives the decentralized game plan by making the close by stage between the cloud and end–customer contraptions.

The Fog perspective means offering a versatile decentralized response for this issue. This is refined by making another dynamically flowed and close-by stage between the Cloud framework and end-customer contraptions [1], as displayed in Fig. 1. This stage is prepared for filtering, adding up to, dealing with, separating, and sending data, and will achieve saving time and correspondence assets. From the start, this new perspective was introduced by Cisco and is formally known as Fog Computing [2].

There is the common misconception that Edge Computing will replace Cloud Computing nevertheless Fog Computing can stay considered as hybrid computing because both of them provide capacity, data, and applications to their end-users [3] (Fig. 2).

According to [4], the following characteristics a Fog System must have:

1. The rich and heterogeneous end customer backing will be situated at the edge of the organization.
2. It gives backing to a huge assortment of modern applications in light of its quick criticism capacity.
3. Network administrations, stores, and assessments are taken care of on their own.
4. Operations are done nearby (only bounce from tool to mist hubs).
5. It is an enormously intense stage.
6. Offers sensible, versatile, and flexible arrangements for both programming and equipment.

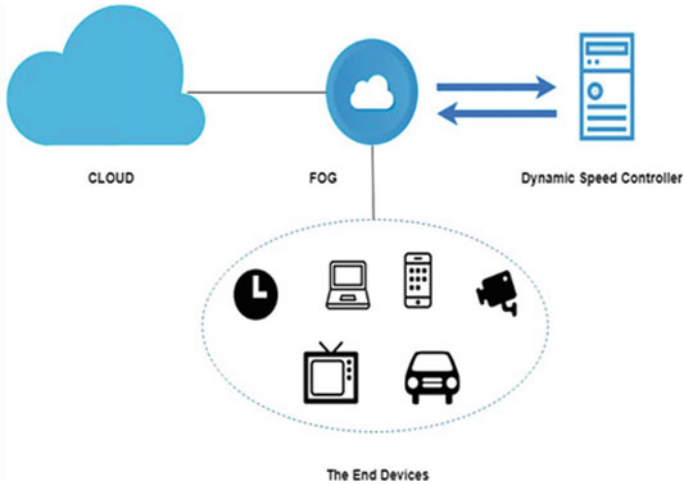

Fig. 2 System architecture

Cloud is a huge bunch of disengaged clusters that give Infrastructure as a Service (IaaS) together, permitting different organizations and customers to give computing services and storage over the internet [5]. Cloud Computing provides information whenever a data request is made from the server but in health applications, it is not the ideal approach to use due to interruption in the broadcast of data [3].

Edge Computing has overcome the consequence of the Internet of Things—cloud atmosphere where cloud-like services have been offered at the edge of the grid. The Internet-Of-Things is continuing quickly and want the enhancement in the quality to improve the human intervention. With the growing use of IoT, it is needed that the platform is built where the consumption of power is less with minimum delay. Edge computing is done where the data is being produced just at the edge of the grid where the connection has been made between the sensors and controllers of the device and information is sent to the cloud but the cloud also has its boundaries concerning storage, safety, and accuracy [3].

Fog Computing processes data locally rather than transmitting it to the cloud due to which the communication is fast and the bandwidth of the network can be saved [3]. Also, it is better in terms of privacy as the data is saved close by rather than sending it to the cloud. The services are provided close to end-users in Fog computing. The possessions are provided at the edge of the grid which contains fog nodes (FNs) [6]. The main differentiation between cloud and fog computing is that in fog computing the data is analyzed in fog nodes like switches and routers among many others, and are located between the cloud and the data source (Fig. 3).

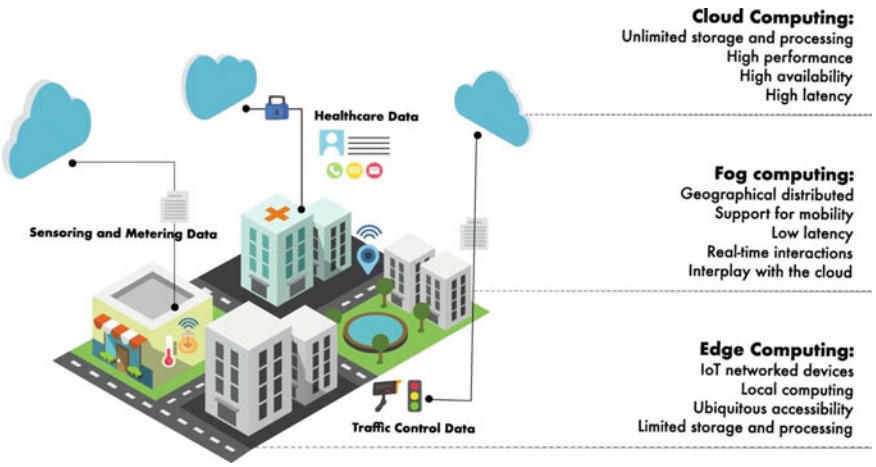

Fig. 3 Smart city with IoT system integration

2 Related Work

2.1 Existing Research

The security apprehension emerges with the utilization of haze processing because of the number of gadgets that are associated with the mist hubs. The disadvantages of utilizing mist processing can hamper the general presentation. In this way, there is a need to coordinate legitimate design for upgrading the exhibition. Mist processing is defenseless against Sybil's assault. This sort of assault is permitting programmers to counterfeit characters which can help them acquire unapproved admittance to delicate data and compromise IoT applications and ongoing services [7]. The information handling engineering for IoT frameworks has moved from a concentrated worldview, for example, distributed computing to an appropriated worldview known as mist registering, as basic issues should be tended to, for example, getting an adaptable, hearty, secure, furthermore experience-driven data taking care of plan and Quality of Service (QoS) from end clients [8].

The fog computing perspective can be simply described as a trademark expansion of the appropriated processing perspective. In the structure, there exist related terms, for example, edge joining up or cloudiness figuring. Around are no standard principles about the layered plan of dimness enlisting and there are assorted methodologies [9, 21].

The presentation of a haze registering design fit for distinguishing continuously an example of framework conduct dependent on the data gathered by the last gadgets should be assessed. All the more unequivocally, the engineering is blessed with the insight essential for information handling through a Complex Event Processing

(CEP) motor [10]. CEP [11] is an innovation that certificates ingest, dissect and correspond a lot of heterogeneous information (straightforward occasions) fully intent on recognizing important circumstances in a specific space (complex occasions).

The articulation "ongoing" takes the significance of imagining a quick period reply from the arrangement in human terms, with higher huge degrees, even up to a very short second [12].

The exploration concentrate has been done to kinda similar report among the highlights of conventional distributed computing against fog registering models. To survey execution, the review depends upon an investigation displaying the testbed assessment in which both the presentation of the end client and user, is done.

Moreover, they keep away from the requirement for exorbitant transmission capacity expansions brought about by transferring/downloading a lot of traffic to/from the central organization. It additionally secures delicate information by investigating them inside the nearby organization. At last, associations that embrace haze figuring get further and quicker data, which expands business readiness, build administration levels, and further develops security [13]. In any case, the plan of a beneficial mist engineering needs to think about Quality of Service (QoS) issues, for example, throughput, reaction period, energy utilization, adaptability, or asset usage [4].

As it has remained seen, one of the standard rudiments to pass on a fog enlisting configuration is to decrease the torpidity in the last submissions. Also, we can see that the update of this assessment remembers overhauls for various ones, for instance, the decrease of energy use [14], further cultivating the QoS [15], increasing the Quality of Experience (QoE) [16], among others. In this sense, for the assessment of the transport of computational resources, it is critical to have the choice to evaluate this kind of plan.

Thusly, [17] a general report total among Data Centers with disseminated processing plan and Nano Information Center with cloudiness enlisting, the last choice being implemented through Raspberry Pis. The introduction of the above two models is appraised contemplating different points anyway reliably based on energy usage. For this, a couple of tests are done, for instance, static site page heaps, applications with the active substance and video perception, and static blended-media stacking for accounts on request.

At last, a spine-leaf mist figuring society to diminish network idleness and clog issues in a multi-facet and conveyed virtualized IoT server farm climate is introduced in Okafor et al. [15]. This methodology is practical as it expands transfer speed while keeping up with excess and protection from disappointments in crucial applications.

3 Future Prospects

Due to an extra addition of security measures, typically result in decreasing of computational resources available for normal Fog-based functions [18]. Additionally, the encrypted test takes more space in disk compared to the original text resulting in an additional impact on the working of request and record layers.

It is rather expensive for practical reasons to avoid cache-based attacks or the solution is only applicable for some type of attacks. It has been detected that cache interference attack's removal requires hardware as well as software changes and is the most common attack [17].

As fog network is linked to many small devices most of the time. Even though the data gathered from one single device might be minuscule, combined data from many connected devices will be hard to handle [19]. Therefore, it's very important to filter each network packet so that the system will work without a noteworthy upsurge in the processing & memory capacity of the total system.

4 Conclusion

With the continuous growth of technology, computers need to behave like humans and will become essential to take decisions within devices. While taking fog or nodes into consideration we should also keep in mind the security/privacy of the information. The foremost intention of Fog Computing is to make big data smaller and easily manageable. For making the system run effectively we have to make it possible for all the data to be quickly processed and analyzed. Another important aspect is to rapidly and securely process a variety of data, though many times it will be difficult to completely rely on fog computing for such a huge amount of data and we have to continue the use of cloud in the overall IoT system.

For deploying Fog Computing fully there should be parallel and continuous data collection from each node also it should consume less power and support real-time data processing and analyzing [20].

References

1. Cisco (2016) Fog computing and the internet of things: extend the cloud to where the things are. Online (Link), 13 Dec 2016
2. Tang B, Chen Z, Hefferman G, Wei T, He H, Yang Q (2015) A hierarchical distributed fog computing architecture for big data analysis in smart cities. In: Proceedings of the ASE bigdata & social informatics 28. ACM
3. Toor A, Islam Su, Ahmed G, Jabbar S, Khalid S, Sharif AM (2019) Energy efficient edge-of-things. EURASIP J Wirel Commun Netw 2019
4. Haghi Kashani M, Rahmani AM, Jafari Navimipour N (2020) Quality of service-aware approaches in fog computing. Int J Commun Syst 33(8):4340
5. Aslam A, ul Islam S, Khan A, Ahmed M, Akhundzada A, Khan MK (2017) Information collection centric techniques for cloud resource management: taxonomy, analysis and challenges. J Netw Comput Appl 100:80–94
6. Goudarzi M, Wu H, Palaniswami MS, Buyya R (2020) An application placement technique for concurrent IoT applications in edge and fog computing environments. IEEE Trans Mob Comput 20(4):1–1
7. Adel A (2020) Utilizing technologies of fog computing in educational IoT systems: privacy, security, and agility perspective. J Big Data 7(99)

8. Xiong Z, Feng S, Wang W, Niyato D, Wang P, Han Z (2018) Cloud/fog computing resource management and pricing for blockchain networks. IEEE Internet Things J 6(3):4585–4600
9. Mahmud R, Ramamohanarao K, Buyya R (2020) Application management in fog computing environments: a taxonomy, review and future directions. ACM Comput Surv 53(4)
10. Garcia-de-Prado A, Ortiz G, Boubeta-Puig J (2017) COLLECT: collaborative context-aware service oriented architecture for intelligent decision-making in the internet of things. Expert Syst Appl 85:231–248
11. Luckham DC Event processing for business: organizing the real-time enterprise. Wiley
12. Mondragón-Ruiz G, Tenorio-Trigoso A, Castillo-Cara M, Caminero B, Carrión C (2021) An experimental study of fog and cloud computing in CEP-based real-time IoT applications. J Cloud Comput 10(32)
13. Bellavista P, Berrocal J, Corradi A, Das SK, Foschini L, Zanni A (2020) A survey on fog computing for the internet of things. Pervasive Mob Comput 52:71–99
14. Castillo-Cara M, Huaranga-Junco E, Quispe-Montesinos M, Orozco-Barbosa L, Antúnez EA (2018) FROG: a robust and green wireless sensor node for fog computing platforms. J Sensors
15. Okafor KC, Achumba IE, Chukwudebe GA, Ononiwu GC (2017) Leveraging fog computing for scalable IoT datacenter using spine-leaf network topology. J Electr Comput Eng 5(4):3246–3257
16. Shah-Mansouri H, Wong VWS (2018) Hierarchical fog-cloud computing for iot systems: a computation offloading game. IEEE Internet Things J 5(4):3246–3257
17. Jalali F, Hinton K, Ayre R, Alpcan T, Tucker RS (2016) Fog computing may help to save energy in cloud computing. IEEE J Sel Areas Commun 34(5):1728–1739
18. Shmueli E, Vaisenberg R, Elovici Y, Glezer C (2010) Database encryption: an overview of contemporary challenges and design considerations. ACM SIGMOD Rec 38(3):29–34
19. Hu F, Hao Q, Bao K (2014) A survey on software-defined network and openflow: from concept to implementation. IEEE Commun Surv Tutorials 16(4):2181–2206
20. Li X, Zhou L, Sun Y, Ulziinyam B (2020) Multi-task offloading scheme for UAV-enabled fog computing networks. EURASIP J Wirel Commun Netw
21. Tewari N, Datt G (2020)Towards FoT (fog-of-things) enabled architecture in governance: transforming e-governance to smart governance. In: 2020 international conference on intelligent engineering and management (ICIEM), pp 223–227. https://doi.org/10.1109/ICIEM48762.2020.9160037

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